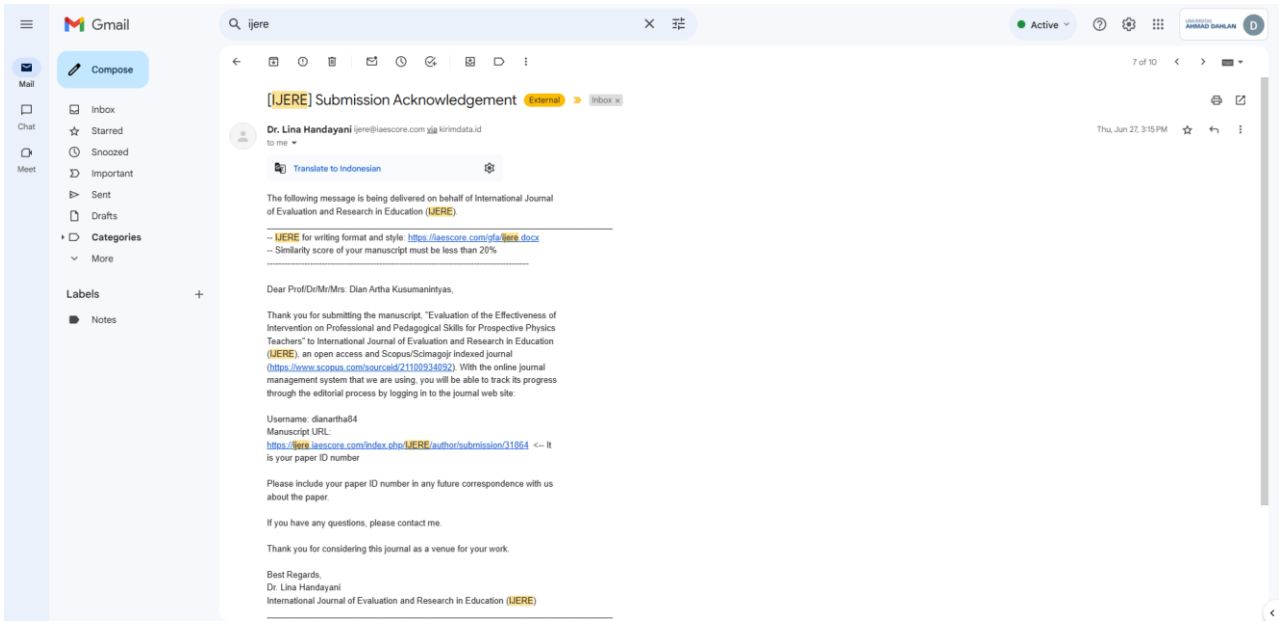
BUKTI KORESPONDENSI

ARTIKEL JURNAL INTERNATIONAL BEREPUTASI

Judul artikel	:	Evaluating the effectiveness of intervention on professional and pedagogical skills among prospective physics teachers
Jurnal	:	International Journal of Evaluation and Research in Education (IJERE)
Penulis	:	Dian Artha Kusumaningtyas, Moh. Irma Sukarelawan, Muhammad Syahriandi Adhantoro, Wahyu Nanda Eka Saputra

No	Perihal	Tanggal
1	Bukti konfirmasi submit artikel dan artikel yang disubmit	27 Juni 2024
2	Bukti Konfirmasi review dan hasil review Pertama	30 Juli 2024
3	Bukti konfirmasi submit review pertama dan artikel yang diresubmit	15 Agustus 2024
4	Bukti kofirmasi review kedua dan artikel yang diresubmit	02 September 2024
5	Respon author for reviewer	11 September 2024
6	Bukti Konfirmasi review ketiga,	15 Oktorber 2024
7	Bukti Resubmit review ketiga	21 Oktober 2024
8	Bukti konfirmasi review keempat dan artikel yang diresubmit	31 Oktober 2024
9	Bukti Konfirmasi article accepted	10 April 2025
10	Bukti Konfirmasi artikel publish online	19 Mei 2025

1.Bukti konfirmasi submit artikel dan artikel yang disubmit (27 Juni 2024)


Gmail
ijere
Active
Compose
Inbox
Starred
Snoozed
Important
Sent
Drafts
Categories
More
Labels
Notes
[IJERE] Submission Acknowledgement
External
Inbox
Dr. Lina Handayani ijere@iaescore.com via kirimdata.id
to me
Thu, Jun 27, 3:15 PM
Translate to Indonesian
The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).
-- IJERE for writing format and style: https://iaescore.com/gfa/ijere.docx
-- Similarity score of your manuscript must be less than 20%
Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,
Thank you for submitting the manuscript, "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), an open access and Scopus/Scimagojr indexed journal (https://www.scopus.com/sourceid/21100934092). With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:
Username: dianartha84
Manuscript URL:
https://ijere.iaescore.com/index.php/IJERE/author/submission/31864 <-- It is your paper ID number
Please include your paper ID number in any future correspondence with us about the paper.
If you have any questions, please contact me.
Thank you for considering this journal as a venue for your work.
Best Regards,
Dr. Lina Handayani
International Journal of Evaluation and Research in Education (IJERE)

Evaluating the effectiveness of intervention on professional and pedagogical skills among prospective physics teachers

Jurnal	International Journal of Evaluation and Research in Education (IJERE)
Manuscript ID	31864
Manuscript Type	Article
Keyword	Mann-Whitney test; Pedagogical skills; Professional skills; Teacher competency; Wilcoxon test
Abstract	This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective physics teachers, addressing a key gap in teacher education. The research involved an experimental group that received the intervention and a control group that did not. The research subjects in the experimental and control groups were 120 each. To rigorously assess the impact, Whitney and Wilcoxon's statistical tests were employed to compare pretest and posttest outcomes. Additionally, Wright map analysis was used to visualizes kill development. The results revealed a significant improvement in the professional and pedagogical skills of the experimental group compared to the control group, as indicated by Mann-Whitney test ($U=1274.500$, $p<0.05$ and $U=421.500$, $p<0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This study contributes to the field by demonstrating the effectiveness of interventions in improving the skills of prospective physics teachers, offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research provides valuable insights that can inform the design and implementation of more effective teacher training strategies.

Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2] , Muhammad Syahriandi Adhantoro[3]

[1,2]Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

[3]Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT (10 PT)

This study aims to evaluate the effectiveness of an intervention on the professional and pedagogical skills of prospective Physics teachers. This study involved two groups, namely an experimental group that received an intervention and a control group that did not receive an intervention. The research methods used include Mann-Whitney and Wilcoxon statistical tests to compare pre-test and post-test results between the two groups, as well as Wright map analysis to visualize the distribution of pre-test and post-test results for pedagogical skills. The results showed that the intervention significantly improved the professional and pedagogical skills of prospective Physics teachers in the experimental group compared to the control group. This significant difference can be seen from the Mann-Whitney test values ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). Wright map analysis showed that the experimental group experienced more regular and significant improvement in pedagogical skills compared to the control group. The implication of this research is the importance of an appropriate intervention in improving the quality of teaching preparation for prospective Physics teachers. Thus, this study makes a significant contribution to the development of educational policies to improve educational standards and the preparation of future Physics teacher candidates. Ongoing evaluation is recommended to monitor the long-term effectiveness of the intervention and improve the program to be more responsive to changing and increasingly complex educational needs.

Corresponding Author:

Azlina Mohd Kosnin
Faculty of Social Sciences and Humanities, School of Education, Universiti Teknologi Malaysia
Sultan Ibrahim Chancellery Building, Jalan Iman, 81310 Skudai, Johor, Malaysia
Email: p-azlina@utm.my

1. INTRODUCTION (10 PT)

Teacher professional development is a crucial aspect in improving the quality of education. In Indonesia, teacher professional development still faces various challenges, including limited access to quality training, lack of incentives and adequate facilities. Teacher professional development in Indonesia is often focused on improving pedagogical, personality, professional and social competencies [1], [2]. Training and development programs such as Teacher Professional Education and Training (PLPG) and Teacher Professional Education Program (PPG) have been implemented as an effort to improve teacher quality and competency [3]. However, implementation is often hampered by budget constraints and inadequate infrastructure.

In contrast, in developed countries such as Finland, Singapore and the United States, teacher professional development is carried out systematically and continuously. In Finland, for example, teachers must have a master's degree before they can teach, and teacher education is heavily focused on research and teaching practice [4]. Teachers in Finland also receive full support from the government in the form of adequately funded advanced training as well as attractive incentives to retain high-quality teaching staff [5]. In neighboring countries such as Singapore, the government implements the "Career Development Framework" policy which allows teachers to continue to develop themselves through regular training and scholarships for further study [6]. Singapore also has a strong mentoring system where junior teachers receive guidance from experienced senior teachers [7].

Meanwhile, in the United States, teacher professional development varies greatly from one district to another. However, in general, there are a variety of certification and advanced training programs provided by states and professional organizations. Many schools in the US also provide time and resources for teachers to participate in professional development, including teacher-to-teacher collaboration and school-based development [8], [9]. Although efforts to improve teacher competency in Indonesia already exist, significant improvements are still needed in terms of accessibility, continuity and adequate support. Experiences from developed countries show that sustainable investment in teacher professional development is very important to achieve high quality education and can be an inspiration for improving the system in Indonesia [10].

A teacher's pedagogical and professional competence is the main foundation in the world of education, because both play an important role in creating an effective learning environment and motivating students to reach their maximum potential [11]. Pedagogical competence includes the teacher's ability to design, implement and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional competence includes in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without this competency, a teacher will have difficulty

conveying material effectively, facilitating constructive discussions, and cultivating critical skills in students.

If a teacher's pedagogical and professional competence is lacking, serious challenges can arise. Students may experience difficulties in understanding lesson material, which leads to low learning outcomes and motivation [14]. Lack of competence can also lead to less effective classroom management, which can create a learning environment that is not conducive [15]. In addition, a lack of innovation in teaching methods can make the learning process monotonous and uninteresting for students. Therefore, improving teachers' pedagogical and professional competence is very important to ensure high quality education and optimal students' academic achievement ([16].

The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs (Evens et al., 2018). This research compares the achievements of pedagogical and professional competencies between prospective teachers who have participated in the professional teacher education program for the field of physics with classes who have not participated in the program [17]. This approach provides a clearer and more objective picture of the real impact of increasing teacher competence on students' academic achievement. This research also identifies the challenges faced by teachers in implementing the results of competency development programs.

The aim of this research is to evaluate the effectiveness of teacher pedagogical and professional competency development programs in improving the quality of learning in schools. This research will compare student learning outcomes between classes taught by teachers who have participated in a competency development program (experimental class) with classes taught by teachers who have not participated in the program (control class). It is expected that this research can provide a clear picture of the impact of increasing teacher competency on the transformation of education in Indonesia. Apart from that, this research also aims to identify the challenges encountered by prospective Physics teachers in improving their personal qualifications and continuing professional development after becoming professional teachers. It is also expected that the results of this research can become a basis for policy makers in designing more effective and sustainable teacher professional development strategies.

2. METHOD

This research methodology uses a quantitative approach to evaluate the effectiveness of the pedagogical competency and professional competency development program for prospective Physics teachers. This research involved two groups, namely the experimental and control groups. The experimental group consisted of prospective Physics teachers from two educational institutions for educational staff (LTPK) providing PPG for the field of Physics Education, who had participated in a competency

development program, while the control group consisted of prospective physics teachers who had not participated in the program from the same two LPTKs as the experimental class.

Data collection was carried out through pretest and posttest to measure the pedagogical and professional skills of prospective teachers. This test is carried out before and after the implementation of the competency development program. To analyze the data, this study used the Mann-Whitney test to compare the results between the experimental class and the control class, as well as the Wilcoxon test to see changes in teacher skills from pretest to posttest.

The Mann-Whitney test is used to determine whether there are significant differences between two independent groups, namely the experimental and control groups [18]. Meanwhile, the Wilcoxon test is used to test changes in two paired sets of data, namely pretest and posttest scores in groups, to see whether there is a significant increase in teachers' pedagogical and professional skills after participating in the development program [19], [20].

After carrying out the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map (Matsouaka et al., 2018). The Wright map allows a clear visualization of the increase in teachers' pedagogical and professional competence after participating in the development program [21].

3. RESULTS AND DISCUSSION

3.1. RESULTS

Professional skills and pedagogical skills are two critical aspects of the teaching profession that play an important role in improving the quality of education [22]. Professional skills include in-depth knowledge of subject matter, the ability to design relevant and engaging learning, and skills in using technology and other supporting resources [23]. Teachers who have good professional skills are able to deliver material comprehensively and inspire students to learn independently. Table 1 visualizes the results of the identification of professional skills and pedagogical skills.

Table 1. Fit statistics of Professional Skills and Pedagogical Skills

	Keterampilan Profesional		Keterampilan Pedagogik	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test of professional skills and pedagogical skills in Table 1 show high quality based on the results of the analysis of various statistical indicators. The average (mean) for items and persons is 0.00 and 0.36 respectively, reflecting a balanced distribution of values between the abilities measured. The range of measures for items ranges from -1.89 to 1.61, while for persons is from -1.62 to 3.23, indicating that this instrument is able to measure variations in abilities with a wide scope. The standard deviation for items is 0.69 and for persons is 0.97 indicating relatively consistent variations in the level of expertise measured. The Mean Outfit MnSq index for items is 1.02 and for persons is -0.04, and the Mean Outfit ZStd for items is 0.06 and for persons is 1.02, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The Separation values for items and persons are 4.42 and 3.07, indicating the ability of this instrument to differentiate well among different levels of ability. The high level of reliability is also proven by the Cronbach alpha value of 0.91 for items and 0.90 for persons, confirming that this instrument is consistent in measuring the professional skills of prospective Physics teachers accurately.

The instrument for measuring the pedagogical skills of prospective Physics teachers also show good quality based on the results of statistical analysis. The average (mean) for items and persons is 0.00 and 0.82 respectively, indicating a balanced distribution of values with a positive tendency in the abilities measured. The range of measures for items ranges from -2.73 to 1.20, while for persons ranges from -1.09 to 3.96, indicating that this instrument can measure a wide range of abilities. The standard deviation of items is 0.68 and for persons is 0.88 indicating consistent variation in the level of expertise measured. The Mean Outfit MnSq index for items is 1.00 and for persons is 0.21, and the Mean Outfit ZStd for items is -0.11 and for persons is 0.92, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The high separation for items of 4.17 and for persons of 2.10 indicates the ability of this instrument to differentiate well between various levels of pedagogical ability. A good level of reliability is also seen from the Cronbach alpha value of 0.81 for items and 0.81 for persons, indicating that this instrument can be relied on to

measure the pedagogical skills of prospective Physics teachers accurately and consistently.

3.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for teachers, statistical analysis was conducted on the pre-test and post-test data from prospective Physics teachers in the experimental and control groups [24]. This analysis aims to identify significant differences in skill improvement after the intervention of competence development program. The Mann-Whitney test was used to compare the distribution of scores between two unpaired groups, namely the experimental and control groups, both before (pre-test) and after (post-test) the intervention [25]. The Wilcoxon test was applied to evaluate changes in pre-test and post-test scores within each group, to ensure that the skill improvement was significant [26]. The results of this statistical analysis provide important insights regarding the impact of the competence development program on improving the professional skills of prospective Physics teachers. The results of this analysis are illustrated in Table 2 and Table 3.

Table 2. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Post-test	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 3. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test illustrated in Table 2 show that there is a statistically significant difference in the pre-test and post-test results between the prospective Physics teachers in the experimental group and the control group. In the pre-test results, the U value = 1347.500 with a significance level of $p < 0.05$, indicating that before the intervention there was a significant difference between the two groups. After the intervention, the post-test results show a U value = 183.500 with a significance level of $p < 0.05$, indicating that the intervention carried out has a significant impact on improving the professional skills of prospective Physics teachers in the experimental group compared to the control group.

Analysis using the Wilcoxon test illustrated in Table 3 strengthens this finding. The Wilcoxon test shows that there is a significant difference between the pre-test and post-

test results in both groups. In the experimental group, the Z value obtained is -6.736 with a significance level of $p < 0.05$, while in the control group, the Z value is -6.435 with the same significance level. This indicates that there is a significant increase in the professional skills of prospective Physics teachers after the intervention, either in the experimental or control groups.

However, the higher significant difference in the experimental group compared to the control group indicates that the implemented competency development program is more effective in improving the professional skills of prospective Physics teachers. The professional skills of prospective Physics teachers in the experimental group improved better compared to the control group after the intervention was carried out. This confirms that the intervention of competency development program has a greater positive impact on prospective Physics teachers who are involved in the program compared to those who do not participate in the program. This finding supports the importance of ongoing competency development programs as efforts to improve the quality of teaching and teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

The step in evaluating the effectiveness of the professional skills development program for prospective Physics teachers was conducted by carrying out an in-depth analysis of the pretest and posttest data. One of the tools used for visualization and analysis of this data is the Wright map, which allows mapping the skills of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear picture of the distribution of abilities held by the prospective Physics teachers in the control group and the experimental group. By mapping the pretest and posttest results of the two groups, we can identify significant differences in the professional skill attainment. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur as a result of the intervention; providing a more comprehensive insight related to the effectiveness of the training program that has been implemented [27]. The analysis on the professional skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 1 and Figure 2.

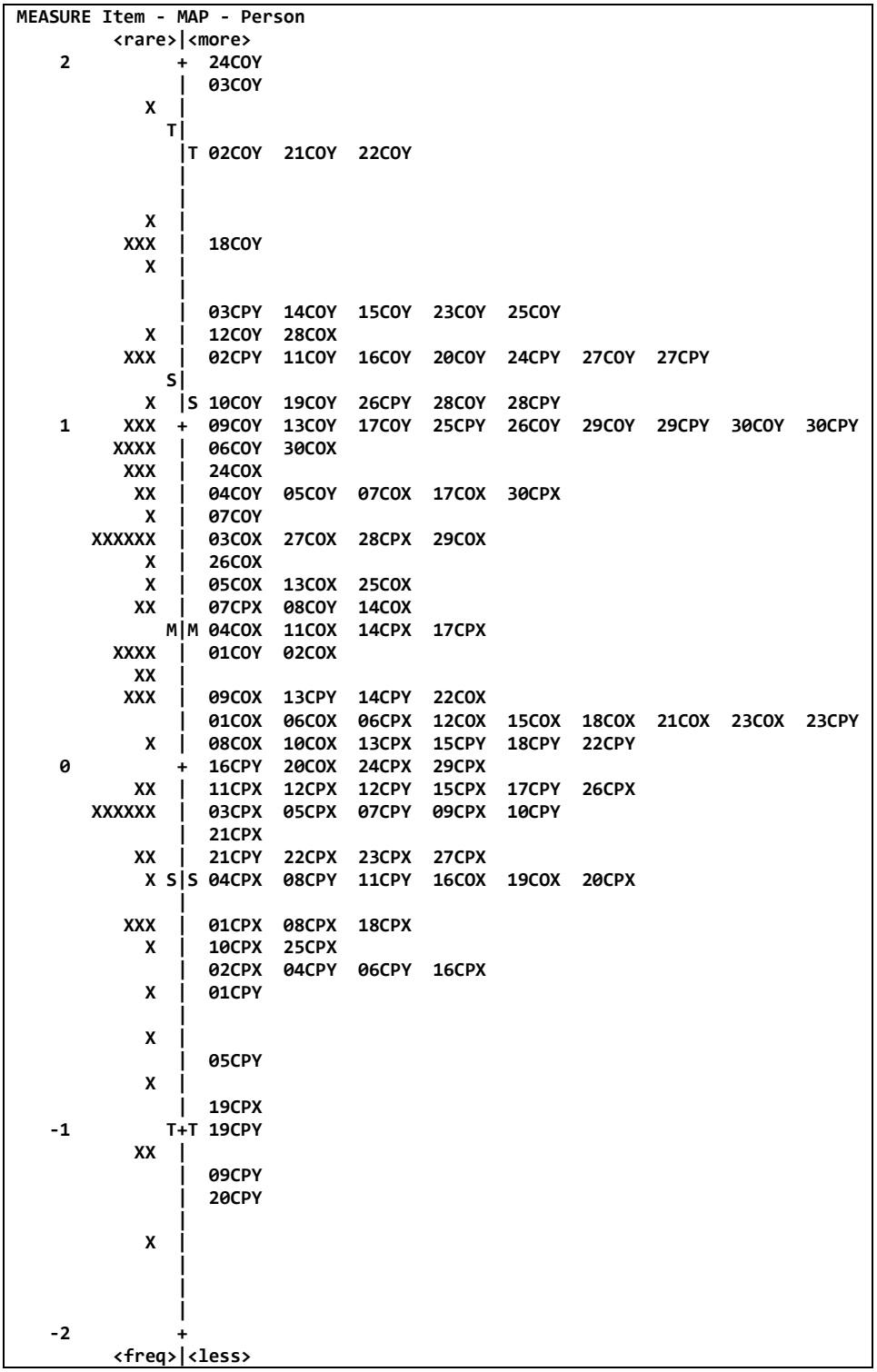
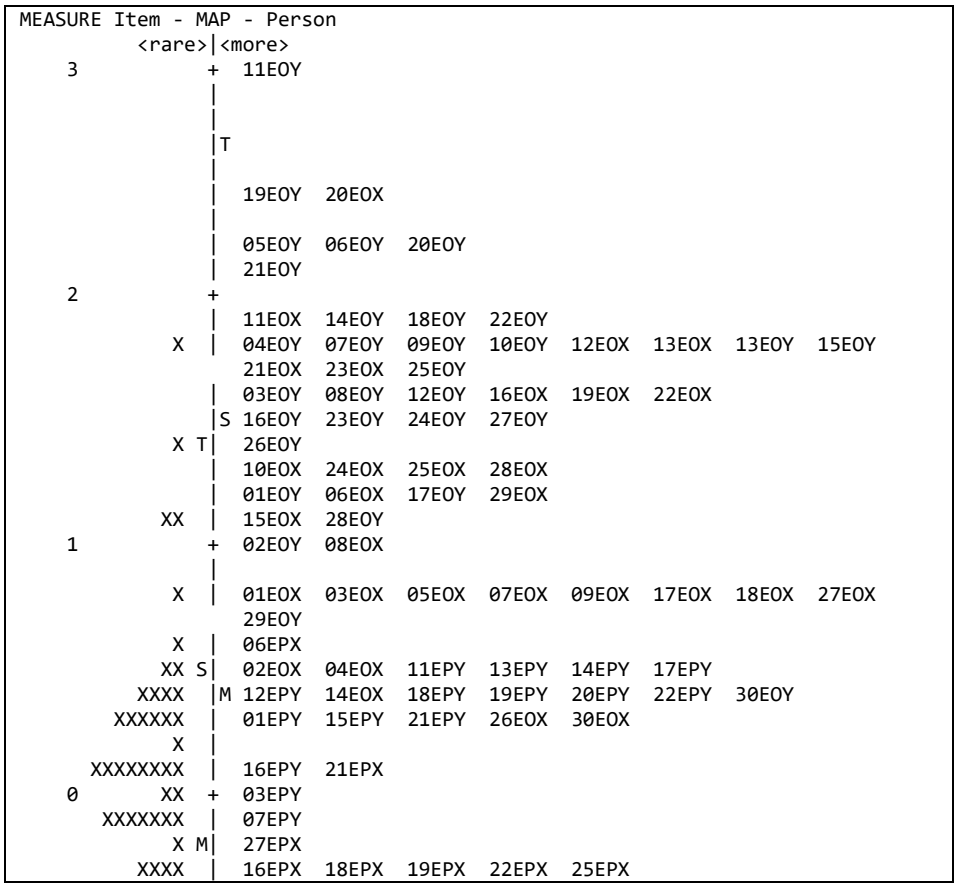


Figure 1. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) shows the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. On this map, it can be seen that items and people are spread over a fairly wide range. Most of the values are around the average with some items and persons being less or more frequent than that value. For example, the item with the highest measure is 24COY, indicating that only a few prospective Physics teachers having very high professional skills before the intervention. In contrast, there are many people with measure values between -1 and 0, indicating lower or moderate professional skills before the intervention. This distribution shows significant variation in ability among prospective Physics teachers in the control group.

After the intervention, the person's score is seen to shift significantly towards higher values, although there are still people who are at the low level. This shows that although there has been an increase in professional skills after the intervention, there are still some prospective Physics teachers who have not achieved the expected increase in skills. However, in general, this increase shows that the intervention has a positive impact even though it is not evenly distributed across all people.



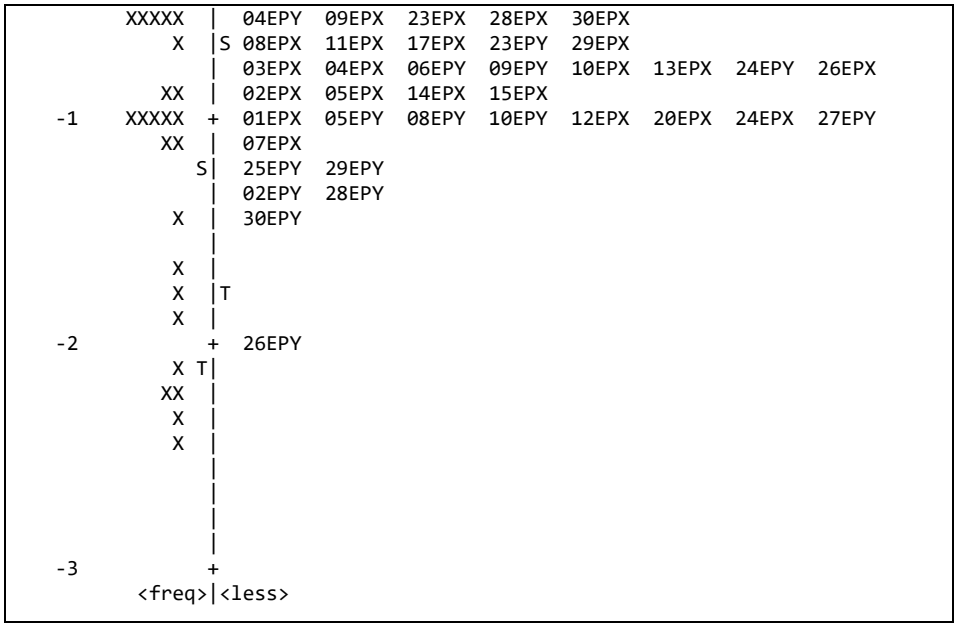


Figure 2. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group shows a more striking difference between the pretest and posttest compared to the control group. In the experimental group, item and person measures are also spread over a wide range, but there is a higher concentration of higher measure values after the intervention. This shows that more prospective Physics teachers in the experimental group show significant improvement in professional skills [28].

In the pretest, there are people with the highest measures such as 11EOY, indicating high professional skills before the intervention. However, after the intervention, the measure values for many individuals increase significantly, with some individuals achieving higher measure values than before the intervention, such as 29EOX and 30EOY. This shows that the competency development program applied to the experimental group is more effective in improving the professional skills of prospective Physics teachers compared to the control group [29].

This Wright map indicates that the intervention carried out in the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group shows the effectiveness of the competency development program implemented. The significant difference in the score distribution of these two groups confirms that the approach applied in the experimental

group was more successful in improving the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers, statistical analysis was carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare distribution differences between two independent groups, namely the experimental group that received the intervention and the control group that did not receive the intervention [30]. This test helps determine whether there are any significant differences in pedagogical skills between the two groups. On the other hand, the Wilcoxon test was used to assess changes in the same group within two measurement times, namely before and after the intervention [31]. This analysis provides a more comprehensive picture on the impact of the intervention on the development of the pedagogical skills of prospective Physics teachers. The results of the statistical analysis of the two tests are illustrated in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Post-test	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 5. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) show that there is a statistically significant difference in the results of the pre-test ($U=1274.500$, $p < 0.05$) and post-test ($U=421.500$, $p < 0.05$) among the prospective Physics teacher in both experimental and control groups. The Mann-Whitney test is a non-parametric statistical method used to compare two independent groups. In this context, the experimental group received a specific intervention, while the control group received no intervention. The significant results in this test indicate that the intervention given to the experimental group had a real effect on improving pedagogical skills compared to the control group.

The Wilcoxon test results (Table 5) strengthen these findings by showing that there is a significant difference between the pre-test and post-test results of prospective

Physics teachers both in the experimental group (Z=-6.729, $p < 0.05$) and in the control group (Z =-2.721, $p < 0.05$). The Wilcoxon test, which is also a non-parametric statistical method, is used to compare two sets of paired data, namely pre-test and post-test results from the same individual. These results indicate that there was a significant increase in pedagogical skills after the intervention in both groups, although the increase in the experimental group was higher compared to the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. However, the improvement was greater in the experimental group compared to the control group, indicating the effectiveness of the intervention implemented. The higher pedagogical skills in the experimental group compared to the control group after the intervention indicate that the training program or method applied was successful in significantly increasing the pedagogical competence of prospective Physics teachers. This emphasizes the importance of developing a structured and sustainable training program to improve the quality of teaching and professionalism of prospective Physics teachers [32]. Through appropriate and evidence-based approaches, the development of pedagogical skills can have a significant positive impact on improving the overall quality of education [33].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual depiction of the distribution of test takers' abilities and the difficulty of the test items, making it easier to identify differences in abilities before and after the intervention. Wright Map analysis was carried out on pretest and posttest data on the pedagogical skills of prospective Physics teachers for two groups, namely the control group and the experimental group. Understanding the results of this mapping is very important to assess the effectiveness of the interventions that have been implemented. The following is a detailed analysis of the Wright Map pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group, which provides insight into improvements or changes in pedagogical abilities after the intervention was carried out. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.

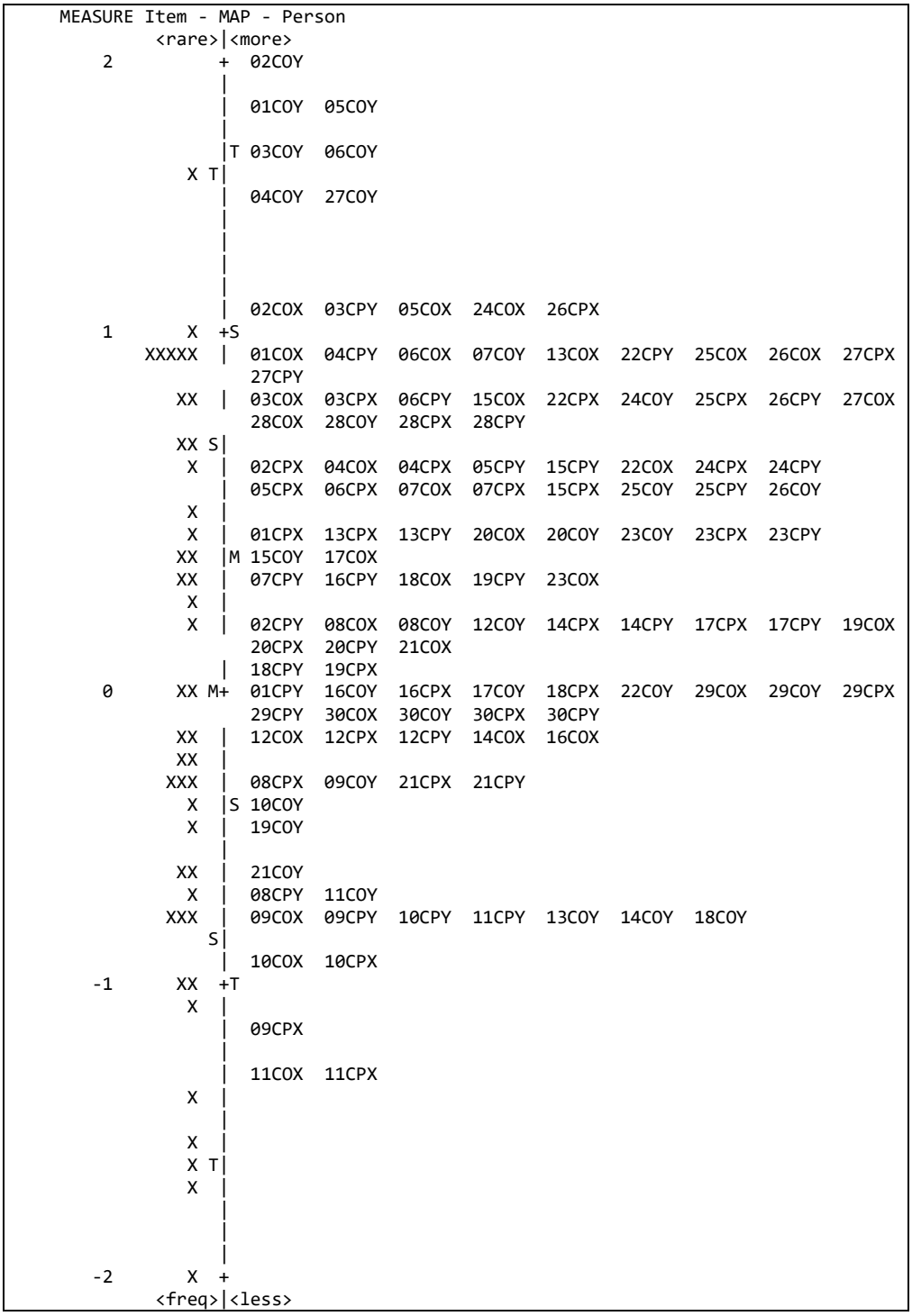


Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group

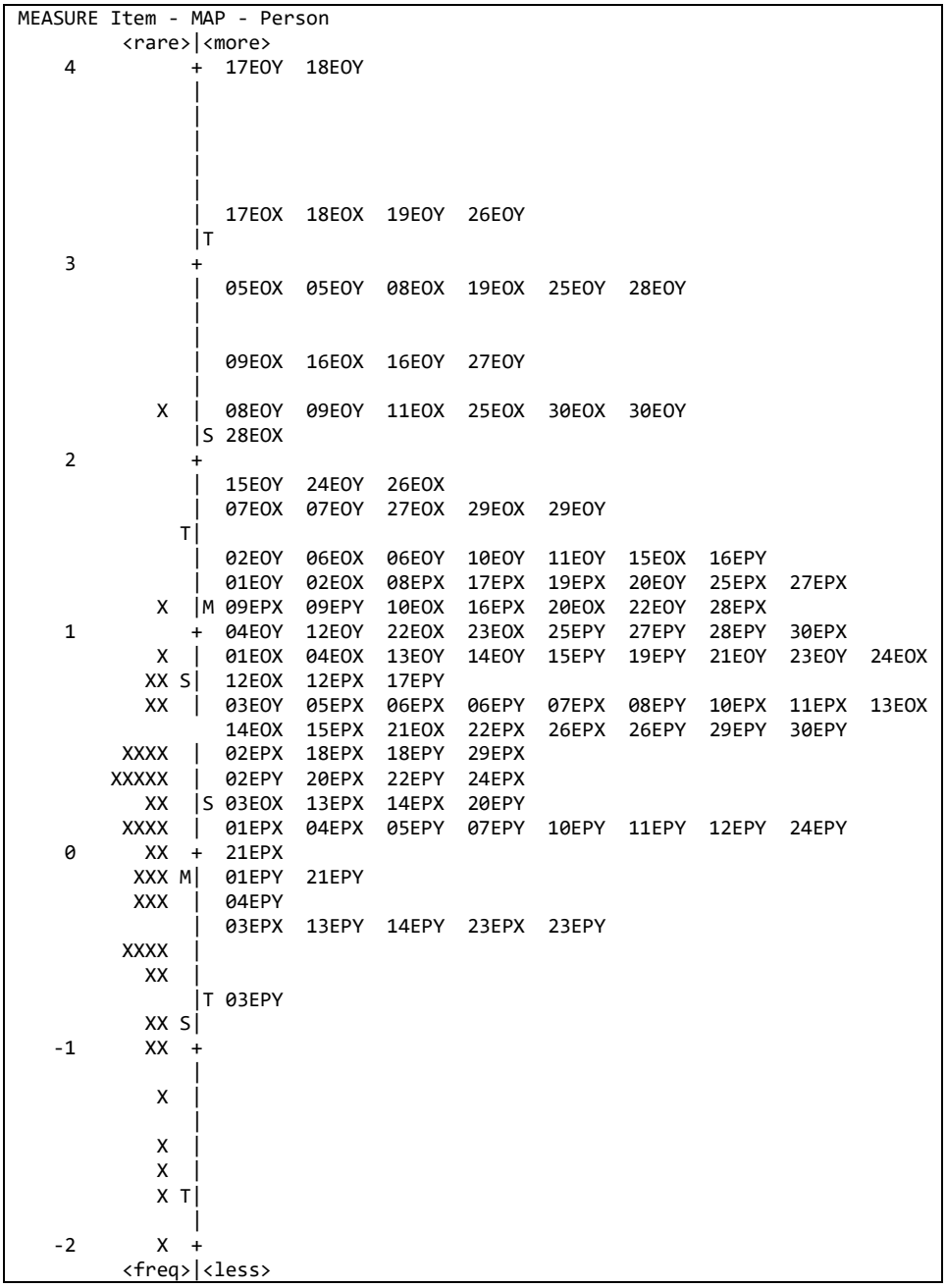


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group provides an in-depth picture of the distribution of ability and difficulty of items. In the Wright Map of the control group,

it can be seen that the distribution of persons and items shows that the majority of prospective Physics teachers have varied pedagogical skills with some items being more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY are in higher positions, indicating better pedagogical skills, while other persons are spread along the scale with the majority being around the middle of the scale (measure=1), indicating moderate variation in pedagogical abilities . This distribution indicates that there are differences in pedagogical abilities among the prospective Physics teachers in the control group, with some items indicating significant challenges for them.

In contrast, in the Wright Map experimental group, the distribution of persons and items show a more significant increase in pedagogical skills after the intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX are at higher measures (measure=3 and 4), indicating that the intervention provided was successful in improving their pedagogical skills. Many people from the experimental group are at higher levels compared to the control group, indicating that the intervention implemented was effective in improving the pedagogical skills of prospective Physics teachers. The distribution of items also shows that there are several items that remain difficult for most people, but overall, people in the experimental group show better abilities compared to the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group succeeded in improving the pedagogical skills of prospective Physics teachers significantly better than the control group [34]. The Wright Map provides a clear visualization of the distribution of ability and difficulty of items, assisting in understanding the effectiveness of the implemented intervention. This emphasizes the importance of structured and evidence-based training programs in improving the pedagogical quality of prospective Physics teachers [35].

3.2. Discussion

3.2.1. Professional Skills of Prospective Physics Teachers

Professional skills for prospective Physics teachers are an integral aspect in their preparation to face teaching assignments in the world of education. These skills include various competencies that are not only limited to mastering academic material, but also the ability to adapt to the work environment, interact with students, and manage the class effectively [36], [37]. A prospective Physics teacher who has strong professional skills can implement innovative teaching strategies, apply fair and objective assessments of student achievement, and build good relationships with all relevant parties in the educational context [38], [39].

The importance of the professional skills of prospective Physics teachers is also reflected in their ability to continue learning and developing themselves, either through additional training, workshops or independent study. This supports their ability to integrate the latest developments in education into their teaching practice so that it can

improve the overall quality of students' learning experiences [5], [40]. The evaluation aspect of professional skills often involves the use of measurement tools such as validity and reliability tests, as well as competency mapping to assess the extent to which a prospective Physics teacher has achieved the standards set in their field [41].

Academically, the professional skills of prospective Physics teachers can be measured through various indicators, such as test results, assessments by fellow professionals, and the ability to plan and implement effective learning strategies [42]. Developing these skills also plays an important role in creating an inclusive learning environment and encouraging balanced intellectual and emotional growth of students.

3.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers are the main foundation in their ability to convey subject matter in a way that arouses interest and facilitates students' understanding [43]. The main aspects of pedagogical skills include the ability to design a curriculum that is relevant and in accordance with educational standards, choosing appropriate teaching methods to accommodate students' diverse learning styles, and utilizing educational technology and other resources effectively in the learning process [44].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50].

4. CONCLUSION

The intervention carried out on prospective Physics teachers in the experimental group significantly improved their professional and pedagogical skills compared to the control group. The results of the Mann-Whitney and Wilcoxon statistical tests confirmed that there were significant differences in the pre-test and post-test between the two groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation for prospective Physics teachers. Wright map analysis of pedagogical skills illustrates that the experimental group showed more regular and significant improvements compared to the control group, indicating that the intervention

program was able to provide a positive and consistent impact on the development of teaching skills. The implications of this research are highly relevant for future educational policy, showing that appropriate intervention methods can improve educational standards and the overall preparation of prospective Physics teachers. Ongoing evaluation is needed to monitor and evaluate the effectiveness of this program in order to continue making necessary improvements in an effort to improve the quality of teaching. Overall, this research provides a valuable contribution to our understanding of ways to prepare prospective Physics teachers who are competent and ready to face future demands in an increasingly complex and dynamic world of education.

ACKNOWLEDGEMENTS

We would like to thanks Universitas Ahmad Dahlan for supporting and founding this work under the supported proffesorship candidate research grant 2024.

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education,"

Eur Phy Educ Rev, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, "The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States," *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, "Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States," *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, "The Human Teacher, the AI Teacher and the AIed-Teacher Relationship," *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, "Pedagogies of embodiment in physical education – a literature review," *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, "Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy," *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, "Indonesian teacher performance: Professional and Character," *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, "The Effects of Students' Perception of the School Environment and Students' Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[15] G. B. Gudmundsdottir and O. E. Hatlevik, "Newly qualified teachers' professional digital competence: implications for teacher education," *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[16] D. Ramandanis and S. Xinogalos, "Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review," *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[17] P. S. Lisenbee and C. M. Ford, “Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children’s Experiences,” *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[18] T. Lin, T. Chen, J. Liu, and X. M. Tu, “Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks,” *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[19] Y. Fong and Y. Huang, “Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null,” *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[20] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, “An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome,” *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[21] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, “Wright-Map to investigate the actual abilities on math test of elementary students,” *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[22] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, “The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia,” *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

[23] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, “Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being,” *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[24] S. Handayani, L. Peddell, and T. Yeigh, “Participants’ Experiences in Heutagogy Teacher Professional Education in Indonesia,” *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[25] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, “The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians,” *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[26] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, “A Wilcoxon-Mann-Whitney spatial scan statistic for functional data,” *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[27] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, “A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[28] F. J. Rodríguez Muñoz, “Pre-test and structural analysis of the pragmatic awareness questionnaire destined to teachers’ communicative instruction,” *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[29] M.-Y. Chen, S.-M. Huang, and W. Chou, “Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19,” *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[30] L. Mao, “Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance,” *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[31] R. Wilcox, “Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions,” *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[32] M. Mawarto, W. Widodo, and S. Sulistiasih, “The Antecedence of Teacher’s Professional Performance: Evidence from Indonesia,” *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[33] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, “The professional development of higher education-based teacher educators: needs and realities,” *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[34] Y. Cheng, W. Jia, R. Chi, and A. Li, “A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing,” *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[35] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, “Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling,” *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[36] L. Lukman *et al.*, “Effective teachers’ personality in strengthening character education,” *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[37] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, “The importance of attitudes toward technology for pre-service teachers’ technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches,” *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[38] A. H. Abdulrazzaq, “Teacher Appraisers’ Perceptions of Teacher Appraisal,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[39] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, “Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement,” *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[40] N. Ishartono *et al.*, “The Role of Instructional Design in Improving Pre-Service and In-Service Teacher’s Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[41] M. A. Flores, “Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education,” *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[42] H. T. Yusuf, “Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[43] M. Mu’arifin and B. S. Narmaditya, “Professional development program for physical education teachers in Indonesia,” *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[44] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, “Makerspaces in early childhood education: Principles of pedagogy and practice,” *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[45] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, “Community-based teacher professional development in remote areas in Indonesia,” *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[46] Rusdiana, “Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif,” 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[47] J. Sargent and A. Casey, “Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time,” *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[48] J. M. Ramdani and X. (Andy) Gao, “Exploratory practice for teacher professional development in Indonesia,” *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

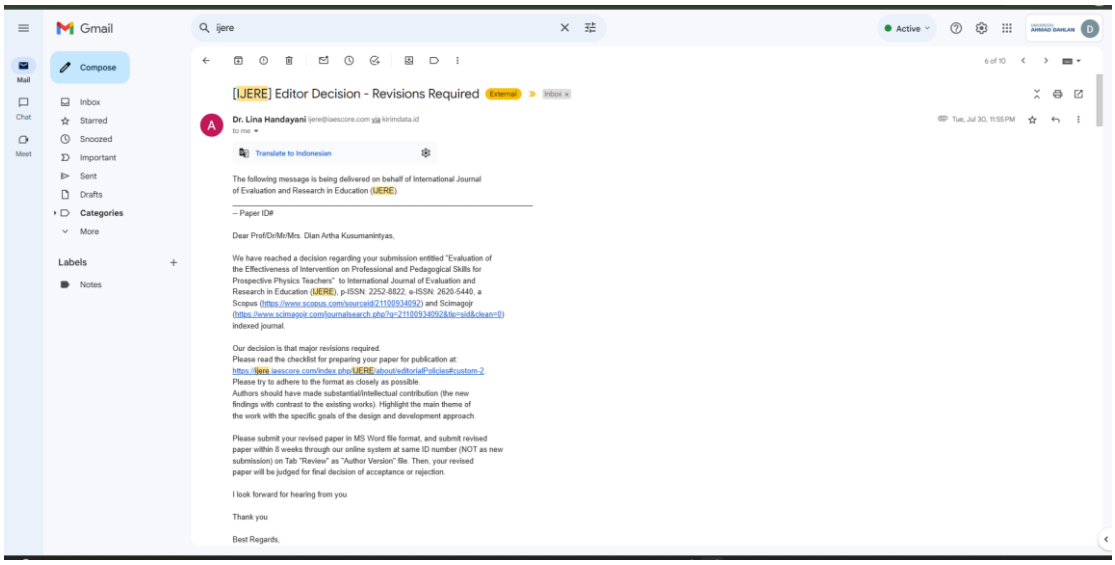
[49] M. Portuguez Castro and M. G. Gómez Zermeño, “Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education,” *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[50] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

BIOGRAPHIES OF AUTHORS

	**Dian Artha Kusumaningtyas** is a senior lecturer in the Physics Education Program at Ahmad Dahlan University, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id)
	**Moh Irma Sukarelawan** is an assistant professor at Universitas Ahmad Dahlan (Department of Physics Education, Faculty of Teacher Training and Education), Yogyakarta, Indonesia. He obtained his Doctoral degree in the Department of Educational Science, Graduate School, Universitas Negeri Yogyakarta (UNY) in 2023. His research focuses on physics education, misconception, metacognition, and the Rasch modeling. He can be contacted at irma.sukarelawan@pfis.uad.ac.id
	**Muhammad Syahriandi Adhantoro** is an enthusiast of information technology who has created various works in the field of education, including educational games and learning information systems. He also has an interest in Educational Informatics research.

2.Bukti Konfirmasi review dan hasil review Pertama (30 Juli 2024)


Gmail
ijere
Active
Compose
Inbox
Starred
Snoozed
Important
Sent
Drafts
Categories
More
Labels
Notes
[IJERE] Editor Decision - Revisions Required
External
Inbox
Dr. Lina Handayani ijere@iaescore.com via kirimdata.id
to me
Tue, Jul 30, 11:55 PM
Translate to Indonesian
The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).
-- Paper ID#
Dear Prof/Dr/Mr/Mrs. Dian Artha Kusumanintyas,
We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), p-ISSN: 2252-8822, e-ISSN: 2620-5440, a Scopus (https://www.scopus.com/sourceid/21100934092) and Scimagojr (https://www.scimagojr.com/journalsearch.php?q=21100934092&tip=sid&clean=0) indexed journal.
Our decision is that major revisions required.
Please read the checklist for preparing your paper for publication at:
https://ijere.iaescore.com/index.php/IJERE/about/editorialPolicies#custom-2
Please try to adhere to the format as closely as possible.
Authors should have made substantial/intellectual contribution (the new findings with contrast to the existing works). Highlight the main theme of the work with the specific goals of the design and development approach.
Please submit your revised paper in MS Word file format, and submit revised paper within 8 weeks through our online system at same ID number (NOT as new submission) on Tab "Review" as "Author Version" file. Then, your revised paper will be judged for final decision of acceptance or rejection.
I look forward for hearing from you
Thank you
Best Regards,

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Editor Decision - Revisions Required

2 messages

Dr. Lina Handayani <ijere@iaescore.com> Tue, Jul 30, 2024 at 11:55 PM
Reply-To: "Dr. Lina Handayani" <ijere@iaesjournal.com>
To: Dian Artha Kusumanintyas <dian.artha@pfis.uad.ac.id>

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID#

Dear Prof/Dr/Mr/Mrs. Dian Artha Kusumanintyas,

We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), p-ISSN: 2252-8822, e-ISSN: 2620-5440, a Scopus (https://www.scopus.com/sourceid/21100934092) and Scimagojr (https://www.scimagojr.com/journalsearch.php?q=21100934092&tip=sid&clean=0) indexed journal.

Our decision is that major revisions required.
Please read the checklist for preparing your paper for publication at: https://ijere.iaescore.com/index.php/IJERE/about/editorialPolicies#custom-2.
Please try to adhere to the format as closely as possible.
Authors should have made substantial/intellectual contribution (the new findings with contrast to the existing works). Highlight the main theme of the work with the specific goals of the design and development approach.

Please submit your revised paper in MS Word file format, and submit revised paper within 8 weeks through our online system at same ID number (NOT as new submission) on Tab "Review" as "Author Version" file. Then, your revised paper will be judged for final decision of acceptance or rejection.

I look forward for hearing from you

Thank you

Best Regards,
Dr. Lina Handayani

Reviewer A:

Please answer the following questions!
- Why did you do the study?
- Why is the study relevant?
- What did you do?
- What approach did you use?
- What did you find?
- What did you conclude?

Reorganize your abstract by stating the problem clearly, proposing a solution or approach, and emphasizing key findings and conclusion within 150-200 words.

use quantitative methods, the sample size must be at least 100. And enrich with the supported references of your research.
- If there is funding in the acknowledgement section, please kindly provide its contract number.
- Please provide all of the authors' social media link accounts as complete as possible: ORCID (required), followed by Google Scholar, Scopus, and Web of Science (WoS) (if any).

Reviewer B:

The IJERE form to evaluate submitted papers
Content:
Fair

Significance:
Very good

Originality:
Bad

Relevance:
Very good

Presentation:
Very good

Recommendation:
Good

Comments to the Author

This comment will be visible to the Author
:
Dear Authors,
I have conducted a thorough review of your paper and have highlighted the following strengths:
• The topic is interesting considering the current times
However, there are several key areas that need more work prior to publication. I have summarized the required changes in the hope that the feedback will be useful to you as you update the paper. I am not able to consider your manuscript for publication at the present time, but I hope you will consider the feedback provided to revise your manuscript and re-submit.
Abstract
• The research contributions of the paper should be articulated more clearly. The abstract does not seem to properly convey the rigor of research.
• The abstract could become much better if re-written to state clearly the contribution of this study to the field as well as the gap this study intends to address in the field.
• The abstract could become much better if it properly introduces the study from a research standpoint. Also, the main findings could be stated more pointedly in the abstract.

Introduction
-The introduction section would read better if the following were better stated and explained: focus of research conceptual/theoretical framework including relevant literature review studies that were used to conduct this research study
-The introduction section must explain without any ambiguity why there was a need for this research, what research gap(s) it addresses, and how it

contributes to the body of knowledge. In addition, it could explain the benefits of the study to the research and how and why the research advances knowledge in the field. In short, the important and justification for the study needs to be better articulated.

Literature Review

- Sources are out of date. More recent studies should be included. Also, it should lead up to the research questions in a logical manner. Adding additional sources/references that could speak to the importance of the study will help to strengthen this section.
- The literature review is deficient in its addressal of the research gap and research model. It needs to be rewritten with a focus on the quality of the content.
- The theoretical background presentation could be improved by incorporating clarity and additional evidence regarding recent studies. The vague nature should be eliminated. It could be extended and expanded by including additional theoretical and empirical literature which support the importance of the study.
- The literature review section could be improved by adding references to the theoretical framework underpinning the study and include a discussion of theories pertaining to learning and knowledge assimilation by students. There are not enough studies from Europe or western countries. Before I can make a final decision on the paper, please refer to more references. It is suggested that the author(s) can consider the following papers etc to strengthen the background and conclusions of the study:
  - Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). A review of the literature for designing and developing a framework for adaptive gamification in physics education. The international handbook of physics education research: Teaching physics, 5-1.
  - Karakose, T., Polat, H., Yirci, R., Tülübaş, T., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2023). Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling. Mathematics, 11(2), 449.
  - Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation. Computers, 12(7), 143.

Methodology

The methodology section could be improved by incorporating greater rigor and providing for generalizability of the findings.

Findings

- The value of the research to the academician and the practitioner should be expressed in an unambiguous manner.
- Based on the concerns expressed in the above paragraphs about the generalizability of the results, it is recommended that the authors collect more data and conduct further data analysis. This will improve the paper and may result in more findings.
- Making the findings less contextualized and more informative for the readers is recommended.

Discussion

- Improve the discussion section to better ascertain what is unique / novel about your findings
- This section could be improved by explaining in detail how the article contributes to new knowledge in the domain. Evidence from published research studies should be tied into the new contributions in the discussion section.
- This section could be improved by discussing the findings with reference to the theoretical framework used.
- This section could be improved by integrating previous work which was discussed and critiqued in the literature review and discussion sections, with the findings and tone of the study and bring out what was done in this study which addressed some of the shortcomings of those studies.

- To make the section even better, there needs to be an explanation of how results could be replicated in different disciplines in the academic environment. Additionally, the replication and demographics versus generalizability concerns noted earlier should be addressed and discussed in detail.
- Recommendations for practitioners could be articulated clearly to improve the application of the research.
- To improve readability, it is recommended that the discussion section be separated into paragraphs with themes based on the paper research questions and preceding suggestions.

Conclusion

- The conclusion section is currently a repeat or rehash of the preceding sections, and needs to be re-written to improve it, keeping in mind the following suggestions.
- Update the conclusion to include the newly formulated theoretical contributions
- Mention the limitations of the study and prospects for future research.
- Summarize the key results in a compact form and re-emphasize their significance.
- Summarize how the article contributes to new knowledge in the domain.
- This conclusion could be worded in a manner as to emphatically motivate the academic community to get down to actionable, practical engaged scholarship.

In general, the English in the present manuscript is not of publication quality and requires significant improvement. Please carefully proof-read spell check to eliminate grammatical errors
Plagiarism check results:
/* Similarity check with iThenticate revealed a similarity index of 23%, which is considered not appropriate. A maximum of around 60 quoted words is accepted per paper. There are papers with over 60 words. No previously copyrighted material was used.

In preparing a revised manuscript, please also include a table of how you have responded to each of the issues listed above point by point.
Dear AUTHOR, summarizing my feedback, I expect your contribution to be highly valued by the journal's readers if you improve it according to the review statements. I look forward to receiving your revised manuscript shortly.
With best regards,

Reviewer C:

The IJERE form to evaluate submitted papers
Content:
Good

Significance:
Good

Originality:
Good

Relevance:
Very good

Presentation:
Good

Recommendation:

Good

Comments to the Author

This comment will be visible to the Author
:
The title includes important terms that are necessary to reflect the study that was conducted.

The introduction and background are related to the study that was carried out.
The literature review provided are relevant to the study.

The research methodology selected is appropriate for the study that was carried out.

The discussion includes key terms that are required to reflect the study.

Please include the scope of further research

The conclusion and recommendation are acceptable. Kindly include the study's limitations.

Be consistent with the format used to cite the sources. Ensure that the font style and size are consistent across all references. Please refer the latest APA format.

International Journal of Evaluation and Research in Education (IJERE)
http://ijere.iaescore.com

ijere template 2022.docx
671K

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id> Wed, Jul 31, 2024 at 7:46 AM
To: "Dr. Lina Handayani" <ijere@iaesjournal.com>

Thank you for the input you have given us.
We will make improvements according to what the reviewer provided. We sincerely hope that you will be one of the authors who can contribute to your journal
[Quoted text hidden]

3. Bukti konfirmasi submit review pertama dan artikel yang diresubmit (5 Agustus 2024)

Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2] , Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]

[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia

[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. The research involved an experimental group receiving the intervention and a control group that did not. To rigorously assess the impact, Mann-Whitney and Wilcoxon statistical tests were used to compare pre-test and post-test outcomes, alongside Wright map analysis to visualize skill development. The results revealed a significant improvement in the professional and pedagogical competencies of the experimental group compared to the control group, as indicated by Mann-Whitney test values ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This research contributes to the field by providing empirical evidence supporting the use of targeted interventions in Physics teacher preparation programs. The findings underscore the importance of refining educational policies to better equip future educators and suggest ongoing evaluations to ensure that such programs adapt to the evolving needs of education. This study fills a critical gap in the literature and informs the development of more effective teacher training strategies.

Corresponding Author:

Dian Artha Kusumaningtyas

Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

5. INTRODUCTION

In Indonesia, teacher professional development still faces various challenges, including limited access to quality training, lack of incentives and adequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social competencies [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore also has a strong mentoring system where junior teachers receive guidance from experienced senior teachers [7]. Many schools in the US also provide time and resources for teachers to participate in professional development, including teacher-to-teacher collaboration and school-based development [8], [9].

Although efforts to improve teacher competency in Indonesia already exist, significant improvements are still needed in terms of accessibility, continuity, and adequate support. Experiences from developed countries show that sustainable investment in teacher professional development is very important to achieve high-quality education and can be an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional competence is the main foundation in the world of education [11]. Pedagogical competence includes the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional competence includes in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without this competency, a teacher will have difficulty conveying material effectively, facilitating constructive discussions, and cultivating critical skills in students.

If a teacher's pedagogical and professional competence is lacking, serious challenges can arise. Students may experience difficulties in understanding lesson material, which leads to low learning outcomes and motivation [14], [15]. Therefore, improving teachers' pedagogical and professional competence is very important to ensure high-quality education and optimal student academic achievement [16]. The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs. This research compares the achievements of pedagogical and professional competencies between

prospective teachers who have participated in the professional teacher education program for the field of physics with classes who have not participated in the program [17]. This research is expected to provide a clear picture of the impact of increasing teacher competency on the transformation of education in Indonesia. It is also expected that the results of this research can become a basis for policymakers in designing more effective and sustainable teacher professional development strategies.

6. METHOD

This research methodology uses a quantitative approach to evaluate the effectiveness of the pedagogical competency and professional competency development program for prospective Physics teachers. This research involved two groups, namely the experimental (n= 120) and control groups (n= 120). The experimental group consisted of prospective Physics teachers from two educational institutions for educational staff (LTPK) providing PPG for the field of Physics Education, who had participated in a competency development program, while the control group consisted of prospective physics teachers who had not participated in the program from the same two LPTKs as the experimental class.

Data collection was carried out through pretest and posttest to measure the pedagogical and professional skills of prospective teachers. This test is carried out before and after the implementation of the competency development program. Data collection tools in this research are pedagogical and professional tests, each consisting of 45 question items. The instrument has validity and reliability, so it has a reliable ability to measure the intended competency.

The Mann-Whitney test is used to determine whether there are significant differences between two independent groups, namely the experimental and control groups [18]. Meanwhile, the Wilcoxon test is used to test changes in two paired sets of data, namely pretest and posttest scores in groups, to see whether there is a significant increase in teachers' pedagogical and professional skills after participating in the development program [19], [20]. After carrying out the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map [20]. The Wright map allows a clear visualization of the increase in teachers' pedagogical and professional competence after participating in the development program [21].

7. RESULTS AND DISCUSSION

3.1. RESULTS

Professional skills and pedagogical skills are two critical aspects of the teaching profession that play an important role in improving the quality of education [22]. Professional skills include in-depth knowledge of subject matter, the ability to design relevant and engaging learning, and skills in using technology and other supporting resources [23]. Teachers who have good professional skills are able to deliver material comprehensively and inspire students to learn independently. Table 1 visualizes the results of the identification of professional skills and pedagogical skills.

Table 6. Fit statistics of Professional Skills and Pedagogical Skills

	Professional Skills		Pedagogical Skills	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test of professional skills and pedagogical skills in Table 1 show high quality based on the results of the analysis of various statistical indicators. The average (mean) for items and persons is 0.00 and 0.36 respectively, reflecting a balanced distribution of values between the abilities measured. The range of measures for items ranges from -1.89 to 1.61, while for persons is from -1.62 to 3.23, indicating that this instrument is able to measure variations in abilities with a wide scope. The standard deviation for items is 0.69 and for persons is 0.97 indicating relatively consistent variations in the level of expertise measured. The Mean Outfit MnSq index for items is 1.02 and for persons is -0.04, and the Mean Outfit ZStd for items is 0.06 and for persons is 1.02, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The Separation values for items and persons are 4.42 and 3.07, indicating the ability of this instrument to differentiate well among different levels of ability. The high level of reliability is also proven by the Cronbach alpha value of 0.91 for items and 0.90 for persons, confirming that this instrument is consistent in measuring the professional skills of prospective Physics teachers accurately.

The instrument for measuring the pedagogical skills of prospective Physics teachers also show good quality based on the results of statistical analysis. The average (mean) for items and persons is 0.00 and 0.82 respectively, indicating a balanced

distribution of values with a positive tendency in the abilities measured. The range of measures for items ranges from -2.73 to 1.20, while for persons ranges from -1.09 to 3.96, indicating that this instrument can measure a wide range of abilities. The standard deviation of items is 0.68 and for persons is 0.88 indicating consistent variation in the level of expertise measured. The Mean Outfit MnSq index for items is 1.00 and for persons is 0.21, and the Mean Outfit ZStd for items is -0.11 and for persons is 0.92, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The high separation for items of 4.17 and for persons of 2.10 indicates the ability of this instrument to differentiate well between various levels of pedagogical ability. A good level of reliability is also seen from the Cronbach alpha value of 0.81 for items and 0.81 for persons, indicating that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

7.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for teachers, statistical analysis was conducted on the pre-test and post-test data from prospective Physics teachers in the experimental and control groups [24]. This analysis aims to identify significant differences in skill improvement after the intervention of competence development program. The Mann-Whitney test was used to compare the distribution of scores between two unpaired groups, namely the experimental and control groups, both before (pre-test) and after (post-test) the intervention [25]. The Wilcoxon test was applied to evaluate changes in pre-test and post-test scores within each group, to ensure that the skill improvement was significant [26]. The results of this statistical analysis provide important insights regarding the impact of the competence development program on improving the professional skills of prospective Physics teachers. The results of this analysis are illustrated in Table 2 and Table 3.

Table 7. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Post-test	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 8. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test illustrated in Table 2 show that there is a statistically significant difference in the pre-test and post-test results between the prospective Physics teachers in the experimental group and the control group. In the pre-test results, the U value = 1347.500 with a significance level of $p < 0.05$, indicating that before the intervention there was a significant difference between the two groups. After the intervention, the post-test results show a U value = 183.500 with a significance level of $p < 0.05$, indicating that the intervention carried out has a significant impact on improving the professional skills of prospective Physics teachers in the experimental group compared to the control group.

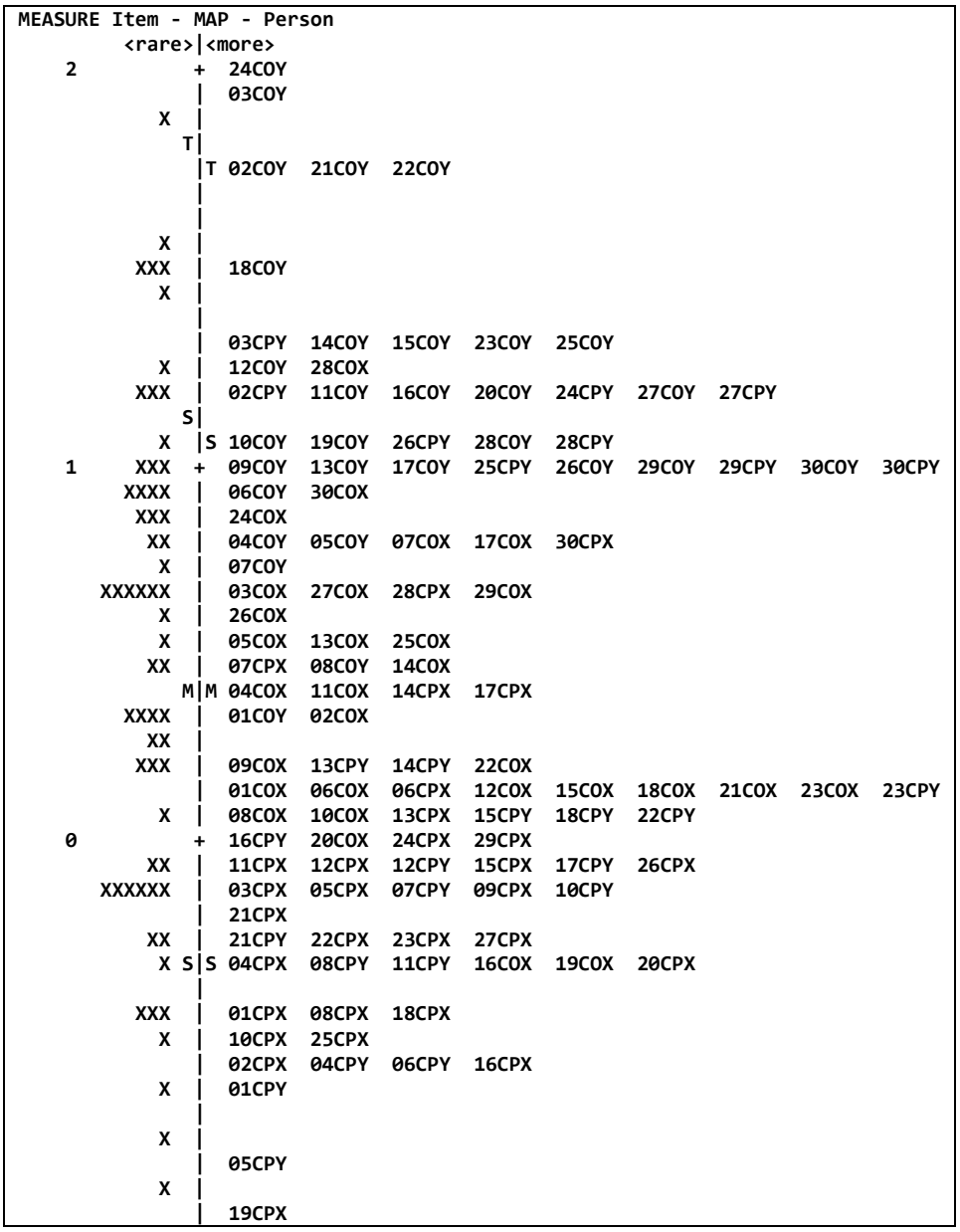
Analysis using the Wilcoxon test illustrated in Table 3 strengthens this finding. The Wilcoxon test shows that there is a significant difference between the pre-test and post-test results in both groups. In the experimental group, the Z value obtained is -6.736 with a significance level of $p < 0.05$, while in the control group, the Z value is -6.435 with the same significance level. This indicates that there is a significant increase in the professional skills of prospective Physics teachers after the intervention, either in the experimental or control groups.

However, the higher significant difference in the experimental group compared to the control group indicates that the implemented competency development program is more effective in improving the professional skills of prospective Physics teachers. The professional skills of prospective Physics teachers in the experimental group improved better compared to the control group after the intervention was carried out. This confirms that the intervention of competency development program has a greater positive impact on prospective Physics teachers who are involved in the program compared to those who do not participate in the program. This finding supports the importance of ongoing competency development programs as efforts to improve the quality of teaching and teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

The step in evaluating the effectiveness of the professional skills development program for prospective Physics teachers was conducted by carrying out an in-depth analysis of the pretest and posttest data. One of the tools used for visualization and analysis of this data is the Wright map, which allows mapping the skills of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear picture of the distribution of abilities held by the prospective Physics teachers in the

control group and the experimental group. By mapping the pretest and posttest results of the two groups, we can identify significant differences in the professional skill attainment. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur as a result of the intervention; providing a more comprehensive insight related to the effectiveness of the training program that has been implemented [27]. The analysis on the professional skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 1 and Figure 2.



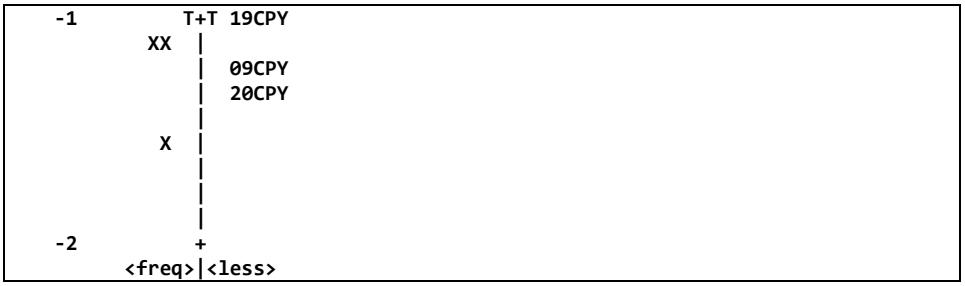
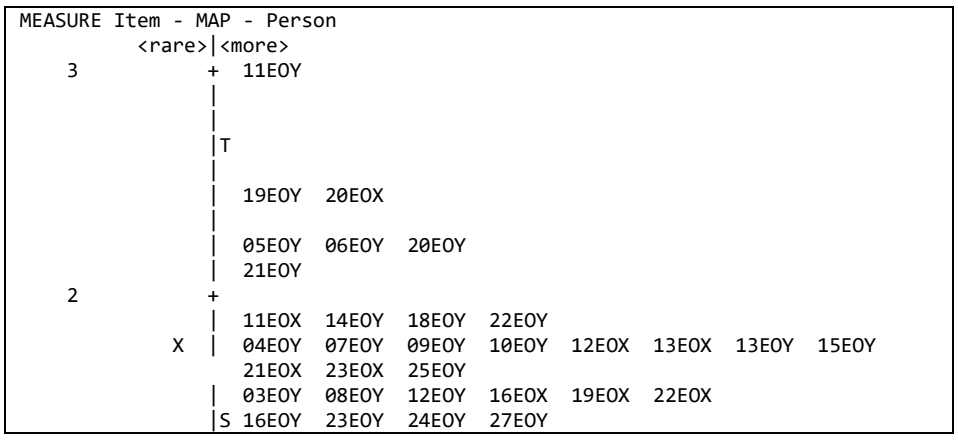


Figure 3. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) shows the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. On this map, it can be seen that items and people are spread over a fairly wide range. Most of the values are around the average with some items and persons being less or more frequent than that value. For example, the item with the highest measure is 24COY, indicating that only a few prospective Physics teachers having very high professional skills before the intervention. In contrast, there are many people with measure values between -1 and 0, indicating lower or moderate professional skills before the intervention. This distribution shows significant variation in ability among prospective Physics teachers in the control group.

After the intervention, the person's score is seen to shift significantly towards higher values, although there are still people who are at the low level. This shows that although there has been an increase in professional skills after the intervention, there are still some prospective Physics teachers who have not achieved the expected increase in skills. However, in general, this increase shows that the intervention has a positive impact even though it is not evenly distributed across all people.



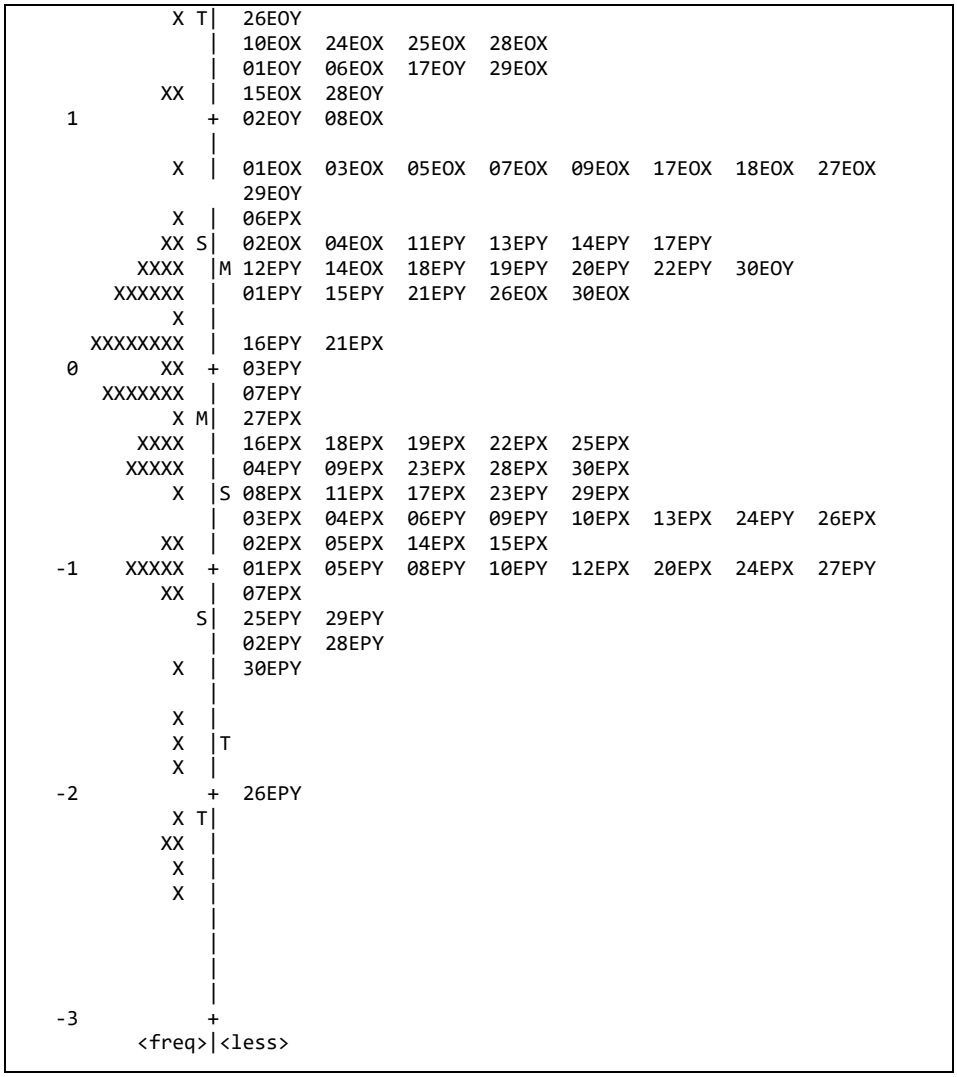


Figure 4. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group shows a more striking difference between the pretest and posttest compared to the control group. In the experimental group, item and person measures are also spread over a wide range, but there is a higher concentration of higher measure values after the intervention. This shows that more prospective Physics teachers in the experimental group show significant improvement in professional skills [28].

In the pretest, there are people with the highest measures such as 11EOY, indicating high professional skills before the intervention. However, after the

intervention, the measure values for many individuals increase significantly, with some individuals achieving higher measure values than before the intervention, such as 29EOX and 30EOY. This shows that the competency development program applied to the experimental group is more effective in improving the professional skills of prospective Physics teachers compared to the control group [29].

This Wright map indicates that the intervention carried out in the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group shows the effectiveness of the competency development program implemented. The significant difference in the score distribution of these two groups confirms that the approach applied in the experimental group was more successful in improving the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers, statistical analysis was carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare distribution differences between two independent groups, namely the experimental group that received the intervention and the control group that did not receive the intervention [30]. This test helps determine whether there are any significant differences in pedagogical skills between the two groups. On the other hand, the Wilcoxon test was used to assess changes in the same group within two measurement times, namely before and after the intervention [31]. This analysis provides a more comprehensive picture on the impact of the intervention on the development of the pedagogical skills of prospective Physics teachers. The results of the statistical analysis of the two tests are illustrated in Table 4 and Table 5.

Table 9. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Post-test	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 10. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**

Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) show that there is a statistically significant difference in the results of the pre-test (U=1274.500, $p < 0.05$) and post-test (U=421.500, $p < 0.05$) among the prospective Physics teacher in both experimental and control groups. The Mann-Whitney test is a non-parametric statistical method used to compare two independent groups. In this context, the experimental group received a specific intervention, while the control group received no intervention. The significant results in this test indicate that the intervention given to the experimental group had a real effect on improving pedagogical skills compared to the control group.

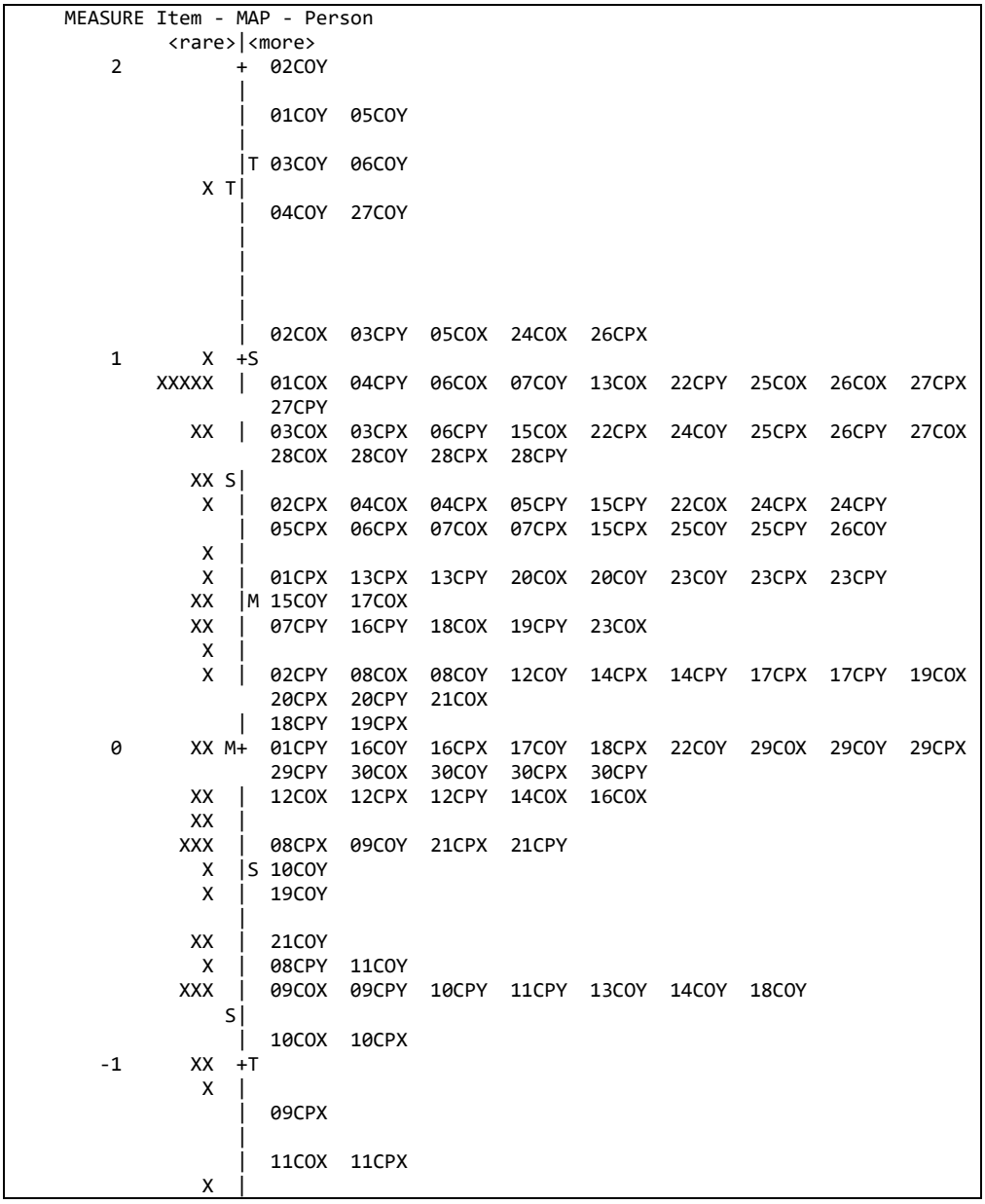
The Wilcoxon test results (Table 5) strengthen these findings by showing that there is a significant difference between the pre-test and post-test results of prospective Physics teachers both in the experimental group (Z=-6.729, $p < 0.05$) and in the control group (Z =-2.721, $p < 0.05$). The Wilcoxon test, which is also a non-parametric statistical method, is used to compare two sets of paired data, namely pre-test and post-test results from the same individual. These results indicate that there was a significant increase in pedagogical skills after the intervention in both groups, although the increase in the experimental group was higher compared to the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. However, the improvement was greater in the experimental group compared to the control group, indicating the effectiveness of the intervention implemented. The higher pedagogical skills in the experimental group compared to the control group after the intervention indicate that the training program or method applied was successful in significantly increasing the pedagogical competence of prospective Physics teachers. This emphasizes the importance of developing a structured and sustainable training program to improve the quality of teaching and professionalism of prospective Physics teachers [32]. Through appropriate and evidence-based approaches, the development of pedagogical skills can have a significant positive impact on improving the overall quality of education [33].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual depiction of the distribution of test takers' abilities and the difficulty of the test items, making it easier to identify differences in abilities before and after the intervention. Wright Map analysis was carried out on pretest and posttest data on the pedagogical skills of prospective Physics teachers for two groups, namely the control group and the

experimental group. Understanding the results of this mapping is very important to assess the effectiveness of the interventions that have been implemented. The following is a detailed analysis of the Wright Map pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group, which provides insight into improvements or changes in pedagogical abilities after the intervention was carried out. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.



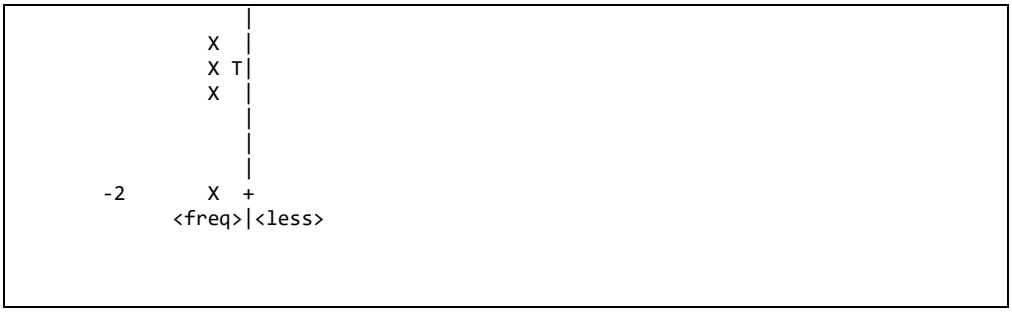
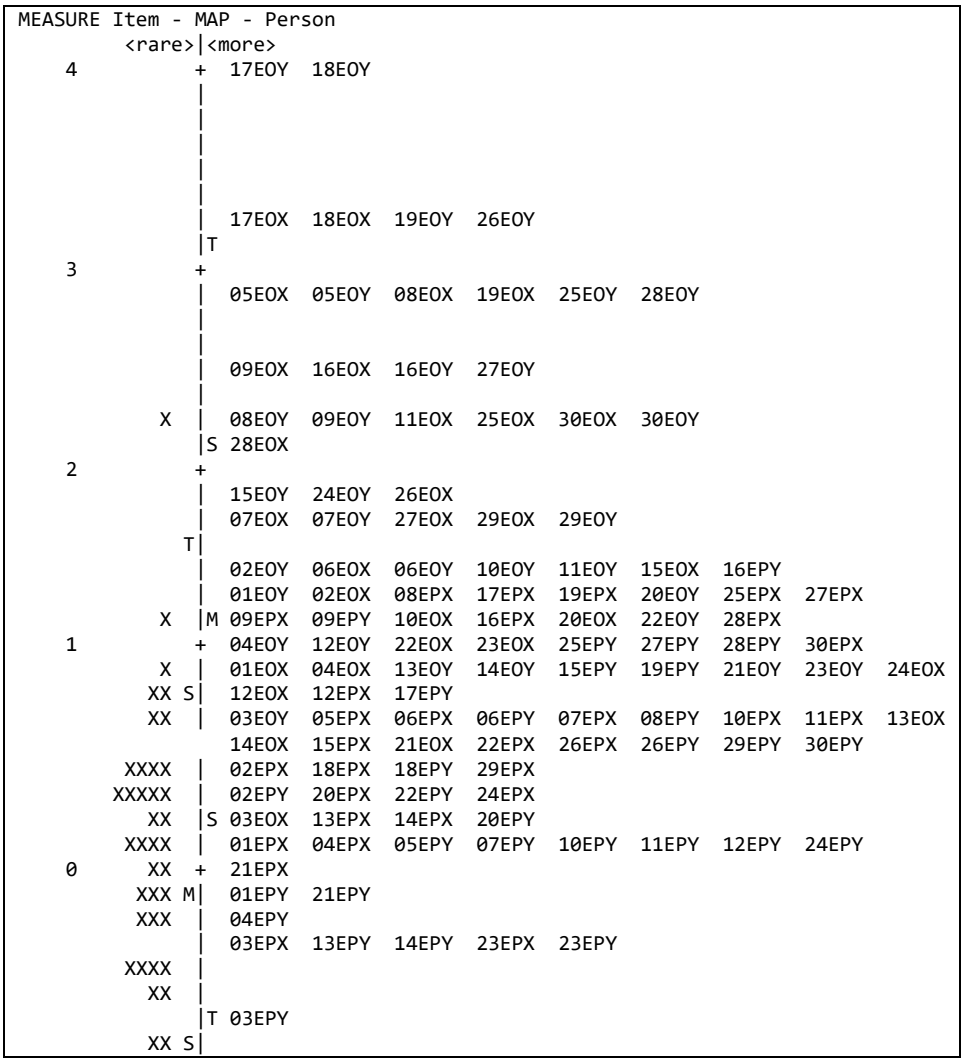


Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group



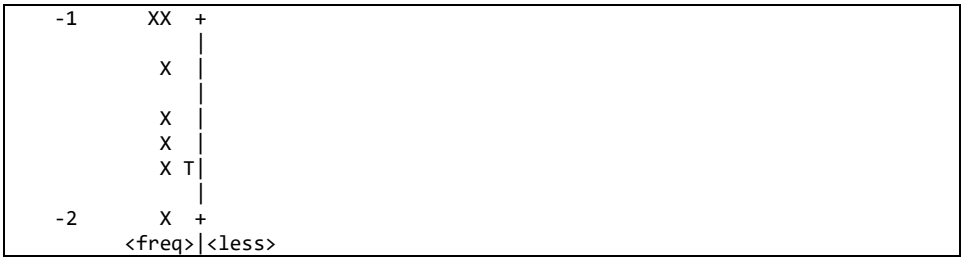


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group provides an in-depth picture of the distribution of ability and difficulty of items. In the Wright Map of the control group, it can be seen that the distribution of persons and items shows that the majority of prospective Physics teachers have varied pedagogical skills with some items being more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY are in higher positions, indicating better pedagogical skills, while other persons are spread along the scale with the majority being around the middle of the scale (measure=1), indicating moderate variation in pedagogical abilities . This distribution indicates that there are differences in pedagogical abilities among the prospective Physics teachers in the control group, with some items indicating significant challenges for them.

In contrast, in the Wright Map experimental group, the distribution of persons and items show a more significant increase in pedagogical skills after the intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX are at higher measures (measure=3 and 4), indicating that the intervention provided was successful in improving their pedagogical skills. Many people from the experimental group are at higher levels compared to the control group, indicating that the intervention implemented was effective in improving the pedagogical skills of prospective Physics teachers. The distribution of items also shows that there are several items that remain difficult for most people, but overall, people in the experimental group show better abilities compared to the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group succeeded in improving the pedagogical skills of prospective Physics teachers significantly better than the control group [34]. The Wright Map provides a clear visualization of the distribution of ability and difficulty of items, assisting in understanding the effectiveness of the implemented intervention. This emphasizes the importance of structured and evidence-based training programs in improving the pedagogical quality of prospective Physics teachers [35].

7.2. Discussion

7.2.1. Professional Skills of Prospective Physics Teachers

Professional skills for prospective Physics teachers are an integral aspect in their preparation to face teaching assignments in the world of education. These skills include various competencies that are not only limited to mastering academic material, but also the ability to adapt to the work environment, interact with students, and manage the class effectively [36], [37]. A prospective Physics teacher who has strong professional skills can implement innovative teaching strategies, apply fair and objective assessments of student achievement, and build good relationships with all relevant parties in the educational context [38], [39].

The importance of the professional skills of prospective Physics teachers is also reflected in their ability to continue learning and developing themselves, either through additional training, workshops or independent study. This supports their ability to integrate the latest developments in education into their teaching practice so that it can improve the overall quality of students' learning experiences [5], [40]. The evaluation aspect of professional skills often involves the use of measurement tools such as validity and reliability tests, as well as competency mapping to assess the extent to which a prospective Physics teacher has achieved the standards set in their field [41].

Academically, the professional skills of prospective Physics teachers can be measured through various indicators, such as test results, assessments by fellow professionals, and the ability to plan and implement effective learning strategies [42]. Developing these skills also plays an important role in creating an inclusive learning environment and encouraging balanced intellectual and emotional growth of students.

7.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers are the main foundation in their ability to convey subject matter in a way that arouses interest and facilitates students' understanding [43]. The main aspects of pedagogical skills include the ability to design a curriculum that is relevant and in accordance with educational standards, choosing appropriate teaching methods to accommodate students' diverse learning styles, and utilizing educational technology and other resources effectively in the learning process [44].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in

their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [51], [52].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [53], [54].

8. CONCLUSION

The results showed a significant difference in the pre-test and post-test between the two groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation of prospective Physics teachers. Wright's map analysis of pedagogical skills showed that the experimental group showed a more regular and significant increase compared to the control group, indicating that the intervention program was able to provide a positive and consistent impact on the development of teaching skills. Further research is recommended to conduct ongoing evaluations to monitor and evaluate the effectiveness of this program in order to continue to make necessary improvements in an effort to improve the quality of teaching. The number of research subjects that are not yet representative of all of Indonesia is also the basis for providing recommendations for further research, which seeks to examine the success of the program in a national context. Overall, this study provides a valuable contribution to our understanding of how to prepare prospective Physics teachers who are competent and ready to face the demands of the future in an increasingly complex and dynamic world of education.

ACKNOWLEDGEMENTS

We would like to thanks Universitas Ahmad Dahlan for supporting and founding this work under the supported proffesorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, “The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States,” *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, “Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States,” *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, “The Human Teacher, the AI Teacher and the AIed-Teacher Relationship,” *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, “Pedagogies of embodiment in physical education – a literature review,” *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, “Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy,” *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, “Indonesian teacher performance: Professional and Character,” *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, “The Effects of Students’ Perception of the School Environment and Students’ Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[15] G. B. Gudmundsdottir and O. E. Hatlevik, “Newly qualified teachers’ professional digital competence: implications for teacher education,” *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[16] D. Ramandanis and S. Xinogalos, “Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review,” *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[17] P. S. Lisenbee and C. M. Ford, “Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children’s Experiences,” *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[18] T. Lin, T. Chen, J. Liu, and X. M. Tu, “Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks,” *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[19] Y. Fong and Y. Huang, “Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null,” *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[20] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, “An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome,” *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[21] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, “Wright-Map to investigate the actual abilities on math test of elementary students,” *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[22] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, “The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia,” *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

[23] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, “Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being,” *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[24] S. Handayani, L. Peddell, and T. Yeigh, “Participants’ Experiences in Heutagogy Teacher Professional Education in Indonesia,” *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[25] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, “The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians,” *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[26] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, “A Wilcoxon-Mann-Whitney spatial scan statistic for functional data,” *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[27] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, “A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[28] F. J. Rodríguez Muñoz, “Pre-test and structural analysis of the pragmatic awareness questionnaire destined to teachers’ communicative instruction,” *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[29] M.-Y. Chen, S.-M. Huang, and W. Chou, “Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19,” *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[30] L. Mao, “Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance,” *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[31] R. Wilcox, “Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions,” *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[32] M. Mawarto, W. Widodo, and S. Sulistiasih, “The Antecedence of Teacher’s Professional Performance: Evidence from Indonesia,” *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[33] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, “The professional development of higher education-based teacher educators: needs and realities,” *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[34] Y. Cheng, W. Jia, R. Chi, and A. Li, “A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing,” *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[35] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, “Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling,” *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[36] L. Lukman *et al.*, “Effective teachers’ personality in strengthening character education,” *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[37] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, “The importance of attitudes toward technology for pre-service teachers’ technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches,” *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[38] A. H. Abdulrazzaq, “Teacher Appraisers’ Perceptions of Teacher Appraisal,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[39] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, “Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement,” *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[40] N. Ishartono *et al.*, “The Role of Instructional Design in Improving Pre-Service and In-Service Teacher’s Mathematics Learning Sets Skills: A Systematic Literature Review in

Indonesian Context," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[41] M. A. Flores, "Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education," *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[42] H. T. Yusuf, "Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[43] M. Mu'arifin and B. S. Narmaditya, "Professional development program for physical education teachers in Indonesia," *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[44] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, "Makerspaces in early childhood education: Principles of pedagogy and practice," *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[45] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, "Community-based teacher professional development in remote areas in Indonesia," *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[46] Rusdiana, "Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif," 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[47] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[48] J. M. Ramdani and X. (Andy) Gao, "Exploratory practice for teacher professional development in Indonesia," *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[49] M. Portuguez Castro and M. G. Gómez Zermeño, "Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education," *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[50] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[51] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in physics education', in *The international handbook of physics education research: Teaching physics*, M. F. Taşar

and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[52] T. Karakose *et al.*, 'Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling', *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

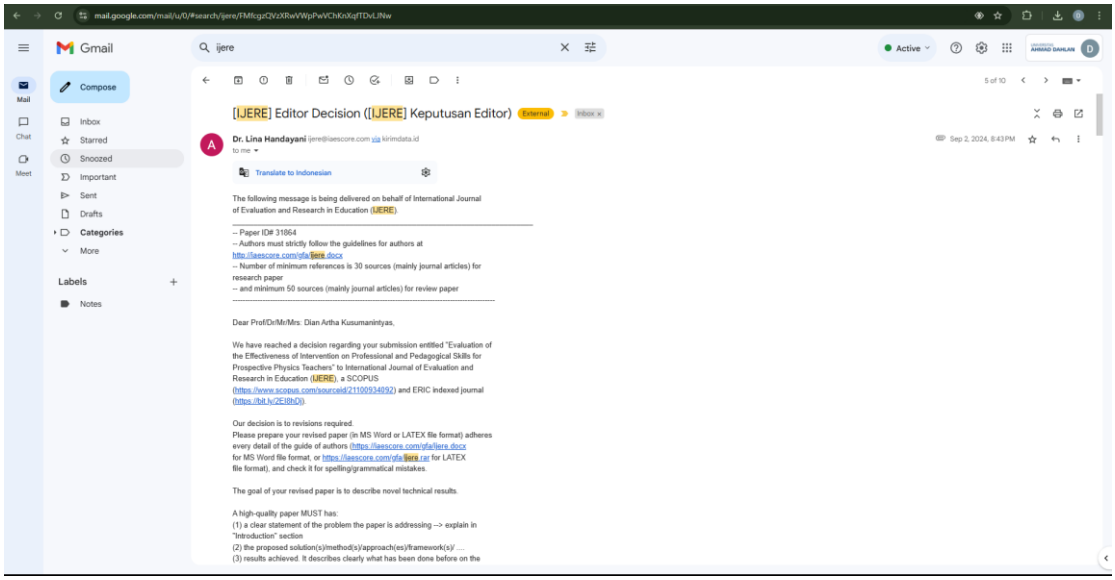
[53] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[54] I. Setianingrum and A. Da Costa, 'Mapping research on Indonesian professional teacher: The bibliometric analysis', *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

BIOGRAPHIES OF AUTHORS

	**Dian Artha Kusumaningtyas** is a senior lecturer in the Physics Education Program at Ahmad Dahlan University, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id)
	**Moh Irma Sukarelawan** is an assistant professor at Universitas Ahmad Dahlan (Department of Physics Education, Faculty of Teacher Training and Education), Yogyakarta, Indonesia. He obtained his Doctoral degree in the Department of Educational Science, Graduate School, Universitas Negeri Yogyakarta (UNY) in 2023. His research focuses on physics education, misconception, metacognition, and the Rasch modeling. He can be contacted at irma.sukarelawan@pfis.uad.ac.id
	**Muhammad Syahriandi Adhantoro** is an enthusiast of information technology who has created various works in the field of education, including educational games and learning information systems. He also has an interest in Educational Informatics research.
	**Wahyu Nanda Eka Saputra** is a Ph.D. & Lecturer, Department of Guidance and Counseling, Universitas Ahmad Dahlan, Indonesia. His research focuses on peace education, strategy of counseling intervension, counseling based on local wisdom, and counseling based on creative art. He can be contacted at email: wahyu.saputra@bk.uad.ac.id.

4. Bukti kofirmasi review kedua dan artikel yang diresubmit (2 September 2024)


mail.google.com/mail/u/0/#search/ijere/FMfcgzQVzXRwVWpPwVChKnXqfTDvLlNw
Gmail
ijere
Active
Compose
Inbox
Starred
Snoozed
Important
Sent
Drafts
Categories
More
Labels
Notes
[IJERE] Editor Decision ([IJERE] Keputusan Editor)
External
Inbox
Dr. Lina Handayani ijere@iaescore.com via kirimdata.id
to me
Sep 2, 2024, 8:43 PM
Translate to Indonesian
The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).
-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper
Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,
We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ERIC indexed journal (https://bit.ly/2EI8h0l).
Our decision is to revisions required.
Please prepare your revised paper (in MS Word or LATEX file format) adheres every detail of the guide of authors (https://iaescore.com/gfa/ijere.docx for MS Word file format, or https://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.
The goal of your revised paper is to describe novel technical results.
A high-quality paper MUST has:
(1) a clear statement of the problem the paper is addressing --> explain in "Introduction" section
(2) the proposed solution(s)/method(s)/approach(es)/framework(s)/ ....
(3) results achieved. It describes clearly what has been done before on the

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Editor Decision

5 messages

Dr. Lina Handayani <ijere@iaescore.com> Mon, Sep 2, 2024 at 8:43 PM
Reply-To: "Assoc. Prof. Dr. Lina Handayani" <ijere@iaescore.com>
To: Dian Artha Kusumanintyas <dian.artha@pfis.uad.ac.id>

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper

---

Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,

We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ERIC indexed journal (https://bit.ly/2EI8hDj).

Our decision is to revisions required.
Please prepare your revised paper (in MS Word or LATEX file format) adheres every detail of the guide of authors (https://iaescore.com/gfa/ijere.docx for MS Word file format, or https://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.

The goal of your revised paper is to describe novel technical results.

A high-quality paper MUST has:
(1) a clear statement of the problem the paper is addressing --> explain in "Introduction" section
(2) the proposed solution(s)/method(s)/approach(es)/framework(s)/ ....
(3) results achieved. It describes clearly what has been done before on the problem, and what is new.

Please submit your revised paper within 6 weeks.

I look forward for hearing from you

Thank you

Best Regards,
Assoc. Prof. Dr. Lina Handayani
Institute of Advanced Engineering and Science
ijere@iaescore.com

Reviewer A:

The IJERE form to evaluate submitted papers

Content:
Good

Significance:
Very good

Originality:
Good

Relevance:
Good

Presentation:
Very good

Recommendation:
Good

Comments to the Author

This comment will be visible to the Author
:
Overall, the paper entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" is good and well organized. The revised manuscript represents a significant improvement over the original draft, and the author has addressed my questions and comments in a satisfactory manner. However, this paper has shortcomings in its appearance, so this paper needs some improvement(s) in its appearance.

- Complete all the authors' social media link accounts as complete as possible in Biographies of Authors section: ORCID (required- Muhammad Syahriandi Adhantoro), followed by Google Scholar, Scopus, and Web of Science (WoS).

Reviewer B:

The IJERE form to evaluate submitted papers
Content:
Fair

Significance:
Good

Originality:
Good

Relevance:
Good

Presentation:
Fair

Recommendation:
Fair

Comments to the Author

This comment will be visible to the Author

:

Dear author(s),
please consider the suggestions below that synthesize my comments and suggestions.
Best wishes

Abstract
1. Best to include the theoretical contribution of the study, particularly on how it extends the previous theory.
2. Helpful to identify the target audience for the current study, given the rather technical nature of the research topic.

Introduction
The Introduction includes a fair discussion since the authors provided context to the study. The structure is not well-explained, and it's not easy to follow the discussion. Thus, reviews on the following are needed:
1. Specify what makes this article different from the other studies available in the literature.
2. Identify the gap in the existing literature by arguing what is missing or inadequate in existing solutions. Thus, it needs to be briefly stated in the Introduction and further elaborated in the Literature Review, with in-depth analysis and substantiation of citations.
3. The research problem and objectives need to be better articulated to issues and problems associated with these variables.

Literature Review
The literature review is not thorough and does not appears to be comprehensive. However, consider the following:
1. Add some literature related to the main research questions.
2. The research context should be explicitly established, as the readers should be able to share the authors' views.
3. Before developing the conceptual framework of the current research, the paper should first engage with existing theoretical frameworks in the literature to demonstrate the need for the proposed framework. What literature is there to support this claim? This aspect of the paper is one of the weakest and needs an in-depth relook to strengthen the theoretical aspect.
4. It would be helpful to clarify the proposed study's importance if the paper could include references to some latest articles published in recent years within the scope of the current research. The literature review should be carefully synthesized and structured, and using sub-headings and signposting would help the reader follow the argument developed throughout the paper. For clarity and to strengthen the literature review, the authors should begin by presenting past work and identifying the gaps in the previous work that the findings from the proposed study may shed some light on.
5. A more recent bibliography is necessary. Remove all outdated references! Furthermore, the reference list of new publications is a little bit weak. There are not enough studies from Europe or western countries. Before I can make a final decision on the paper, please refer to more references. It is suggested that the author(s) can consider the following papers related to gamification, new forms of educational reforms and technology etc. to strengthen the background and conclusions of the study:
1. Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation. Computers, 12(7), 143.
2. Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). A review of the literature for designing and developing a framework for adaptive gamification in physics education. The international handbook of physics education research: Teaching physics, 5-1.
3. Karakose, T., Polat, H., Yirci, R., Tülübaş, T., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2023). Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling. Mathematics, 11(2), 449.

Method/Methodology
The following should be included/amended:
1. The article needs to explain more clearly and in enough depth the research approach of the study.
2. The methods should be adequately described to show how the research was conducted to improve its transparency and trustworthiness. For example, the use of the data-gathering methods needs to be justified, and their appropriateness needs to be substantiated in the literature.
3. Similarly, it needs to be clear how the data analysis methods used in the paper are appropriate for analysing the data obtained. It can be extended to explain the stages of data analysis, including the measurement and structural models.
4. It would also be helpful to include a paragraph at the end of the methodology section by moving the second paragraph of the section on results, which explains the software used to analyse data and why it was used over others. Furthermore, the questionnaire items and from which literature each item was adopted could be added in this section.
5. It is also suggested to discuss the reliability and validity of the study outcomes. It is also essential to address the study's limitations and provide a comprehensive discussion of the expected benefits of the proposed new teaching practice.

Discussion
The comparisons of the current findings with the findings of previous research are not discussed. Furthermore, elaborations regarding the rejected hypotheses are also not included. Thus, the discussions could be summarized by stating clear answers to the research questions.

Conclusion
1. The aims and objectives of the study are not summarized in the conclusion. Furthermore, the main findings are not explicitly stated.
2. The study's contribution must be clearly articulated in this section.
3. The section needs to include recommendations for practitioners based on the findings, if appropriate.

Finally, the author(s) need to review the References section as there are incorrectly entered entries.

Also, proofread the paper.

Reviewer C:

The IJERE form to evaluate submitted papers
Content:
Good

Significance:
Good

Originality:
Excellent

Relevance:
Very good

Presentation:
Very good

Recommendation:
Very good

Comments to the Author

This comment will be visible to the Author
:

Dear Authors,

This article potentially forges a good understanding in the context of Physics Education. The Findings are clear and the Discussions are satisfying with a sufficient compare and contrast to the literature. The Discussions, however, can be improved once the Introduction is improved.

Accordingly, more work need to be done in the Introduction section to incorporate all variables in the title, and better support your Findings. In particular, more explanations on the previous studies related to Physics Education, Prospective Physics Teachers, and the strength comparisons between quant and qual studies should be explored. Especially when the journal has no place for specified Literature Review. The points of Content and Significance in the above review will be improved if you revise your work accordingly.

I wish you the best of luck with your revisions and looking forward to read the final version.

=========
IMPORTANT!!
=========
For ORIGINAL/RESEARCH PAPER: the paper should be presented with IMRaD model:
1. Introduction
2. Research Method
3. Results and Discussion
4. Conclusion.
We will usually expect a minimum of 30 references primarily to journal papers. Citations of textbooks should be used very rarely and citations to web pages should be avoided. All cited papers must be referenced within the body text of the manuscript.

For REVIEW PAPER: the paper should present a critical and constructive analysis of existing published literature in a field, through summary, classification, analysis and comparison. The function and goal of the review paper is:
1) to organize literature;
2) to evaluate literature;
3) to identify patterns and trends in the literature;
4) to synthesize literature; or
5) to identify research gaps and recommend new research areas.
The structure of a review paper includes:
1. Title – in this case does not indicate that it is a review article.
2. Abstract – includes a description of subjects covered.
3. Introduction includes a description of context (paragraph 1-3), motivation for review (paragraph 4, sentence 1) and defines the focus (paragraph 4, sentences 2-3)
4. Body – structured by headings and subheadings
5. Conclusion – states the implications of the findings and an identifies possible new research fields
Number of minimum references for review paper is 50 references (included minimum 40 recently journal articles).

In preparing your revised paper, you should pay attention to:
1. Please ensure that: all references have been cited in your text; Each

citation should be written in the order of appearance in the text; The citations must be presented in numbering and CITATION ORDER is SEQUENTIAL [1], [2], [3], [4], ...
Please download & study our published papers for your references:
- http://ijere.iaescore.com
- http://journal.uad.ac.id/index.php/edulearn
- http://ijece.iaescore.com
- http://ijeecs.iaescore.com
(Please use “Search” menu under "JOURNAL CONTENT" menu in right side of the site)

2 An Introduction should contain the following three (3) parts:
- Background: Authors have to make clear what the context is. Ideally, authors should give an idea of the state-of-the art of the field the report is about.
- The Problem: If there was no problem, there would be no reason for writing a manuscript, and definitely no reason for reading it. So, please tell readers why they should proceed reading. Experience shows that for this part a few lines are often sufficient.
- The Proposed Solution: Now and only now! - authors may outline the contribution of the manuscript. Here authors have to make sure readers point out what are the novel aspects of authors work. Authors should place the paper in proper context by citing relevant papers. At least, 5 references (recently journal articles) are cited in this section.

3. Results and discussion section: The presentation of results should be simple and straightforward in style. This section report the most important findings, including results of statistical analyses as appropriate. You should present the comparison between performance of your approach and other researches. Results given in figures should not be repeated in tables. It is very important to prove that your manuscript has a significant value and not trivial.

_____
International Journal of Evaluation and Research in Education (IJERE)
http://ijere.iaescore.com

31864-69118-1-RV.docx
269K

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id> Tue, Sep 3, 2024 at 7:20 AM
To: Wahyu Nanda Eka Saputra <wahyu.saputra@bk.uad.ac.id>

-------- Pesan yang diteruskan --------
Dari: **Dr. Lina Handayani** <ijere@iaescore.com>
Tanggal: Sen, 2 Sep 2024 pukul 8.43 PM
Subjek: [IJERE] Editor Decision
Ke: Dian Artha Kusumanintyas <dian.artha@pfis.uad.ac.id>
[Quoted text hidden]

31864-69118-1-RV.docx
269K

International Journal of Evaluation and Research in Education (IJERE)
Vol. 99, No. 1, Month 2099, pp. 1~1x
ISSN: 2252-8822, DOI: 10.11591/ijere.v99i1.paperID

Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers

Deleted[Ria Arista Asih]: **Physics**

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2] , Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]
[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia
[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia
[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Deleted[Ria Arista Asih]: Physics

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. This study aims to fill a critical gap in the literature and informs the development of more effective teacher training strategies. The research involved an experimental group receiving the intervention, and a control group that did not. To rigorously assess the impact, Mann-Whitney and Wilcoxon's statistical tests were used to compare pre-test and post-test outcomes, alongside Wright map analysis to visualize skill development. The results revealed a significant improvement in the professional and pedagogical competencies of the experimental group compared to the control group, as indicated by Mann-Whitney test values ($U=1274.500$, $p<0.05$ and $U=421.500$, $p<0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. The findings underscore the importance of refining educational policies to better equip future educators and suggest ongoing evaluations to ensure that such programs adapt to the evolving needs of education. This research contributes to the field by providing empirical evidence supporting the use of targeted interventions in Physics teacher preparation programs.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Wilcoxon

Deleted[Ria Arista Asih]:

Deleted[Ria Arista Asih]:

Deleted[Ria Arista Asih]:

Deleted[Ria Arista Asih]:

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: The findings underscore the importance of refining educational policies to better equip future educators and suggest ongoing evaluations to ensure that such programs adapt to the evolving needs of education. This study fills a critical gap in the literature and informs the development of more effective teacher training strategies.

Deleted[Ria Arista Asih]: *open access*

Deleted[Ria Arista Asih]: Physics

Corresponding Author:

Dian Artha Kusumaningtyas
Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

1. INTRODUCTION

In Indonesia, teacher professional development still faces various challenges, including limited access to quality training, lack of incentives and adequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social competencies [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore also has a strong mentoring system where junior teachers receive guidance from experienced senior teachers [7]. Many schools in the US also provide time and resources for teachers to participate in professional development, including teacher-to-teacher collaboration and school-based development [8], [9].

Although efforts to improve teacher competency in Indonesia already exist, significant improvements are still needed in terms of accessibility, continuity, and adequate support. Experiences from developed countries show that sustainable investment in teacher professional development is very important to achieve high-quality education and can be an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional competence is the main foundation in the world of education [11]. Pedagogical competence includes the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional competence includes in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without this competency, a teacher will have difficulty conveying material effectively, facilitating constructive discussions, and cultivating critical skills in students.

ADD A PARAGRAPH HERE DETAILING THE IMPORTANCE OF TRAINING PROSPECTIVE TEACHERS, ESPECIALLY IN PHYSICS. CONNECT WITH THE ABOVE EXPLANATION ON PROFESSIONAL AND PEDAGOGICAL COMPETENCE. CONNECT THE GAPS IN THE LITERATURE WITH THE PROBLEMS YOU ALREADY DETAIL BELOW.

If a teacher's pedagogical and professional competence is lacking, serious challenges can arise. Students may experience difficulties in understanding lesson material, which leads to low learning outcomes and motivation [14], [15]. Therefore, improving teachers' pedagogical and professional competence is very important to ensure high-quality education and optimal student academic achievement [16].

ADD A PARAGRAPH HERE CRITICISING THE SAMPLES OF EXISTING RESEARCH IN DETAILS, ESPECIALLY ON QUANT, TO COMPARE AND CONTRAST WITH YOUR IDEA BEFORE JUMPING INTO THE CONCLUSIONS OF NOVELTY. IF YOU CAN ADD IDEAS ON THE IMPORTANCE OF QUANT STUDIES TO COMPLETE THE EXISTING QUAL STUDIES, IT'D BE BETTER.

The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs. This research compares the achievements of pedagogical and professional competencies between prospective teachers who have participated in the professional teacher education program for the field of Physics with classes who have not participated in the program [17]. This research is expected to provide a clear picture of the impact of increasing teacher competency on the transformation of education in Indonesia. It is also expected that the results of this research can become a basis for policymakers in designing more effective and sustainable teacher professional development strategies.

Deleted[Ria Arista Asih]:

Deleted[Ria Arista Asih]: physics

2. METHOD

This research methodology uses a quantitative approach to evaluate the effectiveness of the pedagogical competency and professional competency development program for prospective Physics teachers. This research involved two groups, namely the experimental (n=120) and control groups (n= 120). The experimental group consisted of prospective Physics teachers from two educational institutions for educational staff (EXPAND THE INDONESIAN VERSION OF THIS ABBREVIATION LTPK) providing PPG (EXPAND THE INDONESIAN VERSION OF THIS ABBREVIATION). THIS IS AN EXAMPLE ON HOW YOU WRITE SUCH = *Pengembangan Profesi Guru* (PPG) or in English known as Teacher Professional Development …. for the field of Physics Education, who had participated in a competency development program, while the control group consisted of prospective Physics teachers who had not participated in the program from the same two LPTKs as the experimental class.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: n= 120

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: physics

Data collection was carried out through pretest and posttest to measure the pedagogical and professional skills of prospective teachers. This test is carried out before and after the implementation of the competency development program. Data collection tools in this research are pedagogical and professional tests, each consisting of 45 question items (ADAPTED? ADOPTED? SELF-MADE? BY WHOM AND EXPLAIN WHY THAT TEST WAS CHOSEN IN THIS STUDY). ARE THERE ANY SAMPLE OF QUESTION ITEMS THAT CAN BE INSERTED HERE? ALSO BETTER TO ATTACH THE QUESTIONNAIRES IN THE APPENDIX AFTER REFERENCES. The instrument has validity and reliability (EXPLAIN HOW. ARE THERE SPECIFIC CRONBACH'S ALPHA? OR HAS IT BEEN USED IN MULTIPLE PREVIOUS STUDIES? EXPLAIN MORE ABOUT THE TESTS USED TO ASSURE THE READERS), so it has a reliable ability to measure the intended competency.

The Mann-Whitney test is used to determine whether there are significant differences between two independent groups, namely the experimental and control groups [18]. Meanwhile, the Wilcoxon test is used to test changes in two paired sets of data, namely pretest and posttest scores in groups, to see whether there is a significant increase in teachers' pedagogical and professional skills after participating in the development program [19], [20]. After carrying out the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the

pretest and posttest were visualized using the Wright map [20]. The Wright map allows a clear visualization of the increase in teachers' pedagogical and professional competence after participating in the development program [21].

3. RESULTS AND DISCUSSION

3.1. RESULTS

Professional skills and pedagogical skills are two critical aspects of the teaching profession that play an important role in improving the quality of education [22]. Professional skills include in-depth knowledge of the subject matter, the ability to design relevant and engaging learning, and skills in using technology and other supporting resources [23]. Teachers who have good professional skills can deliver material comprehensively and inspire students to learn independently. Table 1 visualizes the results of the identification of professional skills and pedagogical skills.

Table 1. Fit Statistics of Professional Skills and Pedagogical Skills

	Professional Skills		Pedagogical Skills	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test of professional skills and pedagogical skills in Table 1 show high quality based on the results of the analysis of various statistical indicators. The average (mean) for items and persons is 0.00 and 0.36 respectively, reflecting a balanced distribution of values between the abilities measured. The range of measures for items ranges from -1.89 to 1.61, while for persons is from -1.62 to 3.23, indicating that this instrument can measure variations in abilities with a wide scope. The standard deviation for items is 0.69 and for persons is 0.97 indicating relatively consistent variations in the level of expertise measured. The Mean Outfit MnSq index for items is 1.02 and for persons is -0.04, and the Mean Outfit ZStd for items is 0.06 and for persons is 1.02, indicating that the data from this instrument is following the expected model and does not show any significant deviations. The Separation values for items and persons are 4.42 and 3.07, indicating the ability of this instrument to differentiate well among different levels of ability. The high level of reliability is also proven by the Cronbach alpha value of 0.91 for items and 0.90 for persons, confirming that this instrument is consistent in measuring the professional skills of prospective Physics teachers accurately.

The instrument for measuring the pedagogical skills of prospective Physics teachers also shows good quality based on the results of statistical analysis. The average (mean) for items and persons is 0.00 and 0.82 respectively, indicating a balanced distribution of values with a positive tendency in the abilities measured. The range of measures for items ranges from -2.73 to 1.20, while for persons ranges from -1.09 to 3.96, indicating that this instrument can measure a wide range of abilities. The standard deviation of items is 0.68 and for persons is 0.88 indicating consistent variation in the level of expertise measured. The Mean Outfit MnSq index for items is 1.00 and for persons are 0.21, and the Mean Outfit ZStd for items is -0.11 and for persons is 0.92, indicating that the data from this instrument is following the expected model and does not show any significant deviations. The high separation for items of 4.17 and persons of 2.10 indicates the ability of this instrument to differentiate well between various levels of pedagogical ability. A good level of reliability is also seen from the Cronbach alpha value of 0.81 for items and 0.81 for persons, indicating that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

3.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for teachers, statistical analysis was conducted on the pre-test and post-test data from prospective Physics teachers in the experimental and control groups [24]. This analysis aims to identify significant differences in skill improvement after the intervention of competence development program. The Mann-Whitney test was used to compare the distribution of scores between two unpaired groups, namely the experimental and control groups, both before (pre-test) and after (post-test) the intervention [25]. The Wilcoxon test was applied to evaluate changes in pre-test and post-test scores within each group, to ensure that the skill improvement was

Deleted[Ria Arista Asih]: are able to

Deleted[Ria Arista Asih]: statistics

Deleted[Ria Arista Asih]: is able to

Deleted[Ria Arista Asih]: in accordance with

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: show

Deleted[Ria Arista Asih]: is

Deleted[Ria Arista Asih]: in accordance with

Deleted[Ria Arista Asih]: for

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: **Physics**

Deleted[Ria Arista Asih]: Physics

significant [26]. The results of this statistical analysis provide important insights regarding the impact of the competence development program on improving the professional skills of prospective Physics teachers. The results of this analysis are illustrated in Table 2 and Table 3.

Deleted[Ria Arista Asih]: Physics

Table 2. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Post-test	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 3. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test illustrated in Table 2 show that there is a statistically significant difference in the pre-test and post-test results between the prospective Physics teachers in the experimental group and the control group. In the pre-test results, the U value = 1347.500 with a significance level of $p < 0.05$, indicating that before the intervention there was a significant difference between the two groups. After the intervention, the post-test results show a U value = 183.500 with a significance level of $p < 0.05$, indicating that the intervention carried out has a significant impact on improving the professional skills of prospective Physics teachers in the experimental group compared to the control group.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Analysis using the Wilcoxon test illustrated in Table 3 strengthens this finding. The Wilcoxon test shows that there is a significant difference between the pre-test and post-test results in both groups. In the experimental group, the Z value obtained is -6.736 with a significance level of $p < 0.05$, while in the control group, the Z value is -6.435 with the same significance level. This indicates that there is a significant increase in the professional skills of prospective Physics teachers after the intervention, either in the experimental or control groups.

Deleted[Ria Arista Asih]: Physics

However, the higher significant difference in the experimental group compared to the control group indicates that the implemented competency development program is more effective in improving the professional skills of prospective Physics teachers. The professional skills of prospective Physics teachers in the experimental group improved better compared to the control group after the intervention was carried out. This confirms that the intervention of competency development program has a greater positive impact on prospective Physics teachers who are involved in the program compared to those who do not participate in the program. This finding supports the importance of ongoing competency development programs as efforts to improve the quality of teaching and teacher professionalism.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

The step in evaluating the effectiveness of the professional skills development program for prospective Physics teachers was conducted by carrying out an in-depth analysis of the pretest and posttest data. One of the tools used for visualization and analysis of this data is the Wright map, which allows mapping the skills of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear picture of the distribution of abilities held by the prospective Physics teachers in the control group and the experimental group. By mapping the pretest and posttest results of the two groups, we can identify significant differences in the professional skill attainment. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur as a result of the intervention; providing a more comprehensive insight related to the effectiveness of the training program that has been implemented [27]. The analysis on the professional skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 1 and Figure 2.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

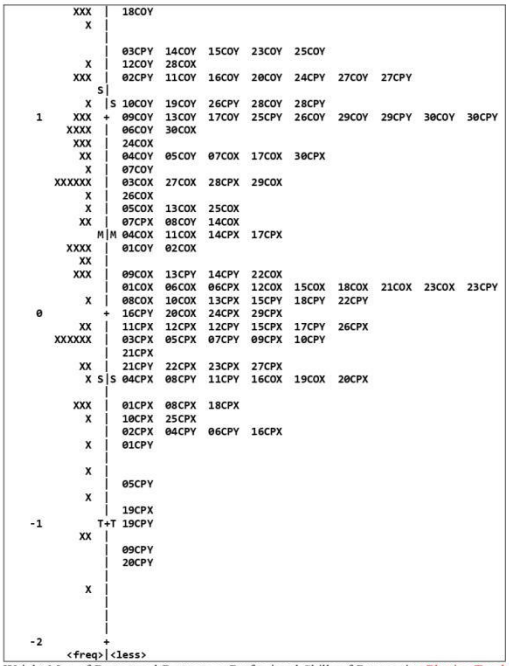


Figure 1. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics Teachers in the Control Group

The Wright map for the control group (Figure 1) shows the distribution of pretest and post-test scores for the professional skills of prospective Physics teachers. On this map, it can be seen that items and people are spread over a fairly wide range. Most of the values are around the average with some items and persons being less or more frequent than that value. For example, the item with the highest measure is 24COY, indicating that only a few prospective Physics teachers having very high professional skills before the intervention. In contrast, there are many people with measure values between -1 and 0, indicating lower or moderate professional skills before the intervention. This distribution shows significant variation in ability among prospective Physics teachers in the control group.

After the intervention, the person's score is seen to shift significantly towards higher values, although there are still people who are at the low level. This shows that although there has been an increase in professional skills after the intervention, there are still some prospective Physics teachers who have not achieved the expected increase in skills. However, in general, this increase shows that the intervention has a positive impact even though it is not evenly distributed across all people.

Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: teachers
Deleted[Ria Arista Asih]: posttest
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics

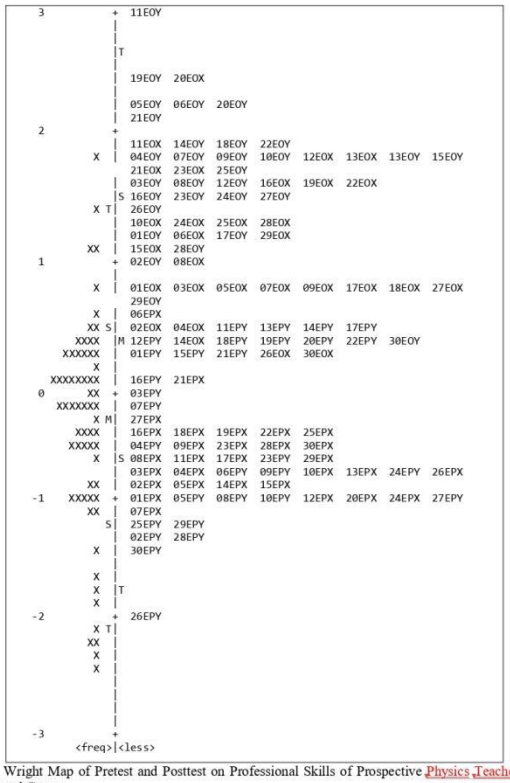


Figure 2. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics Teachers in the Experimental Group

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: teachers

The Wright map for the experimental group shows a more striking difference between the pretest and posttest compared to the control group. In the experimental group, item and person measures are also spread over a wide range, but there is a higher concentration of higher measure values after the intervention. This shows that more prospective Physics teachers in the experimental group show significant improvement in professional skills [28].

Deleted[Ria Arista Asih]: Physics

In the pretest, there are people with the highest measures such as 11EOY, indicating high professional skills before the intervention. However, after the intervention, the measure values for many individuals increase significantly, with some individuals achieving higher measure values than before the intervention, such as 29EOX and 30EOY. This shows that the competency development program applied

to the experimental group is more effective in improving the professional skills of prospective Physics teachers compared to the control group [29].

This Wright map indicates that the intervention carried out in the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher personal concentration on measures after the intervention in the experimental group shows the effectiveness of the competency development program implemented. The significant difference in the score distribution of these two groups confirms that the approach applied in the experimental group was more successful in improving the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers, statistical analysis was carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare distribution differences between two independent groups, namely the experimental group that received the intervention and the control group that did not receive the intervention [30]. This test helps determine whether there are any significant differences in pedagogical skills between the two groups. On the other hand, the Wilcoxon test was used to assess changes in the same group within two measurement times, namely before and after the intervention [31]. This analysis provides a more comprehensive picture on the impact of the intervention on the development of the pedagogical skills of prospective Physics teachers. The results of the statistical analysis of the two tests are illustrated in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Post-test	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 5. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) show that there is a statistically significant difference in the results of the pre-test ($U=1274.500$, $p < 0.05$) and post-test ($U=421.500$, $p < 0.05$) among the prospective Physics teacher in both experimental and control groups. The Mann-Whitney test is a non-parametric statistical method used to compare two independent groups. In this context, the experimental group received a specific intervention, while the control group received no intervention. The significant results in this test indicate that the intervention given to the experimental group had a real effect on improving pedagogical skills compared to the control group.

The Wilcoxon test results (Table 5) strengthen these findings by showing that there is a significant difference between the pre-test and post-test results of prospective Physics teachers both in the experimental group ($Z=-6.729$, $p < 0.05$) and in the control group ($Z =-2.721$, $p < 0.05$). The Wilcoxon test, which is also a non-parametric statistical method, is used to compare two sets of paired data, namely pre-test and post-test results from the same individual. These results indicate that there was a significant increase in pedagogical skills after the intervention in both groups, although the increase in the experimental group was higher compared to the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. However, the improvement was greater in the experimental group compared to the control group, indicating the effectiveness of the intervention implemented. The higher pedagogical skills in the experimental group compared to the control group after the intervention indicate that the training program or method applied was successful in significantly increasing the pedagogical competence of prospective Physics teachers. This emphasizes the importance of developing a structured and sustainable training program to improve the quality of teaching and professionalism of prospective Physics teachers [32]. Through appropriate and evidence-based approaches, the development of pedagogical skills can have a significant positive impact on improving the overall quality of education [33].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: person
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: **Physics**
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: **Physics**

This mapping of prospective Physics teachers' pedagogical skills provides a visual depiction of the distribution of test takers' abilities and the difficulty of the test items, making it easier to identify differences in abilities before and after the intervention. Wright Map analysis was carried out on pretest and posttest data on the pedagogical skills of prospective Physics teachers for two groups, namely the control group and the experimental group. Understanding the results of this mapping is very important to assess the effectiveness of the interventions that have been implemented. The following is a detailed analysis of the Wright Map pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group, which provides insight into improvements or changes in pedagogical abilities after the intervention was carried out. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

```
MEASURE Item - MAP - Person
        <rare>|<more>
     2          +  02COY
                   |
                   |  01COY  05COY
                   |
                   |T 03COY  06COY
              X T  |
                   |  04COY  27COY
                   |
                   |
                   |
                   |
                   |  02COX  03CPY  05COX  24COX  26CPX
     1        X  +S
         XXXXX  |  01COX  04CPY  06COX  07COY  13COX  22CPY  25COX  26COX  27CPX
                   27CPY
            XX  |  03COX  03CPX  06CPY  15COX  22CPX  24COY  25CPX  26CPY  27COX
                   28COX  28COY  28CPX  28CPY
           XX S|
            X  |  02CPX  04COX  04CPX  05CPY  15CPY  22COX  24CPX  24CPY
                   05CPX  06CPX  07COX  07CPX  15CPX  25COY  25CPY  26COY
            X  |
            X  |  01CPX  13CPX  13CPY  20COX  20COY  23COY  23CPX  23CPY
           XX  |M 15COY  17COX
           XX  |  07CPY  16CPY  18COX  19CPY  23COX
            X  |
            X  |  02CPY  08COX  08COY  12COY  14CPX  14CPY  17CPX  17CPY  19COX
                   20CPX  20CPY  21COX
                |  18CPY  19CPX
     0      XX M+  01CPY  16COY  16CPX  17COY  18CPX  22COY  29COX  29COY  29CPX
                   29CPY  30COX  30COY  30CPX  30CPY
           XX  |  12COX  12CPX  12CPY  14COX  16COX
           XX  |
          XXX  |  08CPX  09COY  21CPX  21CPY
            X  |S 10COY
            X  |  19COY
               |
           XX  |  21COY
            X  |  08CPY  11COY
          XXX  |  09COX  09CPY  10CPY  11CPY  13COY  14COY  18COY
             S|
               |  10COX  10CPX
     -1    XX  +T
            X  |
               |  09CPX
               |
               |  11COX  11CPX
            X  |
               |
            X  |
            X T|
            X  |
               |
               |
               |
     -2     X  +
           <freq>|<less>
```

Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group

Deleted[Ria Arista Asih]: Physics

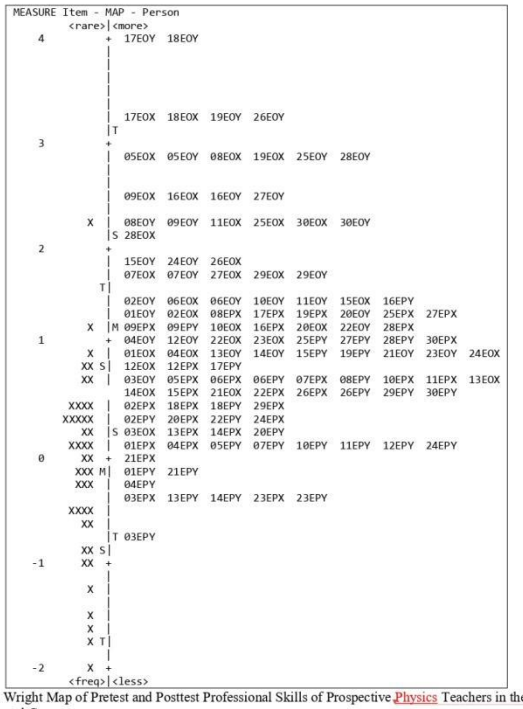


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Deleted[Ria Arista Asih]: Physics

Wright Map analysis for pretest and post-test pedagogical skills of prospective Physics teachers in the control group and experimental group provides an in-depth picture of the distribution of ability and difficulty of items. In the Wright Map of the control group, it can be seen that the distribution of persons and items shows that the majority of prospective Physics teachers have varied pedagogical skills with some items being more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY are in higher positions, indicating better pedagogical skills, while other persons are spread along the scale with the majority being around the middle of the scale (measure=1), indicating moderate variation in pedagogical abilities . This distribution indicates that there are differences in pedagogical abilities among the prospective Physics teachers in the control group, with some items indicating significant challenges for them.

Deleted[Ria Arista Asih]: posttest

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: Physics

In contrast, in the Wright Map experimental group, the distribution of persons and items show a more significant increase in pedagogical skills after the intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX are at higher measures (measure=3 and 4), indicating that the intervention provided was successful in improving their pedagogical skills. Many people from the experimental group are at higher levels compared to the control group, indicating that the intervention implemented was effective in improving the pedagogical skills of prospective Physics teachers. The distribution of items also shows that there are several items that remain difficult for most people, but overall, people in the experimental group show better abilities compared to the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group succeeded in improving the pedagogical skills of prospective Physics teachers significantly better than the control group [34]. The Wright Map provides a clear visualization of the distribution of ability and difficulty of items, assisting in understanding the effectiveness of the implemented intervention. This emphasizes the importance of structured and evidence-based training programs in improving the pedagogical quality of prospective Physics teachers [35].

3.2. Discussion

3.2.1. Professional Skills of Prospective Physics Teachers

Professional skills for prospective Physics teachers are an integral aspect of their preparation to face teaching assignments in the world of education. These skills include various competencies that are not only limited to mastering academic material, but also the ability to adapt to the work environment, interact with students, and manage the class effectively [36], [37]. A prospective Physics teacher who has strong professional skills can implement innovative teaching strategies, apply fair and objective assessments of student achievement, and build good relationships with all relevant parties in the educational context [38], [39].

The importance of the professional skills of prospective Physics teachers is also reflected in their ability to continue learning and developing themselves, either through additional training, workshops or independent study. This supports their ability to integrate the latest developments in education into their teaching practice so that it can improve the overall quality of students' learning experiences [5], [40]. The evaluation aspect of professional skills often involves the use of measurement tools such as validity and reliability tests, as well as competency mapping to assess the extent to which a prospective Physics teacher has achieved the standards set in their field [41].

Academically, the professional skills of prospective Physics teachers can be measured through various indicators, such as test results, assessments by fellow professionals, and the ability to plan and implement effective learning strategies [42]. Developing these skills also plays an important role in creating an inclusive learning environment and encouraging the balanced intellectual and emotional growth of students.

3.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers are the main foundation in their ability to convey subject matter in a way that arouses interest and facilitates students' understanding [43]. The main aspects of pedagogical skills include the ability to design a relevant curriculum and under educational standards, choosing appropriate teaching methods to accommodate students' diverse learning styles, and utilizing educational technology and other resources effectively in the learning process [44].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [51], [52].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [53], [54].

4. CONCLUSION

The results showed a significant difference in the pre-test and post-test between the two groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation of

Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: **Physics**
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: in
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: **Physics**
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: a curriculum that is relevant
Deleted[Ria Arista Asih]: in accordance with
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: Physics

prospective Physics teachers. Wright's map analysis of pedagogical skills showed that the experimental group showed a more regular and significant increase compared to the control group, indicating that the intervention program was able to provide a positive and consistent impact on the development of teaching skills. Further research is recommended to conduct ongoing evaluations to monitor and evaluate the effectiveness of this program to continue to make necessary improvements to improve the quality of teaching. The number of research subjects that are not yet representative of all of Indonesia is also the basis for providing recommendations for further research, which seeks to examine the success of the program in a national context. Overall, this study provides a valuable contribution to our understanding of how to prepare prospective Physics teachers who are competent and ready to face the demands of the future in an increasingly complex and dynamic world of education.

Deleted[Ria Arista Asih]: Physics

Deleted[Ria Arista Asih]: in order to

Deleted[Ria Arista Asih]: in an effort to

Deleted[Ria Arista Asih]: Physics

ACKNOWLEDGEMENTS

We would like to thank Universitas Ahmad Dahlan for supporting and founding this work under the supported professorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

Deleted[Ria Arista Asih]: thanks

Deleted[Ria Arista Asih]: proffesorship

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, "The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States," *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, "Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States," *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, "The Human Teacher, the AI Teacher and the AIed-Teacher Relationship," *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, "Pedagogies of embodiment in physical education – a literature review," *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, "Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy," *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, "Indonesian teacher performance: Professional and Character," *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, "The Effects of Students' Perception of the School Environment and Students' Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[15] G. B. Gudmundsdottir and O. E. Hatlevik, "Newly qualified teachers' professional digital competence: implications for teacher education," *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[16] D. Ramandanis and S. Xinogalos, "Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review," *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[17] P. S. Lisenbee and C. M. Ford, "Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children's Experiences," *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[18] T. Lin, T. Chen, J. Liu, and X. M. Tu, "Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks," *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[19] Y. Fong and Y. Huang, "Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null," *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[20] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, "An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome," *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[21] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, "Wright-Map to investigate the actual abilities on math test of elementary students," *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[22] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, "The influence of online learning on student professionalism Teacher Professional Education Program: Studies in Islamic higher Education in Indonesia," *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

Deleted[Ria Arista Asih]: professional

[23] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, "Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being," *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[24] S. Handayani, L. Peddell, and T. Yeigh, "Participants' Experiences in Heutagogy Teacher Professional Education in Indonesia," *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[25] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, "The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians," *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[26] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, "A Wilcoxon-Mann-Whitney spatial scan statistic for functional data," *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[27] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, "A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[28] F. J. Rodríguez Muñoz, "Pre-test and structural analysis of the pragmatic awareness questionnaire destined to teachers' communicative instruction," *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[29] M.-Y. Chen, S.-M. Huang, and W. Chou, "Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19," *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[30] L. Mao, "Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance," *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[31] R. Wilcox, "Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions," *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[32] M. Mawarto, W. Widodo, and S. Sulistiasih, "The Antecedence of Teacher's Professional Performance: Evidence from Indonesia," *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[33] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, "The professional development of higher education-based teacher educators: needs and realities," *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[34] Y. Cheng, W. Jia, R. Chi, and A. Li, "A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing," *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[35] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, "Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling," *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[36] L. Lukman *et al.*, "Effective teachers' personality in strengthening character education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[37] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, "The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches," *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[38] A. H. Abdulrazzaq, "Teacher Appraisers' Perceptions of Teacher Appraisal," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[39] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, "Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement," *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[40] N. Ishartono *et al.*, "The Role of Instructional Design in Improving Pre-Service and In-Service Teacher's Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[41] M. A. Flores, "Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education," *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[42] H. T. Yusuf, "Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[43] M. Mu'arifin and B. S. Narmaditya, "Professional development program for physical education teachers in Indonesia," *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[44] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, "Makerspaces in early childhood education: Principles of pedagogy and practice," *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[45] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, "Community-based teacher professional development in remote areas in Indonesia," *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[46] Rusdiana, "Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif," 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[47] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[48] J. M. Ramdani and X. (Andy) Gao, "Exploratory practice for teacher professional development in Indonesia," *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[49] M. Portuguez Castro and M. G. Gómez Zermeño, "Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education," *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[50] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[51] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in Physics education', in *The international handbook of Physics education research: Teaching Physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[52] T. Karakose *et al.*, 'Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic motivation and attitudes toward the teaching profession using structural equation modelling', *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

[53] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[54] I. Setianingrum and A. Da Costa, 'Mapping research on Indonesian professional teacher: The bibliometric analysis', *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

Deleted[Ria Arista Asih]: physics

Deleted[Ria Arista Asih]: *physics*

Deleted[Ria Arista Asih]: *physics*

Deleted[Ria Arista Asih]: amotivation

BIOGRAPHIES OF AUTHORS

Dian Artha Kusumaningtyas is a senior lecturer in the Physics Education Program at Ahmad Dahlan University, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id)

Moh Irma Sukarelawan is an assistant professor at Universitas Ahmad Dahlan (Department of Physics Education, Faculty of Teacher Training and Education), Yogyakarta, Indonesia. He obtained his Doctoral degree in the Department of Educational Science, Graduate School, Universitas Negeri Yogyakarta (UNY) in 2023. His research focuses on Physics education, misconception, metacognition, and Rasch modelling. He can be contacted at irma.sukarelawan@pfis.uad.ac.id

Muhammad Syahriandi Adhantoro is an enthusiast of information technology who has created various works in the field of education, including educational games and learning information systems. He also has an interest in Educational Informatics research.

Wahyu Nanda Eka Saputra is a Ph.D. & Lecturer, Department of Guidance and Counseling, Universitas Ahmad Dahlan, Indonesia. His research focuses on peace education, strategy of counseling intervension, counseling based on local wisdom, and counseling based on creative art. He can be contacted at email: wahyu.saputra@bk.uad.ac.id.

Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]:
Deleted[Ria Arista Asih]: Physics
Deleted[Ria Arista Asih]: physics
Deleted[Ria Arista Asih]: the
Deleted[Ria Arista Asih]: modeling

Evaluation of the effectiveness of intervention on professional and pedagogical skills for prospective physics teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2] , Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]

[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia

[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. The research involved an experimental group receiving the intervention and a control group that did not. To rigorously assess the impact, Mann-Whitney and Wilcoxon's statistical tests were used to compare pre-test and post-test outcomes, alongside Wright map analysis to visualize skill development. The results revealed a significant improvement in the professional and pedagogical competencies of the experimental group compared to the control group, as indicated by Mann-Whitney test values ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This study contributes by demonstrating the effectiveness of interventions in improving the skills of prospective Physics teachers, offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research not only fills a crucial gap in the existing body of work but also provides valuable insights that can inform the design and implementation of more effective teacher training strategies moving forward.

Corresponding Author:

Dian Artha Kusumaningtyas

Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

9. INTRODUCTION

In Indonesia, teacher professional development still faces various challenges, including limited access to quality training, lack of incentives and adequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social competencies [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore also has a strong mentoring system where junior teachers receive guidance from experienced senior teachers [7]. Many schools in the US also provide time and resources for teachers to participate in professional development, including teacher-to-teacher collaboration and school-based development [8], [9].

Although efforts to improve teacher competency in Indonesia exist, significant improvements are still needed regarding accessibility, continuity, and adequate support. Experiences from developed countries show that sustainable investment in teacher professional development is very important to achieve high-quality education and can be an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional competence is the main foundation in the world of education [11]. Pedagogical competence includes the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional competence includes in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without this competency, a teacher will have difficulty conveying material effectively, facilitating constructive discussions, and cultivating critical skills in students.

Physics teacher professional education in Indonesia currently faces major challenges in improving teachers' pedagogical and professional competence. Recent studies show that many physics teachers in Indonesia still lack mastery of innovative and technology-based learning methods, as well as the ability to integrate physics concepts with everyday life [14]. In addition, ever-changing education policies add complexity for teachers in adapting to dynamic national curriculum standards [15]. Although teacher professional education programs have been running, the lack of ongoing training and periodic performance evaluations has slowed down the improvement of teaching quality

[16]. On the other hand, improving professional competence, especially in the use of laboratories and digital learning tools, is an urgent need to support more effective physics learning in this digital era [17]. Therefore, a comprehensive reform of the teacher professional curriculum is needed as well as more targeted infrastructure and training improvements.

If a teacher's pedagogical and professional competence is lacking, serious challenges can arise. Students may experience difficulties in understanding lesson material, which leads to low learning outcomes and motivation [18], [19]. Therefore, improving teachers' pedagogical and professional competence is very important to ensure high-quality education and optimal student academic achievement [20]. The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs. This research compares the achievements of pedagogical and professional competencies between prospective teachers who have participated in the professional teacher education program for the field of physics with classes who have not participated in the program [21]. This research is expected to provide a clear picture of the impact of increasing teacher competency on the transformation of education in Indonesia. It is also expected that the results of this research can become a basis for policymakers in designing more effective and sustainable teacher professional development strategies.

10. METHOD

This research methodology uses a quantitative approach to evaluate the effectiveness of the pedagogical competency and professional competency development program for prospective Physics teachers. This research involved two groups, namely the experimental (n= 120) and control groups (n= 120). The experimental group consisted of prospective Physics teachers from two educational institutions for educational staff (LTPK) providing PPG for the field of Physics Education, who had participated in a competency development program, while the control group consisted of prospective physics teachers who had not participated in the program from the same two LPTKs as the experimental class. The involvement of control and experimental groups and random group division aims to increase the internal validity of the experimental results.

Data collection was carried out through pretest and posttest to measure the pedagogical and professional skills of prospective teachers. This test is carried out before and after the implementation of the competency development program. Data collection tools in this research are pedagogical and professional tests, each consisting of 45 question items. The instrument has validity and reliability, so it has a reliable ability to measure the intended competency. The validity of the pedagogical test is in the range of

0.321-0.651 and the professional test is in the range of 0.351-0.541. While the reliability of the pedagogical test is 0.931 and the professional test is 0.891, both are included in the very good category.

The Mann-Whitney test is used to determine whether significant differences exist between two independent groups, namely the experimental and control groups [22]. Meanwhile, the Wilcoxon test is used to test changes in two paired sets of data, namely pretest and posttest scores in groups, to see whether there is a significant increase in teachers' pedagogical and professional skills after participating in the development program [23], [24]. After carrying out the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map [24]. The Wright map allows a clear visualization of the increase in teachers' pedagogical and professional competence after participating in the development program [25].

11. RESULTS AND DISCUSSION

3.1. RESULTS

Professional skills and pedagogical skills are two critical aspects of the teaching profession that play an important role in improving the quality of education [26]. Professional skills include in-depth knowledge of subject matter, the ability to design relevant and engaging learning, and skills in using technology and other supporting resources [27]. Teachers who have good professional skills are able to deliver material comprehensively and inspire students to learn independently. Table 1 visualizes the results of the identification of professional skills and pedagogical skills.

Table 11. Fit statistics of Professional Skills and Pedagogical Skills

	Professional Skills		Pedagogical Skills	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test of professional skills and pedagogical skills in Table 1 show high quality based on the results of the analysis of various statistical indicators. The average (mean) for items and persons is 0.00 and 0.36 respectively, reflecting a balanced distribution of values between the abilities measured. The range of measures for items ranges from -1.89 to 1.61, while for persons is from -1.62 to 3.23, indicating that this instrument is able to measure variations in abilities with a wide scope.

The standard deviation for items is 0.69 and for persons is 0.97 indicating relatively consistent variations in the level of expertise measured. The Mean Outfit MnSq index for items is 1.02 and for persons is -0.04, and the Mean Outfit ZStd for items is 0.06 and for persons is 1.02, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The Separation values for items and persons are 4.42 and 3.07, indicating the ability of this instrument to differentiate well among different levels of ability. The high level of reliability is also proven by the Cronbach alpha value of 0.91 for items and 0.90 for persons, confirming that this instrument is consistent in measuring the professional skills of prospective Physics teachers accurately.

The instrument for measuring the pedagogical skills of prospective Physics teachers also show good quality based on the results of statistical analysis. The average (mean) for items and persons is 0.00 and 0.82 respectively, indicating a balanced distribution of values with a positive tendency in the abilities measured. The range of measures for items ranges from -2.73 to 1.20, while for persons ranges from -1.09 to 3.96, indicating that this instrument can measure a wide range of abilities. The standard deviation of items is 0.68 and for persons is 0.88 indicating consistent variation in the level of expertise measured. The Mean Outfit MnSq index for items is 1.00 and for persons are 0.21, and the Mean Outfit ZStd for items is -0.11 and for persons is 0.92, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The high separation for items of 4.17 and for persons of 2.10 indicates the ability of this instrument to differentiate well between various levels of pedagogical ability. A good level of reliability is also seen from the Cronbach alpha value of 0.81 for items and 0.81 for persons, indicating that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

11.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for teachers, statistical analysis was conducted on the pre-test and post-test data from prospective Physics teachers in the experimental and control groups [28]. This analysis aims to identify significant differences in skill improvement after the intervention of competence development program. The Mann-Whitney test was used to compare the distribution of scores between two unpaired groups, namely the experimental and control groups, both before (pre-test) and after (post-test) the intervention [29]. The Wilcoxon test was applied to evaluate changes in pre-test and post-test scores within each group, to ensure that the skill improvement was significant [30]. The results of this statistical analysis provide important insights regarding the impact of

the competence development program on improving the professional skills of prospective Physics teachers. The results of this analysis are illustrated in Table 2 and Table 3.

Table 12. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Post-test	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 13. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test illustrated in Table 2 show that there is a statistically significant difference in the pre-test and post-test results between the prospective Physics teachers in the experimental group and the control group. In the pre-test results, the U value = 1347.500 with a significance level of $p < 0.05$, indicating that before the intervention there was a significant difference between the two groups. After the intervention, the post-test results show a U value = 183.500 with a significance level of $p < 0.05$, indicating that the intervention carried out has a significant impact on improving the professional skills of prospective Physics teachers in the experimental group compared to the control group.

Analysis using the Wilcoxon test illustrated in Table 3 strengthens this finding. The Wilcoxon test shows that there is a significant difference between the pre-test and post-test results in both groups. In the experimental group, the Z value obtained is -6.736 with a significance level of $p < 0.05$, while in the control group, the Z value is -6.435 with the same significance level. This indicates that there is a significant increase in the professional skills of prospective Physics teachers after the intervention, either in the experimental or control groups.

However, the higher significant difference in the experimental group compared to the control group indicates that the implemented competency development program is more effective in improving the professional skills of prospective Physics teachers. The professional skills of prospective Physics teachers in the experimental group improved better compared to the control group after the intervention was carried out. This confirms that the intervention of competency development program has a greater positive impact on prospective Physics teachers who are involved in the program compared to those who do not participate in the program. This finding supports the importance of ongoing

competency development programs as efforts to improve the quality of teaching and teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

The step in evaluating the effectiveness of the professional skills development program for prospective Physics teachers was conducted by carrying out an in-depth analysis of the pretest and posttest data. One of the tools used for visualization and analysis of this data is the Wright map, which allows mapping the skills of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear picture of the distribution of abilities held by the prospective Physics teachers in the control group and the experimental group. By mapping the pretest and posttest results of the two groups, we can identify significant differences in the professional skill attainment. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur as a result of the intervention; providing a more comprehensive insight related to the effectiveness of the training program that has been implemented [31]. The analysis on the professional skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 1 and Figure 2.

```
MEASURE Item - MAP - Person
        <rare>|<more>
    2          +  24COY
                  |  03COY
             X    |
                T |
                  |T 02COY  21COY  22COY
                  |
                  |
             X    |
            XXX   |  18COY
             X    |
                  |
                  |  03CPY  14COY  15COY  23COY  25COY
             X    |  12COY  28COX
            XXX   |  02CPY  11COY  16COY  20COY  24CPY  27COY  27CPY
                S |
             X    |S 10COY  19COY  26CPY  28COY  28CPY
    1       XXX   +  09COY  13COY  17COY  25CPY  26COY  29COY  29CPY  30COY  30CPY
           XXXX   |  06COY  30COX
            XXX   |  24COX
             XX   |  04COY  05COY  07COX  17COX  30CPX
              X   |  07COY
         XXXXXX   |  03COX  27COX  28CPX  29COX
              X   |  26COX
              X   |  05COX  13COX  25COX
             XX   |  07CPX  08COY  14COX
                M |M 04COX  11COX  14CPX  17CPX
          XXXX    |  01COY  02COX
             XX   |
            XXX   |  09COX  13CPY  14CPY  22COX
                  |  01COX  06COX  06CPX  12COX  15COX  18COX  21COX  23COX  23CPY
             X    |  08COX  10COX  13CPX  15CPY  18CPY  22CPY
    0          +  16CPY  20COX  24CPX  29CPX
            XX    |  11CPX  12CPX  12CPY  15CPX  17CPY  26CPX
         XXXXXX   |  03CPX  05CPX  07CPY  09CPX  10CPY
                  |  21CPX
            XX    |  21CPY  22CPX  23CPX  27CPX
             X S |S 04CPX  08CPY  11CPY  16COX  19COX  20CPX
                  |
            XXX   |  01CPX  08CPX  18CPX
             X    |  10CPX  25CPX
                  |  02CPX  04CPY  06CPY  16CPX
             X    |  01CPY
                  |
             X    |
                  |  05CPY
             X    |
                  |  19CPX
   -1           T+T 19CPY
            XX    |
                  |  09CPY
                  |  20CPY
                  |
             X    |
                  |
                  |
                  |
```

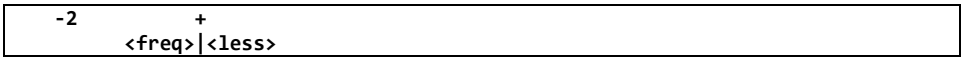
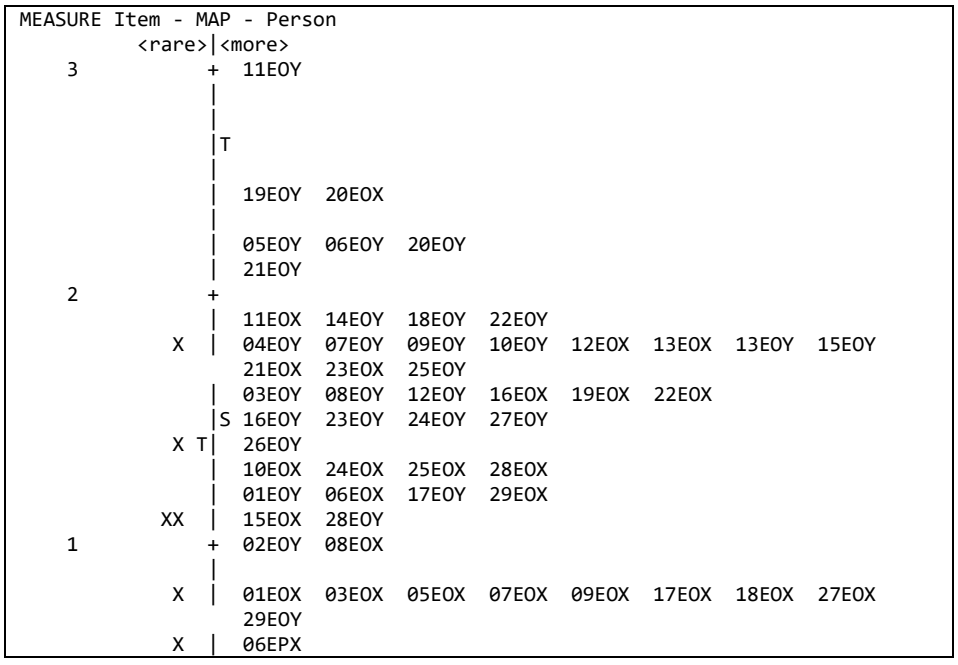


Figure 5. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) shows the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. On this map, it can be seen that items and people are spread over a fairly wide range. Most of the values are around the average with some items and persons being less or more frequent than that value. For example, the item with the highest measure is 24COY, indicating that only a few prospective Physics teachers having very high professional skills before the intervention. In contrast, there are many people with measure values between -1 and 0, indicating lower or moderate professional skills before the intervention. This distribution shows significant variation in ability among prospective Physics teachers in the control group.

After the intervention, the person's score is seen to shift significantly towards higher values, although there are still people who are at the low level. This shows that although there has been an increase in professional skills after the intervention, there are still some prospective Physics teachers who have not achieved the expected increase in skills. However, in general, this increase shows that the intervention has a positive impact even though it is not evenly distributed across all people.



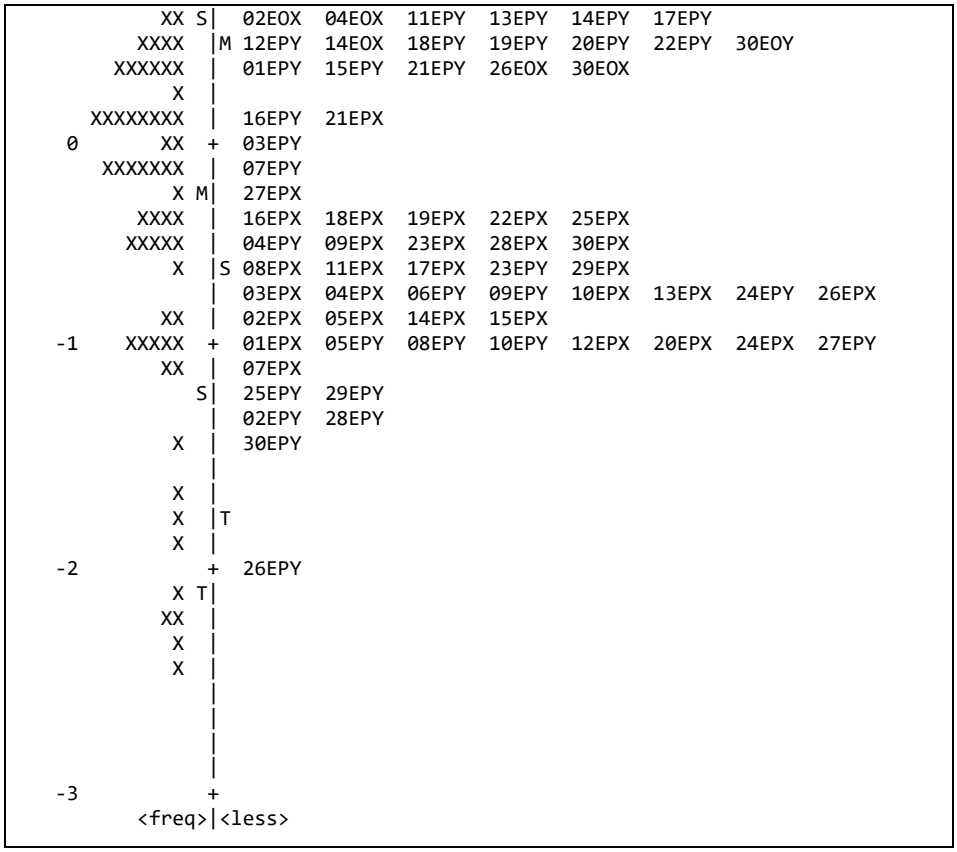


Figure 6. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group shows a more striking difference between the pretest and posttest compared to the control group. In the experimental group, item and person measures are also spread over a wide range, but there is a higher concentration of higher measure values after the intervention. This shows that more prospective Physics teachers in the experimental group show significant improvement in professional skills [32].

In the pretest, there are people with the highest measures such as 11EOY, indicating high professional skills before the intervention. However, after the intervention, the measure values for many individuals increase significantly, with some individuals achieving higher measure values than before the intervention, such as 29EOX and 30EOY. This shows that the competency development program applied to the experimental group is more effective in improving the professional skills of prospective Physics teachers compared to the control group [33].

This Wright map indicates that the intervention carried out in the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group shows the effectiveness of the competency development program implemented. The significant difference in the score distribution of these two groups confirms that the approach applied in the experimental group was more successful in improving the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers, statistical analysis was carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare distribution differences between two independent groups, namely the experimental group that received the intervention and the control group that did not receive the intervention [34]. This test helps determine whether there are any significant differences in pedagogical skills between the two groups. On the other hand, the Wilcoxon test was used to assess changes in the same group within two measurement times, namely before and after the intervention [35]. This analysis provides a more comprehensive picture on the impact of the intervention on the development of the pedagogical skills of prospective Physics teachers. The results of the statistical analysis of the two tests are illustrated in Table 4 and Table 5.

Table 14. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Post-test	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 15. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) show that there is a statistically significant difference in the results of the pre-test ($U=1274.500$, $p < 0.05$) and post-test

(U=421.500, $p < 0.05$) among the prospective Physics teacher in both experimental and control groups. The Mann-Whitney test is a non-parametric statistical method used to compare two independent groups. In this context, the experimental group received a specific intervention, while the control group received no intervention. The significant results in this test indicate that the intervention given to the experimental group had a real effect on improving pedagogical skills compared to the control group.

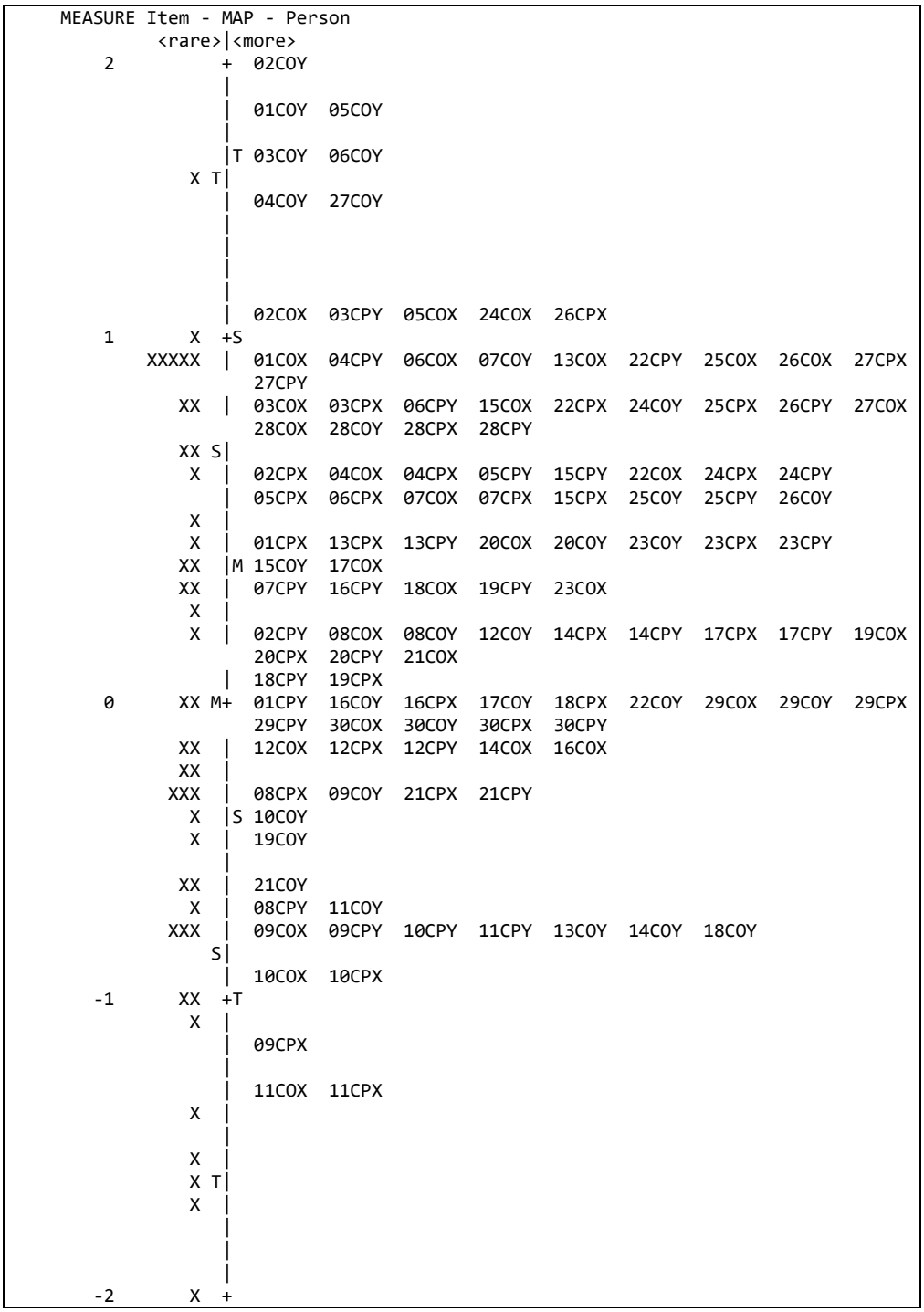
The Wilcoxon test results (Table 5) strengthen these findings by showing that there is a significant difference between the pre-test and post-test results of prospective Physics teachers both in the experimental group ($Z=-6.729$, $p < 0.05$) and in the control group ($Z =-2.721$, $p < 0.05$). The Wilcoxon test, which is also a non-parametric statistical method, is used to compare two sets of paired data, namely pre-test and post-test results from the same individual. These results indicate that there was a significant increase in pedagogical skills after the intervention in both groups, although the increase in the experimental group was higher compared to the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. However, the improvement was greater in the experimental group compared to the control group, indicating the effectiveness of the intervention implemented. The higher pedagogical skills in the experimental group compared to the control group after the intervention indicate that the training program or method applied was successful in significantly increasing the pedagogical competence of prospective Physics teachers. This emphasizes the importance of developing a structured and sustainable training program to improve the quality of teaching and professionalism of prospective Physics teachers [36]. Through appropriate and evidence-based approaches, the development of pedagogical skills can have a significant positive impact on improving the overall quality of education [37].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual depiction of the distribution of test takers' abilities and the difficulty of the test items, making it easier to identify differences in abilities before and after the intervention. Wright Map analysis was carried out on pretest and posttest data on the pedagogical skills of prospective Physics teachers for two groups, namely the control group and the experimental group. Understanding the results of this mapping is very important to assess the effectiveness of the interventions that have been implemented. The following is a detailed analysis of the Wright Map pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group, which provides insight into improvements or changes in pedagogical abilities after the intervention was carried out.

Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.



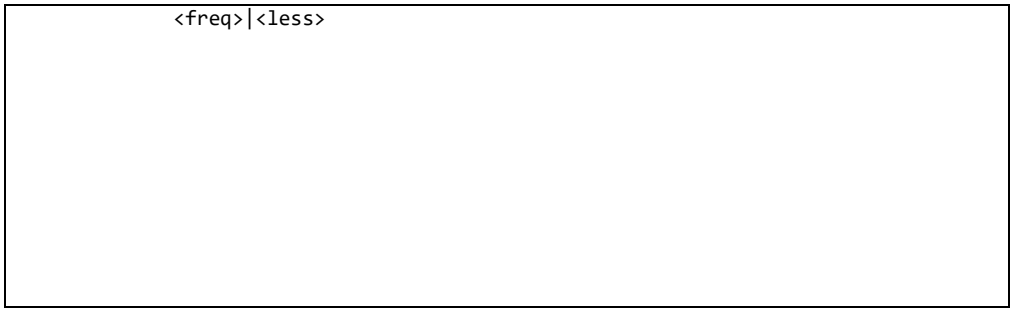


Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group

```
MEASURE Item - MAP - Person
         <rare>|<more>
    4          +  17EOY  18EOY
               |
               |
               |
               |
               |
               |  17EOX  18EOX  19EOY  26EOY
               |T
    3          +
               |  05EOX  05EOY  08EOX  19EOX  25EOY  28EOY
               |
               |
               |  09EOX  16EOX  16EOY  27EOY
               |
          X    |  08EOY  09EOY  11EOX  25EOX  30EOX  30EOY
               |S 28EOX
    2          +
               |  15EOY  24EOY  26EOX
               |  07EOX  07EOY  27EOX  29EOX  29EOY
             T |
               |  02EOY  06EOX  06EOY  10EOY  11EOY  15EOX  16EPY
               |  01EOY  02EOX  08EPX  17EPX  19EPX  20EOY  25EPX  27EPX
          X    |M 09EPX  09EPY  10EOX  16EPX  20EOX  22EOY  28EPX
    1          +  04EOY  12EOY  22EOX  23EOX  25EPY  27EPY  28EPY  30EPX
          X    |  01EOX  04EOX  13EOY  14EOY  15EPY  19EPY  21EOY  23EOY  24EOX
         XX S  |  12EOX  12EPX  17EPY
         XX    |  03EOY  05EPX  06EPX  06EPY  07EPX  08EPY  10EPX  11EPX  13EOX
               |  14EOX  15EPX  21EOX  22EPX  26EPX  26EPY  29EPY  30EPY
        XXXX   |  02EPX  18EPX  18EPY  29EPX
       XXXXX   |  02EPY  20EPX  22EPY  24EPX
         XX    |S 03EOX  13EPX  14EPX  20EPY
        XXXX   |  01EPX  04EPX  05EPY  07EPY  10EPY  11EPY  12EPY  24EPY
    0     XX   +  21EPX
        XXX M  |  01EPY  21EPY
        XXX    |  04EPY
               |  03EPX  13EPY  14EPY  23EPX  23EPY
        XXXX   |
         XX    |
               |T 03EPY
         XX S  |
```

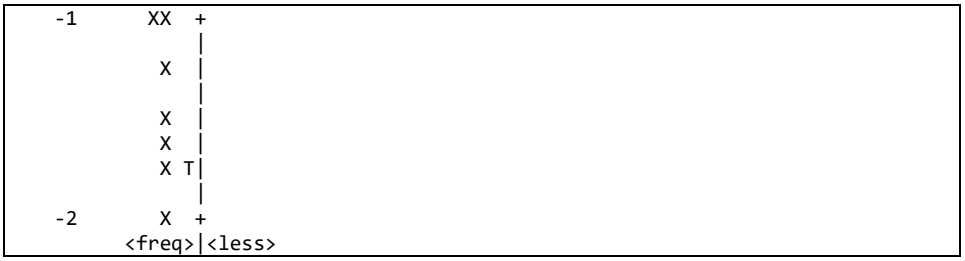


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group provides an in-depth picture of the distribution of ability and difficulty of items. In the Wright Map of the control group, it can be seen that the distribution of persons and items shows that the majority of prospective Physics teachers have varied pedagogical skills with some items being more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY are in higher positions, indicating better pedagogical skills, while other persons are spread along the scale with the majority being around the middle of the scale (measure=1), indicating moderate variation in pedagogical abilities . This distribution indicates that there are differences in pedagogical abilities among the prospective Physics teachers in the control group, with some items indicating significant challenges for them.

In contrast, in the Wright Map experimental group, the distribution of persons and items show a more significant increase in pedagogical skills after the intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX are at higher measures (measure=3 and 4), indicating that the intervention provided was successful in improving their pedagogical skills. Many people from the experimental group are at higher levels compared to the control group, indicating that the intervention implemented was effective in improving the pedagogical skills of prospective Physics teachers. The distribution of items also shows that there are several items that remain difficult for most people, but overall, people in the experimental group show better abilities compared to the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group succeeded in improving the pedagogical skills of prospective Physics teachers significantly better than the control group [38]. The Wright Map provides a clear visualization of the distribution of ability and difficulty of items, assisting in understanding the effectiveness of the implemented intervention. This emphasizes the importance of structured and evidence-based training programs in improving the pedagogical quality of prospective Physics teachers [39].

11.2. Discussion

11.2.1. Professional Skills of Prospective Physics Teachers

Professional skills for prospective Physics teachers are an integral aspect in their preparation to face teaching assignments in the world of education. These skills include various competencies that are not only limited to mastering academic material, but also the ability to adapt to the work environment, interact with students, and manage the class effectively [40], [41]. A prospective Physics teacher who has strong professional skills can implement innovative teaching strategies, apply fair and objective assessments of student achievement, and build good relationships with all relevant parties in the educational context [42], [43].

The importance of the professional skills of prospective Physics teachers is also reflected in their ability to continue learning and developing themselves, either through additional training, workshops or independent study. This supports their ability to integrate the latest developments in education into their teaching practice so that it can improve the overall quality of students' learning experiences [5], [44]. The evaluation aspect of professional skills often involves the use of measurement tools such as validity and reliability tests, as well as competency mapping to assess the extent to which a prospective Physics teacher has achieved the standards set in their field [45].

Academically, the professional skills of prospective Physics teachers can be measured through various indicators, such as test results, assessments by fellow professionals, and the ability to plan and implement effective learning strategies [46]. Developing these skills also plays an important role in creating an inclusive learning environment and encouraging balanced intellectual and emotional growth of students.

11.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers are the main foundation in their ability to convey subject matter in a way that arouses interest and facilitates students' understanding [47]. The main aspects of pedagogical skills include the ability to design a curriculum that is relevant and in accordance with educational standards, choosing appropriate teaching methods to accommodate students' diverse learning styles, and utilizing educational technology and other resources effectively in the learning process [48].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in

their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [51], [52].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [53], [54], [55]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [56], [57], [58].

12. CONCLUSION

This study found a significant difference between the pre-test and post-test results of both groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation of prospective Physics teachers. Wright's map analysis of pedagogical skills revealed that the experimental group experienced a more regular and significant increase than the control group, indicating that the intervention program had a positive and consistent impact on the development of teaching skills. This study contributes to the literature on the development of prospective Physics teachers by showing that a specifically designed intervention program can significantly improve pedagogical skills. Another important contribution is the use of Wright's map analysis, which is rarely applied in the context of educational research in Indonesia, as a tool to evaluate the development of teaching skills in more depth.

Based on these findings, it is recommended that educational practitioners consider implementing similar intervention programs to improve the quality of teacher preparation in various regions. This program can be a model in developing pedagogical skills for prospective Physics teachers in Indonesia. In addition, practitioners are also advised to continuously evaluate the effectiveness of this program so that adaptations and improvements can be made according to local needs and evolving global challenges. Further research is needed to evaluate the success of the program on a national scale, considering the limited number of research subjects and not yet representing all regions in Indonesia. Thus, this study not only provides new insights into improving teaching quality, but also encourages further discussion regarding the implementation of broader intervention programs.

ACKNOWLEDGEMENTS

We would like to thanks Universitas Ahmad Dahlan for supporting and founding this work under the supported proffesorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, “The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States,” *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, “Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States,” *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, “The Human Teacher, the AI Teacher and the AIed-Teacher Relationship,” *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, “Pedagogies of embodiment in physical education – a literature review,” *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, “Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy,” *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, “Indonesian teacher performance: Professional and Character,” *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. Hidayat, ‘Developing and validating a Technological Pedagogical Content Knowledge (TPACK) instrument for secondary Physics preservice teachers in Indonesia’, *Unnes Sci. Educ. J.*, vol. 8, no. 1, pp. 31–40, 2019, doi: 10.15294/usej.v8i1.23087.

[15] R. Pribudhiana, Y. Bin Don, and M. R. Bin Yusof, ‘Determining the influence of teacher quality toward teacher readiness in implementing Indonesian education policy’, *Eurasian J. Educ. Res.*, vol. 93, pp. 373–390, 2021, doi: 10.14689/ejer.2021.93.18.

[16] N. Sulaeman, S. Efwinda, and P. D. A. Putra, ‘Teacher readiness in STEM education: Voices of Indonesian physics teachers’, *J. Technol. Sci. Educ.*, vol. 12, no. 1, pp. 68–82, 2022, doi: https://doi.org/10.3926/jotse.1191.

[17] F. Novitra, ‘Networked-based inquiry: An effective physics learning in the new normal Covid-19 era in Indonesia’, *Int. J. Instr.*, vol. 15, no. 2, pp. 997–1016, 2022, doi: https://doi.org/10.29333/iji.2022.15255a.

[18] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, “The Effects of Students’ Perception of the School Environment and Students’ Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[19] G. B. Gudmundsdottir and O. E. Hatlevik, “Newly qualified teachers’ professional digital competence: implications for teacher education,” *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[20] D. Ramandanis and S. Xinogalos, “Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review,” *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[21] P. S. Lisenbee and C. M. Ford, “Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children’s Experiences,” *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[22] T. Lin, T. Chen, J. Liu, and X. M. Tu, “Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks,” *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[23] Y. Fong and Y. Huang, “Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null,” *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[24] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, “An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome,” *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[25] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, “Wright-Map to investigate the actual abilities on math test of elementary students,” *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[26] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, “The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia,” *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

[27] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, “Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being,” *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[28] S. Handayani, L. Peddell, and T. Yeigh, “Participants’ Experiences in Heutagogy Teacher Professional Education in Indonesia,” *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[29] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, “The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians,” *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[30] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, “A Wilcoxon-Mann-Whitney spatial scan statistic for functional data,” *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[31] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, “A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[32] F. J. Rodríguez Muñoz, “Pre-test and structural analysis of the pragmatic awareness questionnaire destined to teachers’ communicative instruction,” *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[33] M.-Y. Chen, S.-M. Huang, and W. Chou, “Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19,” *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[34] L. Mao, “Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance,” *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[35] R. Wilcox, “Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions,” *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[36] M. Mawarto, W. Widodo, and S. Sulistiasih, “The Antecedence of Teacher’s Professional Performance: Evidence from Indonesia,” *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[37] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, “The professional development of higher education-based teacher educators: needs and realities,” *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[38] Y. Cheng, W. Jia, R. Chi, and A. Li, “A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing,” *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[39] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, “Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling,” *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[40] L. Lukman *et al.*, “Effective teachers’ personality in strengthening character education,” *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[41] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, “The importance of attitudes toward technology for pre-service teachers’ technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches,” *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[42] A. H. Abdulrazzaq, “Teacher Appraisers’ Perceptions of Teacher Appraisal,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[43] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, “Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement,” *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[44] N. Ishartono *et al.*, “The Role of Instructional Design in Improving Pre-Service and In-Service Teacher’s Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[45] M. A. Flores, “Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education,” *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[46] H. T. Yusuf, “Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria,” *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[47] M. Mu’arifin and B. S. Narmaditya, “Professional development program for physical education teachers in Indonesia,” *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[48] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, “Makerspaces in early childhood education: Principles of pedagogy and practice,” *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[49] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, “Community-based teacher professional development in remote areas in Indonesia,” *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[50] Rusdiana, “Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif,” 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[51] J. Sargent and A. Casey, “Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time,” *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[52] J. M. Ramdani and X. (Andy) Gao, “Exploratory practice for teacher professional development in Indonesia,” *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[53] M. Portuguez Castro and M. G. Gómez Zermeño, “Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education,” *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[54] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, “‘Decolonizing’ Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts,” *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[55] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, ‘A review of the literature for designing and developing a framework for adaptive gamification in physics education’, in *The international handbook of physics education research: Teaching physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[56] T. Karakose *et al.*, ‘Assessment of the relationships between prospective mathematics teachers’ classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling’, *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

[57] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, ‘Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students’ motivation’, *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[58] I. Setianingrum and A. Da Costa, ‘Mapping research on Indonesian professional teacher: The bibliometric analysis’, *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

BIOGRAPHIES OF AUTHORS

	**Dian Artha Kusumaningtyas** is a senior lecturer in the Physics Education Program at Ahmad Dahlan University, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id)
	**Moh Irma Sukarelawan** is an assistant professor at Universitas Ahmad Dahlan (Department of Physics Education, Faculty of Teacher Training and Education), Yogyakarta, Indonesia. He obtained his Doctoral degree in the Department of Educational Science, Graduate School, Universitas Negeri Yogyakarta (UNY) in 2023. His research focuses on physics education, misconception, metacognition, and the Rasch modeling. He can be contacted at irma.sukarelawan@pfis.uad.ac.id
	**Muhammad Syahriandi Adhantoro** is an enthusiast of information technology who has created various works in the field of education, including educational games and learning information systems. He also has an interest in Educational Informatics research. He can be contacted at m.syahriandi@ums.ac.id
	**Wahyu Nanda Eka Saputra** is a Ph.D. & Lecturer, Department of Guidance and Counseling, Universitas Ahmad Dahlan, Indonesia. His research focuses on peace education, strategy of counseling intervension, counseling based on local wisdom, and counseling based on creative art. He can be contacted at email: wahyu.saputra@bk.uad.ac.id.

5.Respon Author for reviewer (11 September 2024)

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>
to Lina

Sep 11, 2024, 8:11AM

Dear editorial team

The authors have revised the article based on the suggestions and feedback provided by the reviewers. Each comment and recommendation has been carefully considered, and the necessary changes have been made to enhance the quality of the article following the reviewers' guidance.

Thank you

2 Attachments • Scanned by Gmail


Respond for revie...


Manuscript updat...

Reply Forward

RESPOND FOR REVIEWER

Title manuscript : Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers

ID : 31864

Author : Dian Artha Kusumanintyas, Irma Sukarelawan, Muhammad Syahriandi Adhantoro, Wahyu Nanda Eka Saputra

Reviewer A		
No	**Comment Reviewer**	**Respond**
1	Overall, the paper entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" is good and well organized. The revised manuscript represents a significant improvement over the original draft, and the author has addressed my questions and comments in a satisfactory manner. However, this paper has shortcomings in its appearance, so this paper needs some improvement(s) in its appearance.	Thank you. We have improve the appearance of the article.
2	Complete all the authors' social media link accounts as complete as possible in Biographies of Authors section: ORCID (required- Muhammad Syahriandi Adhantoro), followed by Google Scholar, Scopus, and Web of Science (WoS).	OK, I have done. Thank you.
Reviewer B		
No	**Comment Reviewer**	**Respond**
1	Abstract 1. Best to include the theoretical contribution of the study, particularly on how it extends the previous theory. 2. Helpful to identify the target	I have revised the recommendation of the reviewer. This study contributes by demonstrating the effectiveness of interventions in improving the skills of prospective Physics teachers,

	audience for the current study, given the rather technical nature of the research topic.	offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research not only fills a crucial gap in the existing body of work but also provides valuable insights that can inform the design and implementation of more effective teacher training strategies moving forward.
2	Introduction The Introduction includes a fair discussion since the authors provided context to the study. The structure is not well-explained, and it's not easy to follow the discussion. Thus, reviews on the following are needed: 1. Specify what makes this article different from the other studies available in the literature. 2. Identify the gap in the existing literature by arguing what is missing or inadequate in existing solutions. Thus, it needs to be briefly stated in the Introduction and further elaborated in the Literature Review, with in-depth analysis and substantiation of citations. 3. The research problem and objectives need to be better articulated to issues and problems associated with these variables.	I have done to explain the novelty in the last paragraph. The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs. This research compares the achievements of pedagogical and professional competencies between prospective teachers who have participated in the professional teacher education program for the field of physics with classes who have not participated in the program [21].
3	Literature review The literature review is not thorough and does not appears to be	I explain the literature review in the third paragraph of the introduction section.

	comprehensive. However, consider the following: 1. Add some literature related to the main research questions. 2. The research context should be explicitly established, as the readers should be able to share the authors' views. 3. Before developing the conceptual framework of the current research, the paper should first engage with existing theoretical frameworks in the literature to demonstrate the need for the proposed framework. What literature is there to support this claim? This aspect of the paper is one of the weakest and needs an in-depth relook to strengthen the theoretical aspect. 4. It would be helpful to clarify the proposed study's importance if the paper could include references to some latest articles published in recent years within the scope of the current research. The literature review should be carefully synthesized and structured, and using sub-headings and signposting would help the reader follow the argument developed throughout the paper. For clarity and to strengthen the literature review, the authors should begin by presenting past work and identifying the gaps in the previous work that the findings from the proposed study may shed some light on.	Physics teacher professional education in Indonesia currently faces major challenges in improving teachers' pedagogical and professional competence. Recent studies show that many physics teachers in Indonesia still lack mastery of innovative and technology-based learning methods, as well as the ability to integrate physics concepts with everyday life [14]. In addition, ever-changing education policies add complexity for teachers in adapting to dynamic national curriculum standards [15]. Although teacher professional education programs have been running, the lack of ongoing training and periodic performance evaluations has slowed down the improvement of teaching quality [16]. On the other hand, improving professional competence, especially in the use of laboratories and digital learning tools, is an urgent need to support more effective physics learning in this digital era [17]. Therefore, a comprehensive reform of the teacher professional curriculum is needed as well as more targeted infrastructure and training improvements. I also cited the literature: A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in physics education', in *The international handbook of physics education research: Teaching physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1.

	5. A more recent bibliography is necessary. Remove all outdated references! Furthermore, the reference list of new publications is a little bit weak. There are not enough studies from Europe or western countries. Before I can make a final decision on the paper, please refer to more references. It is suggested that the author(s) can consider the following papers related to gamification, new forms of educational reforms and technology etc. to strengthen the background and conclusions of the study: 1. Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation. Computers, 12(7), 143. 2. Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). A review of the literature for designing and developing a framework for adaptive gamification in physics education. The international handbook of physics education research: Teaching physics, 5-1. 3. Karakose, T., Polat, H., Yirci, R., Tülübaş, T., Papadakis, S., Ozdemir, T. Y., & Demirkol, M. (2023). Assessment of the relationships between prospective mathematics	https://doi.org/10.1063/9780735425712 A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

	teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling. Mathematics, 11(2), 449.	
	Method/Methodology The following should be included/amended: 1. The article needs to explain more clearly and in enough depth the research approach of the study. 2. The methods should be adequately described to show how the research was conducted to improve its transparency and trustworthiness. For example, the use of the data-gathering methods needs to be justified, and their appropriateness needs to be substantiated in the literature. 3. Similarly, it needs to be clear how the data analysis methods used in the paper are appropriate for analysing the data obtained. It can be extended to explain the stages of data analysis, including the measurement and structural models. 4. It would also be helpful to include a paragraph at the end of the methodology section by moving the second paragraph of the section on results, which explains the software used to analyse data and why it was used over others. Furthermore, the questionnaire items and from which	The involvement of control and experimental groups and random group division aims to increase the internal validity of the experimental results. The validity of the pedagogical test is in the range of 0.321-0.651 and the professional test is in the range of 0.351-0.541. While the reliability of the pedagogical test is 0.931 and the professional test is 0.891, both are included in the very good category.

	literature each item was adopted could be added in this section. 5. It is also suggested to discuss the reliability and validity of the study outcomes. It is also essential to address the study's limitations and provide a comprehensive discussion of the expected benefits of the proposed new teaching practice.	
	Discussion The comparisons of the current findings with the findings of previous research are not discussed. Furthermore, elaborations regarding the rejected hypotheses are also not included. Thus, the discussions could be summarized by stating clear answers to the research questions.	OK, i have done. Thank you.
	Conclusion 1. The aims and objectives of the study are not summarized in the conclusion. Furthermore, the main findings are not explicitly stated. 2. The study's contribution must be clearly articulated in this section. 3. The section needs to include recommendations for practitioners based on the findings, if appropriate.	This study found a significant difference between the pre-test and post-test results of both groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation of prospective Physics teachers. Wright's map analysis of pedagogical skills revealed that the experimental group experienced a more regular and significant increase than the control group, indicating that the intervention program had a positive and consistent impact on the development of teaching skills. This study contributes to the literature on the development of prospective Physics teachers by showing that a specifically designed intervention program can significantly improve pedagogical skills.

		Another important contribution is the use of Wright's map analysis, which is rarely applied in the context of educational research in Indonesia, as a tool to evaluate the development of teaching skills in more depth. Based on these findings, it is recommended that educational practitioners consider implementing similar intervention programs in an effort to improve the quality of teacher preparation in various regions. This program can be a model in developing pedagogical skills for prospective Physics teachers in Indonesia. In addition, practitioners are also advised to continuously evaluate the effectiveness of this program so that adaptations and improvements can be made according to local needs and evolving global challenges. Further research is needed to evaluate the success of the program on a national scale, considering the limited number of research subjects and not yet representing all regions in Indonesia. Thus, this study not only provides new insights into improving teaching quality, but also encourages further discussion regarding the implementation of broader intervention programs.
Reviewer C		
No	**Comment Reviewer**	**Respond**
1	This article potentially forges a good understanding in the context of Physics Education. The Findings are clear and the Discussions are satisfying with a sufficient compare and contrast to the	OK, I have done. Thank you.

	literature. The Discussions, however, can be improved once the Introduction is improved.	
2	Accordingly, more work need to be done in the Introduction section to incorporate all variables in the title, and better support your Findings. In particular, more explanations on the previous studies related to Physics Education, Prospective Physics Teachers, and the strength comparisons between quant and qual studies should be explored. Especially when the journal has no place for specified Literature Review. The points of Content and Significance in the above review will be improved if you revise your work accordingly.	I have done. Thank you Physics teacher professional education in Indonesia currently faces major challenges in improving teachers' pedagogical and professional competence. Recent studies show that many physics teachers in Indonesia still lack mastery of innovative and technology-based learning methods, as well as the ability to integrate physics concepts with everyday life [14]. In addition, ever-changing education policies add complexity for teachers in adapting to dynamic national curriculum standards [15]. Although teacher professional education programs have been running, the lack of ongoing training and periodic performance evaluations has slowed down the improvement of teaching quality [16]. On the other hand, improving professional competence, especially in the use of laboratories and digital learning tools, is an urgent need to support more effective physics learning in this digital era [17]. Therefore, a comprehensive reform of the teacher professional curriculum is needed as well as more targeted infrastructure and training improvements.

International Journal of Evaluation and Research in Education (IJERE)
Vol. 99, No. 1, Month 2099, pp. 1~1x
ISSN: 2252-8822, DOI: 10.11591/ijere.v99i1.paperID

Evaluation of the effectiveness of intervention on professional and pedagogical skills for prospective physics teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2], Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]
[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia
[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia
[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. The research involved an experimental group receiving the intervention and a control group that did not. To rigorously assess the impact, Mann-Whitney and Wilcoxon's statistical tests were used to compare pre-test and post-test outcomes, alongside Wright map analysis to visualize skill development. The results revealed a significant improvement in the professional and pedagogical competencies of the experimental group compared to the control group, as indicated by Mann-Whitney test values ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This study contributes by demonstrating the effectiveness of interventions in improving the skills of prospective Physics teachers, offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research not only fills a crucial gap in the existing body of work but also provides valuable insights that can inform the design and implementation of more effective teacher training strategies moving forward.

Corresponding Author:

Dian Artha Kusumaningtyas
Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

1. INTRODUCTION

In Indonesia, teacher professional development still faces various challenges, including limited access to quality training, lack of incentives and adequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social competencies [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore also has a strong mentoring system where junior teachers receive guidance from experienced senior teachers [7]. Many schools in the US also provide time and resources for teachers to participate in professional development, including teacher-to-teacher collaboration and school-based development [8], [9].

Although efforts to improve teacher competency in Indonesia exist, significant improvements are still needed regarding accessibility, continuity, and adequate support. Experiences from developed countries show that sustainable investment in teacher professional development is very important to achieve high-quality education and can be an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional competence is the main foundation in the world of education [11]. Pedagogical competence includes the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional competence includes in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without this competency, a teacher will have difficulty conveying material effectively, facilitating constructive discussions, and cultivating critical skills in students.

Physics teacher professional education in Indonesia currently faces major challenges in improving teachers' pedagogical and professional competence. Recent studies show that many physics teachers in Indonesia still lack mastery of innovative and technology-based learning methods, as well as the ability to integrate physics concepts with everyday life [14]. In addition, ever-changing education policies add complexity for teachers in adapting to dynamic national curriculum standards [15]. Although teacher professional education programs have been running, the lack of ongoing training and periodic performance evaluations has slowed down the improvement of teaching quality [16]. On the other hand, improving professional competence, especially in the use of laboratories and digital learning tools, is an urgent need to support more effective physics learning in this digital era [17]. Therefore, a comprehensive reform of the teacher professional curriculum is needed as well as more targeted infrastructure and training improvements.

If a teacher's pedagogical and professional competence is lacking, serious challenges can arise. Students may experience difficulties in understanding lesson material, which leads to low learning outcomes and motivation [18], [19]. Therefore, improving teachers' pedagogical and professional competence is very important to ensure high-quality education and optimal student academic achievement [20]. The novelty of this research lies in the evaluative approach used to assess the effectiveness of teacher pedagogical and professional competency development programs. This research compares the achievements of pedagogical and professional competencies between prospective teachers who have participated in the professional teacher education program for the field of physics with classes who have not participated in the program [21]. This research is expected to provide a clear picture of the impact of increasing teacher competency on the transformation of education in Indonesia. It is also expected that the results of this research can become a basis for policymakers in designing more effective and sustainable teacher professional development strategies.

2. METHOD

This research methodology uses a quantitative approach to evaluate the effectiveness of the pedagogical competency and professional competency development program for prospective Physics teachers. This research involved two groups, namely the experimental (n= 120) and control groups (n= 120). The experimental group consisted of prospective Physics teachers from two educational institutions for educational staff (LTPK) providing PPG for the field of Physics Education, who had participated in a competency development program, while the control group consisted of prospective physics teachers who had not participated in the program from the same two LPTKs as the experimental class. The involvement of control and experimental groups and random group division aims to increase the internal validity of the experimental results.

Data collection was carried out through pretest and posttest to measure the pedagogical and professional skills of prospective teachers. This test is carried out before and after the implementation of the competency development program. Data collection tools in this research are pedagogical and professional tests, each consisting of 45 question items. The instrument has validity and reliability, so it has a reliable ability to measure the intended competency. The validity of the pedagogical test is in the range of 0.321-0.651 and the professional test is in the range of 0.351-0.541. While the reliability of the pedagogical test is 0.931 and the professional test is 0.891, both are included in the very good category.

The Mann-Whitney test is used to determine whether significant differences exist between two independent groups, namely the experimental and control groups [22]. Meanwhile, the Wilcoxon test is used to test changes in two paired sets of data, namely pretest and posttest scores in groups, to see whether there is a significant increase in teachers' pedagogical and professional skills after participating in the development program [23], [24]. After carrying out the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map [24]. The Wright map allows a clear visualization of the increase in teachers' pedagogical and professional competence after participating in the development program [25].

3. RESULTS AND DISCUSSION

3.1. RESULTS

Professional skills and pedagogical skills are two critical aspects of the teaching profession that play an important role in improving the quality of education [26]. Professional skills include in-depth knowledge of subject matter, the ability to design relevant and engaging learning, and skills in using technology and other supporting resources [27]. Teachers who have good professional skills are able to deliver material comprehensively and inspire students to learn independently. Table 1 visualizes the results of the identification of professional skills and pedagogical skills.

Table 1. Fit statistics of Professional Skills and Pedagogical Skills

	Professional Skills		Pedagogical Skills	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test of professional skills and pedagogical skills in Table 1 show high quality based on the results of the analysis of various statistical indicators. The average (mean) for items and persons is 0.00 and 0.36 respectively, reflecting a balanced distribution of values between the abilities measured. The range of measures for items ranges from -1.89 to 1.61, while for persons is from -1.62 to 3.23, indicating that this instrument is able to measure variations in abilities with a wide scope. The standard deviation for items is 0.69 and for persons is 0.97 indicating relatively consistent variations in the level of expertise measured. The Mean Outfit MnSq index for items is 1.02 and for persons is -0.04, and the Mean Outfit ZStd for items is 0.06 and for persons is 1.02, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The Separation values for items and persons are 4.42 and 3.07, indicating the ability of this instrument to differentiate well among different levels of ability. The high level of reliability is also proven by the Cronbach alpha value of 0.91 for items and 0.90 for persons, confirming that this instrument is consistent in measuring the professional skills of prospective Physics teachers accurately.

The instrument for measuring the pedagogical skills of prospective Physics teachers also show good quality based on the results of statistical analysis. The average (mean) for items and persons is 0.00 and 0.82 respectively, indicating a balanced distribution of values with a positive tendency in the abilities measured. The range of measures for items ranges from -2.73 to 1.20, while for persons ranges from -1.09 to 3.96, indicating that this instrument can measure a wide range of abilities. The standard deviation of items is 0.68 and for persons is 0.88 indicating consistent variation in the level of expertise measured. The Mean Outfit MnSq index for items is 1.00 and for persons are 0.21, and the Mean Outfit ZStd for items is -0.11 and for persons is 0.92, indicating that the data from this instrument is in accordance with the expected model and does not show any significant deviations. The high separation for items of 4.17 and for persons of 2.10 indicates the ability of this instrument to differentiate well between various levels of pedagogical ability. A good level of reliability is also seen from the Cronbach alpha value of 0.81 for items and 0.81 for persons, indicating that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

3.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for teachers, statistical analysis was conducted on the pre-test and post-test data from prospective Physics teachers in the experimental and control groups [28]. This analysis aims to identify significant differences in skill improvement after the intervention of competence development program. The Mann-Whitney test was used to compare the distribution of scores between two unpaired groups, namely the experimental and control groups, both before (pre-test) and after (post-test) the intervention [29]. The Wilcoxon test was applied to evaluate changes in pre-test and post-test scores within each group, to ensure that the skill improvement was significant [30]. The results of this statistical analysis provide important insights regarding the impact of the competence development program on improving the professional skills of prospective Physics teachers. The results of this analysis are illustrated in Table 2 and Table 3.

Table 2. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Post-test	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 3. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups (P < 0.05)

Group	Pre-test	Post-test	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test illustrated in Table 2 show that there is a statistically significant difference in the pre-test and post-test results between the prospective Physics teachers in the experimental group and the control group. In the pre-test results, the U value = 1347.500 with a significance level of p <0.05, indicating that before the intervention there was a significant difference between the two groups. After the intervention, the post-test results show a U value = 183.500 with a significance level of p <0.05, indicating that the intervention carried out has a significant impact on improving the professional skills of prospective Physics teachers in the experimental group compared to the control group.

Analysis using the Wilcoxon test illustrated in Table 3 strengthens this finding. The Wilcoxon test shows that there is a significant difference between the pre-test and post-test results in both groups. In the experimental group, the Z value obtained is -6.736 with a significance level of p < 0.05, while in the control group, the Z value is -6.435 with the same significance level. This indicates that there is a significant increase in the professional skills of prospective Physics teachers after the intervention, either in the experimental or control groups.

However, the higher significant difference in the experimental group compared to the control group indicates that the implemented competency development program is more effective in improving the professional skills of prospective Physics teachers. The professional skills of prospective Physics teachers in the experimental group improved better compared to the control group after the intervention was carried out. This confirms that the intervention of competency development program has a greater positive impact on prospective Physics teachers who are involved in the program compared to those who do not participate in the program. This finding supports the importance of ongoing competency development programs as efforts to improve the quality of teaching and teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

The step in evaluating the effectiveness of the professional skills development program for prospective Physics teachers was conducted by carrying out an in-depth analysis of the pretest and posttest data. One of the tools used for visualization and analysis of this data is the Wright map, which allows mapping the skills of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear picture of the distribution of abilities held by the prospective Physics teachers in the control group and the experimental group. By mapping the pretest and posttest results of the two groups, we can identify significant differences in the professional skill attainment. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur as a result of the intervention; providing a more comprehensive insight related to the effectiveness of the training program that has been implemented [31]. The analysis on the professional skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 1 and Figure 2.

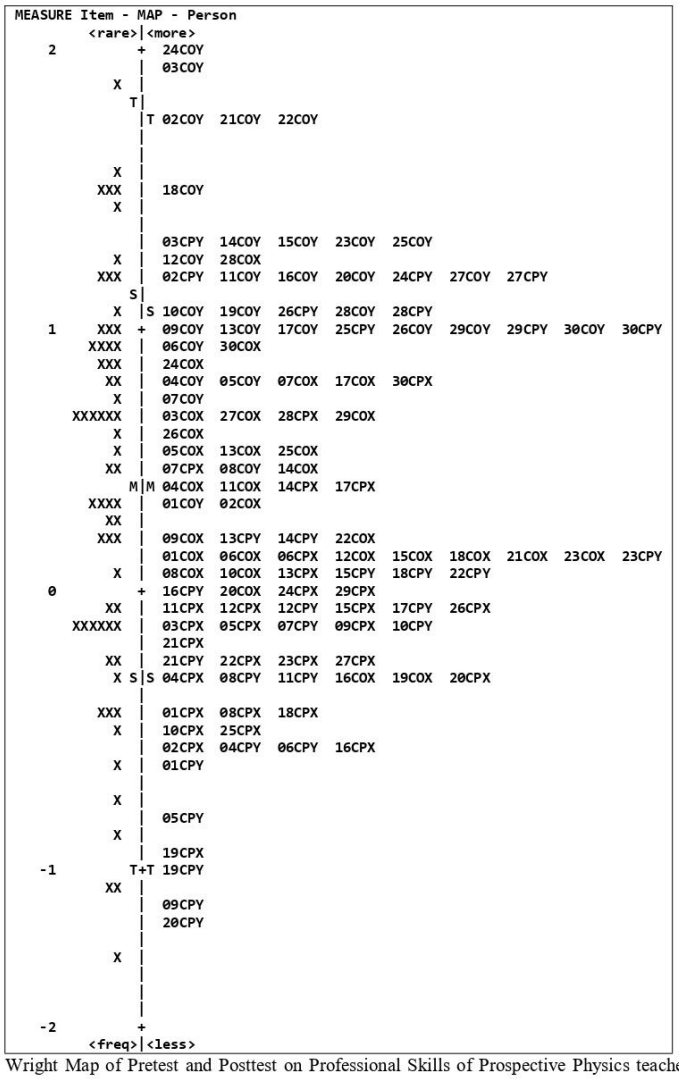


Figure 1. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) shows the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. On this map, it can be seen that items and people are spread over a fairly wide range. Most of the values are around the average with some items and persons being less or more frequent than that value. For example, the item with the highest measure is 24COY, indicating that only a few prospective Physics teachers having very high professional skills before the intervention. In contrast, there are many people with measure values between -1 and 0, indicating lower or moderate professional skills before the intervention. This distribution shows significant variation in ability among prospective Physics teachers in the control group.

After the intervention, the person's score is seen to shift significantly towards higher values, although there are still people who are at the low level. This shows that although there has been an increase in professional skills after the intervention, there are still some prospective Physics teachers who have not achieved the expected increase in skills. However, in general, this increase shows that the intervention has a positive impact even though it is not evenly distributed across all people.

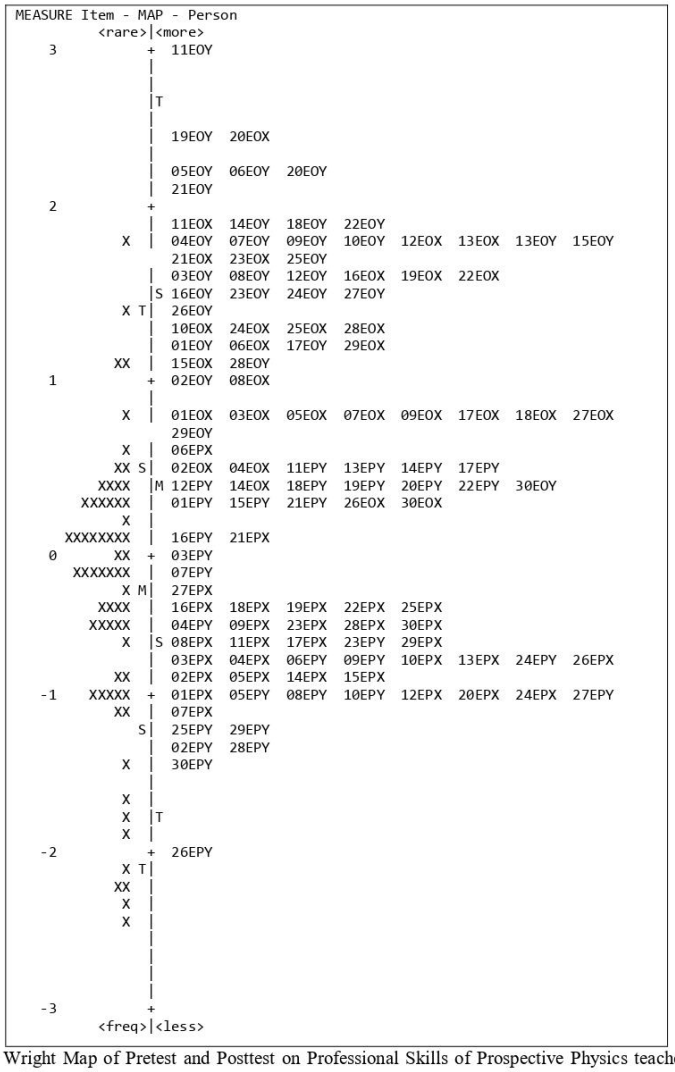


Figure 2. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group shows a more striking difference between the pretest and posttest compared to the control group. In the experimental group, item and person measures are also spread over a wide range, but there is a higher concentration of higher measure values after the intervention. This shows that more prospective Physics teachers in the experimental group show significant improvement in professional skills [32].

In the pretest, there are people with the highest measures such as 11EOY, indicating high professional skills before the intervention. However, after the intervention, the measure values for many individuals increase significantly, with some individuals achieving higher measure values than before the intervention, such as 29EOX and 30EOY. This shows that the competency development program applied to the experimental group is more effective in improving the professional skills of prospective Physics teachers compared to the control group [33].

This Wright map indicates that the intervention carried out in the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group shows the effectiveness of the competency development program implemented. The significant difference in the score distribution of these two groups confirms that the approach applied in the experimental group was more successful in improving the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers, statistical analysis was carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare distribution differences between two independent groups, namely the experimental group that received the intervention and the control group that did not receive the intervention [34]. This test helps determine whether there are any significant differences in pedagogical skills between the two groups. On the other hand, the Wilcoxon test was used to assess changes in the same group within two measurement times, namely before and after the intervention [35]. This analysis provides a more comprehensive picture on the impact of the intervention on the development of the pedagogical skills of prospective Physics teachers. The results of the statistical analysis of the two tests are illustrated in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pre-test	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Post-test	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 5. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pre-test	Post-test	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) show that there is a statistically significant difference in the results of the pre-test ($U=1274.500$, $p < 0.05$) and post-test ($U=421.500$, $p < 0.05$) among the prospective Physics teacher in both experimental and control groups. The Mann-Whitney test is a non-parametric statistical method used to compare two independent groups. In this context, the experimental group received a specific intervention, while the control group received no intervention. The significant results in this test indicate that the intervention given to the experimental group had a real effect on improving pedagogical skills compared to the control group.

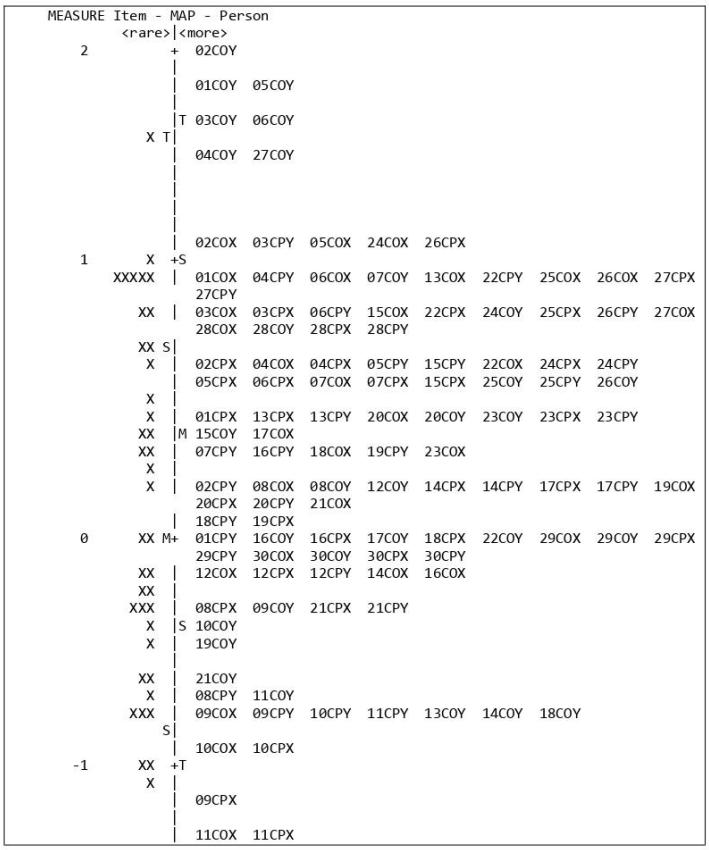
The Wilcoxon test results (Table 5) strengthen these findings by showing that there is a significant difference between the pre-test and post-test results of prospective Physics teachers both in the experimental group ($Z=-6.729$, $p < 0.05$) and in the control group ($Z =-2.721$, $p < 0.05$). The Wilcoxon test, which is also a non-parametric statistical method, is used to compare two sets of paired data, namely pre-test and post-test results from the same individual. These results indicate that there was a significant increase in pedagogical skills after the intervention in both groups, although the increase in the experimental group was higher compared to the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. However, the improvement was greater in the experimental group compared to the control group, indicating the effectiveness of the intervention implemented. The higher pedagogical skills in

the experimental group compared to the control group after the intervention indicate that the training program or method applied was successful in significantly increasing the pedagogical competence of prospective Physics teachers. This emphasizes the importance of developing a structured and sustainable training program to improve the quality of teaching and professionalism of prospective Physics teachers [36]. Through appropriate and evidence-based approaches, the development of pedagogical skills can have a significant positive impact on improving the overall quality of education [37].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual depiction of the distribution of test takers' abilities and the difficulty of the test items, making it easier to identify differences in abilities before and after the intervention. Wright Map analysis was carried out on pretest and posttest data on the pedagogical skills of prospective Physics teachers for two groups, namely the control group and the experimental group. Understanding the results of this mapping is very important to assess the effectiveness of the interventions that have been implemented. The following is a detailed analysis of the Wright Map pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group, which provides insight into improvements or changes in pedagogical abilities after the intervention was carried out. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.



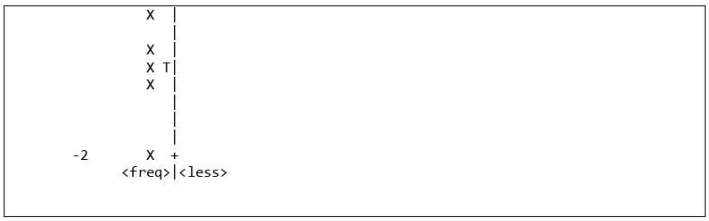


Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group

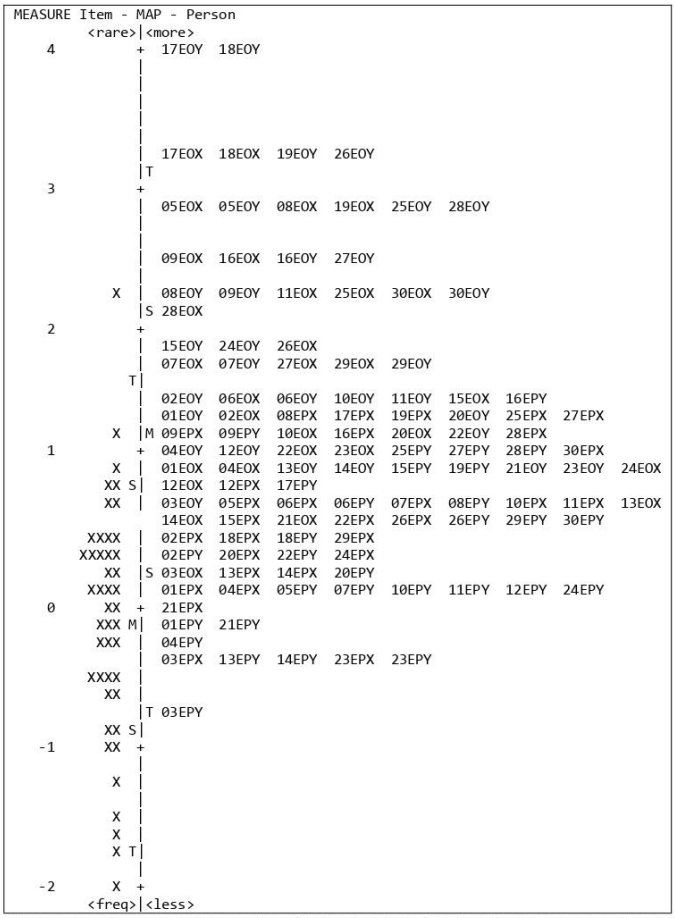


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest pedagogical skills of prospective Physics teachers in the control group and experimental group provides an in-depth picture of the distribution of ability and difficulty of items. In the Wright Map of the control group, it can be seen that the distribution of persons and items shows that the majority of prospective Physics teachers have varied pedagogical skills with some items being more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY are in higher positions, indicating better pedagogical skills, while other persons are spread along the scale with the majority being around the middle of the scale (measure=1), indicating moderate variation in pedagogical abilities . This distribution indicates that there are differences in pedagogical abilities among the prospective Physics teachers in the control group, with some items indicating significant challenges for them.

In contrast, in the Wright Map experimental group, the distribution of persons and items show a more significant increase in pedagogical skills after the intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX are at higher measures (measure=3 and 4), indicating that the intervention provided was successful in improving their pedagogical skills. Many people from the experimental group are at higher levels compared to the control group, indicating that the intervention implemented was effective in improving the pedagogical skills of prospective Physics teachers. The distribution of items also shows that there are several items that remain difficult for most people, but overall, people in the experimental group show better abilities compared to the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group succeeded in improving the pedagogical skills of prospective Physics teachers significantly better than the control group [38]. The Wright Map provides a clear visualization of the distribution of ability and difficulty of items, assisting in understanding the effectiveness of the implemented intervention. This emphasizes the importance of structured and evidence-based training programs in improving the pedagogical quality of prospective Physics teachers [39].

3.2. Discussion

3.2.1. Professional Skills of Prospective Physics Teachers

Professional skills for prospective Physics teachers are an integral aspect in their preparation to face teaching assignments in the world of education. These skills include various competencies that are not only limited to mastering academic material, but also the ability to adapt to the work environment, interact with students, and manage the class effectively [40], [41]. A prospective Physics teacher who has strong professional skills can implement innovative teaching strategies, apply fair and objective assessments of student achievement, and build good relationships with all relevant parties in the educational context [42], [43].

The importance of the professional skills of prospective Physics teachers is also reflected in their ability to continue learning and developing themselves, either through additional training, workshops or independent study. This supports their ability to integrate the latest developments in education into their teaching practice so that it can improve the overall quality of students' learning experiences [5], [44]. The evaluation aspect of professional skills often involves the use of measurement tools such as validity and reliability tests, as well as competency mapping to assess the extent to which a prospective Physics teacher has achieved the standards set in their field [45].

Academically, the professional skills of prospective Physics teachers can be measured through various indicators, such as test results, assessments by fellow professionals, and the ability to plan and implement effective learning strategies [46]. Developing these skills also plays an important role in creating an inclusive learning environment and encouraging balanced intellectual and emotional growth of students.

3.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers are the main foundation in their ability to convey subject matter in a way that arouses interest and facilitates students' understanding [47]. The main aspects of pedagogical skills include the ability to design a curriculum that is relevant and in accordance with educational standards, choosing appropriate teaching methods to accommodate students' diverse learning styles, and utilizing educational technology and other resources effectively in the learning process [48].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [49]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [50], [51], [52].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning goals [53],

[54], [55]. By building strong pedagogical skills, prospective Physics teachers can become effective agents of change in advancing the quality of education in their communities, as well as preparing future generations with relevant knowledge and skills to encounter global challenges [56], [57], [58].

4. CONCLUSION

This study found a significant difference between the pre-test and post-test results of both groups, indicating the effectiveness of the intervention in improving the quality of teaching preparation of prospective Physics teachers. Wright's map analysis of pedagogical skills revealed that the experimental group experienced a more regular and significant increase than the control group, indicating that the intervention program had a positive and consistent impact on the development of teaching skills. This study contributes to the literature on the development of prospective Physics teachers by showing that a specifically designed intervention program can significantly improve pedagogical skills. Another important contribution is the use of Wright's map analysis, which is rarely applied in the context of educational research in Indonesia, as a tool to evaluate the development of teaching skills in more depth.

Based on these findings, it is recommended that educational practitioners consider implementing similar intervention programs to improve the quality of teacher preparation in various regions. This program can be a model in developing pedagogical skills for prospective Physics teachers in Indonesia. In addition, practitioners are also advised to continuously evaluate the effectiveness of this program so that adaptations and improvements can be made according to local needs and evolving global challenges. Further research is needed to evaluate the success of the program on a national scale, considering the limited number of research subjects and not yet representing all regions in Indonesia. Thus, this study not only provides new insights into improving teaching quality, but also encourages further discussion regarding the implementation of broader intervention programs.

ACKNOWLEDGEMENTS

We would like to thanks Universitas Ahmad Dahlan for supporting and founding this work under the supported proffesorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, "The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States," *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, "Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States," *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, "The Human Teacher, the AI Teacher and the AIed-Teacher Relationship," *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, "Pedagogies of embodiment in physical education – a literature review," *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.
[12] S.-C. Kong, M. Lai, and D. Sun, "Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy," *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.
[13] N. Baety, "Indonesian teacher performance: Professional and Character," *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.
[14] A. Hidayat, 'Developing and validating a Technological Pedagogical Content Knowledge (TPACK) instrument for secondary Physics preservice teachers in Indonesia', *Unnes Sci. Educ. J.*, vol. 8, no. 1, pp. 31–40, 2019, doi: 10.15294/usej.v8i1.23087.
[15] R. Pribudhiana, Y. Bin Don, and M. R. Bin Yusof, 'Determining the influence of teacher quality toward teacher readiness in implementing Indonesian education policy', *Eurasian J. Educ. Res.*, vol. 93, pp. 373–390, 2021, doi: 10.14689/ejer.2021.93.18.
[16] N. Sulaeman, S. Efwinda, and P. D. A. Putra, 'Teacher readiness in STEM education: Voices of Indonesian physics teachers', *J. Technol. Sci. Educ.*, vol. 12, no. 1, pp. 68–82, 2022, doi: https://doi.org/10.3926/jotse.1191.
[17] F. Novitra, 'Networked-based inquiry: An effective physics learning in the new normal Covid-19 era in Indonesia', *Int. J. Instr.*, vol. 15, no. 2, pp. 997–1016, 2022, doi: https://doi.org/10.29333/iji.2022.15255a.
[18] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, "The Effects of Students' Perception of the School Environment and Students' Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.
[19] G. B. Gudmundsdottir and O. E. Hatlevik, "Newly qualified teachers' professional digital competence: implications for teacher education," *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.
[20] D. Ramandanis and S. Xinogalos, "Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review," *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.
[21] P. S. Lisenbee and C. M. Ford, "Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children's Experiences," *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.
[22] T. Lin, T. Chen, J. Liu, and X. M. Tu, "Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks," *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.
[23] Y. Fong and Y. Huang, "Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null," *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.
[24] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, "An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome," *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.
[25] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, "Wright-Map to investigate the actual abilities on math test of elementary students," *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.
[26] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, "The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia," *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.
[27] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, "Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being," *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.
[28] S. Handayani, L. Peddell, and T. Yeigh, "Participants' Experiences in Heutagogy Teacher Professional Education in Indonesia," *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.
[29] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, "The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians," *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.
[30] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, "A Wilcoxon-Mann-Whitney spatial scan statistic for functional data," *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.
[31] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, "A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[32] F. J. Rodríguez Muñoz, "Pre-test and structural analysis of the pragmatic awareness questionnaire destined to teachers' communicative instruction," *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[33] M.-Y. Chen, S.-M. Huang, and W. Chou, "Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19," *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[34] L. Mao, "Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance," *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[35] R. Wilcox, "Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions," *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[36] M. Mawarto, W. Widodo, and S. Sulistiasih, "The Antecedence of Teacher's Professional Performance: Evidence from Indonesia," *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[37] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, "The professional development of higher education-based teacher educators: needs and realities," *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[38] Y. Cheng, W. Jia, R. Chi, and A. Li, "A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing," *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[39] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, "Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling," *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[40] L. Lukman *et al.*, "Effective teachers' personality in strengthening character education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[41] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, "The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches," *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[42] A. H. Abdulrazzaq, "Teacher Appraisers' Perceptions of Teacher Appraisal," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[43] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, "Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement," *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[44] N. Ishartono *et al.*, "The Role of Instructional Design in Improving Pre-Service and In-Service Teacher's Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[45] M. A. Flores, "Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education," *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[46] H. T. Yusuf, "Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[47] M. Mu'arifin and B. S. Narmaditya, "Professional development program for physical education teachers in Indonesia," *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[48] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, "Makerspaces in early childhood education: Principles of pedagogy and practice," *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[49] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, "Community-based teacher professional development in remote areas in Indonesia," *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[50] Rusdiana, "Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif," 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[51] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[52] J. M. Ramdani and X. (Andy) Gao, "Exploratory practice for teacher professional development in Indonesia," *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[53] M. Portuguez Castro and M. G. Gómez Zermeño, "Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education," *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[54] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[55] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in physics education', in *The international handbook of physics education research: Teaching physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[56] T. Karakose *et al.*, 'Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling', *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

[57] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[58] I. Setianingrum and A. Da Costa, 'Mapping research on Indonesian professional teacher: The bibliometric analysis', *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

BIOGRAPHIES OF AUTHORS

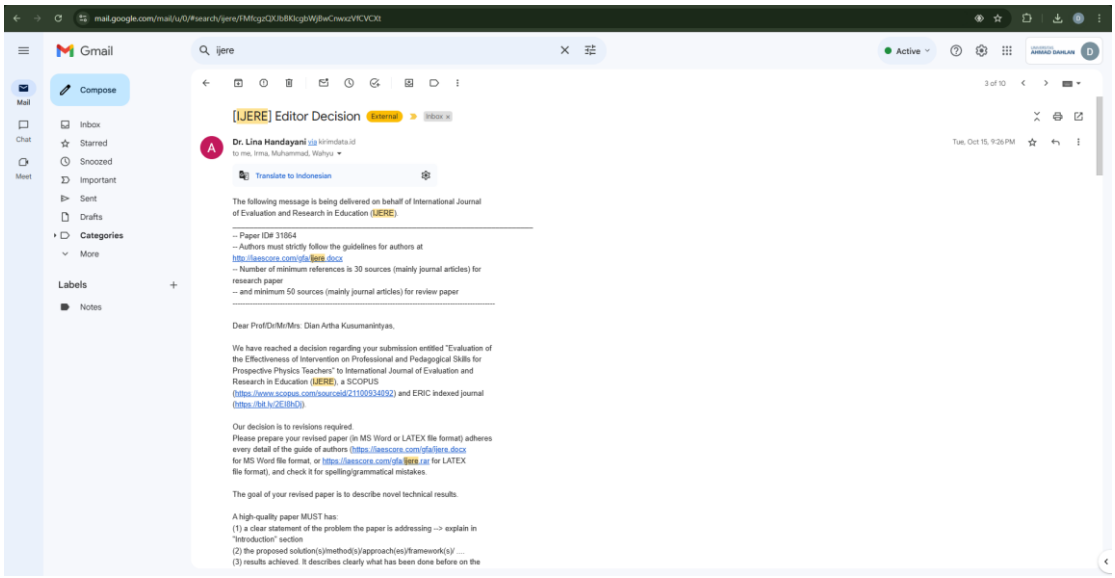
Dian Artha Kusumaningtyas is a senior lecturer in the Physics Education Program at Ahmad Dahlan University, Yogyakarta. Currently, she serves as the Program Coordinator for Character Education and Academic Advisor at the same institution. With a strong commitment to education, Dian's research interests lie in science learning, learning assessment, and school development in suburban areas. For inquiries or collaboration, she can be contacted at (email: dian.artha@pfis.uad.ac.id)

Moh Irma Sukarelawan is an assistant professor at Universitas Ahmad Dahlan (Department of Physics Education, Faculty of Teacher Training and Education), Yogyakarta, Indonesia. He obtained his Doctoral degree in the Department of Educational Science, Graduate School, Universitas Negeri Yogyakarta (UNY) in 2023. His research focuses on physics education, misconception, metacognition, and the Rasch modeling. He can be contacted at irma.sukarelawan@pfis.uad.ac.id

Muhammad Syahriandi Adhantoro is an enthusiast of information technology who has created various works in the field of education, including educational games and learning information systems. He also has an interest in Educational Informatics research. He can be contacted at m.syahriandi@ums.ac.id

Wahyu Nanda Eka Saputra is a Ph.D. & Lecturer, Department of Guidance and Counseling, Universitas Ahmad Dahlan, Indonesia. His research focuses on peace education, strategy of counseling intervension, counseling based on local wisdom, and counseling based on creative art. He can be contacted at email: wahyu.saputra@bk.uad.ac.id.

6. Bukti Konfirmasi review ketiga (15 Oktober 2024)



mail.google.com/mail/u/0/#search/ijere/FMfcgzQXJbBKlcgbWjBwCnwxzVfCVCXt

Gmail

ijere

Active

Compose

Inbox
Starred
Snoozed
Important
Sent
Drafts
Categories
More

Labels

Notes

3 of 10

[IJERE] Editor Decision External Inbox ×

Dr. Lina Handayani via kirimdata.id
to me, Irma, Muhammad, Wahyu

Tue, Oct 15, 9:26 PM

Translate to Indonesian

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at
http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper

---

Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,

We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ERIC indexed journal (https://bit.ly/2EI8hDI).

Our decision is to revisions required.
Please prepare your revised paper (in MS Word or LATEX file format) adheres every detail of the guide of authors (https://iaescore.com/gfa/ijere.docx for MS Word file format, or https://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.

The goal of your revised paper is to describe novel technical results.

A high-quality paper MUST has:
(1) a clear statement of the problem the paper is addressing --> explain in "Introduction" section
(2) the proposed solution(s)/method(s)/approach(es)/framework(s)/ ...
(3) results achieved. It describes clearly what has been done before on the

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Editor Decision

3 messages

Dr. Lina Handayani <ijere@iaescore.com> Tue, Oct 15, 2024 at 9:26 PM
Reply-To: "Dr. Lina Handayani" <ijere@iaesjournal.com>
To: Dian Artha Kusumanintyas <dian.artha@pfis.uad.ac.id>
Cc: Irma Sukarelawan <irma.sukarelawan@pfis.uad.ac.id>, Muhammad Syahriandi Adhantoro <m.syahriandi@ums.ac.id>, Wahyu Nanda Eka Saputra <wahyu.saputra@bk.uad.ac.id>

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper

---

Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,

We have reached a decision regarding your submission entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" to International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ERIC indexed journal (https://bit.ly/2EI8hDj).

Our decision is to revisions required.
Please prepare your revised paper (in MS Word or LATEX file format) adheres every detail of the guide of authors (https://iaescore.com/gfa/ijere.docx for MS Word file format, or https://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.

The goal of your revised paper is to describe novel technical results.

A high-quality paper MUST has:
(1) a clear statement of the problem the paper is addressing --> explain in "Introduction" section
(2) the proposed solution(s)/method(s)/approach(es)/framework(s)/ ....
(3) results achieved. It describes clearly what has been done before on the problem, and what is new.

Please submit your revised paper within 6 weeks.

I look forward for hearing from you

Thank you

Best Regards,
Dr. Lina Handayani

==========
IMPORTANT!!
==========

For ORIGINAL/RESEARCH PAPER: the paper should be presented with IMRaD model:
1. Introduction
2. Research Method
3. Results and Discussion
4. Conclusion.
We will usually expect a minimum of 30 references primarily to journal papers. Citations of textbooks should be used very rarely and citations to web pages should be avoided. All cited papers must be referenced within the body text of the manuscript.

For REVIEW PAPER: the paper should present a critical and constructive analysis of existing published literature in a field, through summary, classification, analysis and comparison. The function and goal of the review paper is:
1) to organize literature;
2) to evaluate literature;
3) to identify patterns and trends in the literature;
4) to synthesize literature; or
5) to identify research gaps and recommend new research areas.
The structure of a review paper includes:
1. Title – in this case does not indicate that it is a review article.
2. Abstract – includes a description of subjects covered.
3. Introduction includes a description of context (paragraph 1-3), motivation for review (paragraph 4, sentence 1) and defines the focus (paragraph 4, sentences 2-3)
4. Body – structured by headings and subheadings
5. Conclusion – states the implications of the findings and an identifies possible new research fields
Number of minimum references for review paper is 50 references (included minimum 40 recently journal articles).

In preparing your revised paper, you should pay attention to:
1. Please ensure that: all references have been cited in your text; Each citation should be written in the order of appearance in the text; The citations must be presented in numbering and CITATION ORDER is SEQUENTIAL [1], [2], [3], [4], ...
Please download & study our published papers for your references:
- http://ijere.iaescore.com
- http://journal.uad.ac.id/index.php/edulearn
- http://ijece.iaescore.com
- http://ijeecs.iaescore.com
(Please use “Search” menu under "JOURNAL CONTENT" menu in right side of the site)

2 An Introduction should contain the following three (3) parts:
- Background: Authors have to make clear what the context is. Ideally, authors should give an idea of the state-of-the art of the field the report is about.
- The Problem: If there was no problem, there would be no reason for writing a manuscript, and definitely no reason for reading it. So, please tell readers why they should proceed reading. Experience shows that for this part a few lines are often sufficient.
- The Proposed Solution: Now and only now! - authors may outline the contribution of the manuscript. Here authors have to make sure readers point out what are the novel aspects of authors work. Authors should place the paper in proper context by citing relevant papers. At least, 5 references (recently journal articles) are cited in this section.

3. Results and discussion section: The presentation of results should be simple and straightforward in style. This section report the most important findings, including results of statistical analyses as appropriate. You should present the comparison between performance of your approach and other researches. Results given in figures should not be repeated in tables. It is

very important to prove that your manuscript has a significant value and not trivial.

Reviewer B:

The IJERE form to evaluate submitted papers
Content:
Excellent

Significance:
Very good

Originality:
Very good

Relevance:
Very good

Presentation:
Excellent

Recommendation:
Excellent

Comments to the Author

This comment will be visible to the Author
:
The revised manuscript represents a significant improvement over the original draft, and the author has addressed my questions and comments in a satisfactory manner. I therefore recommend publication of this article, as it is a well-written and scientifically rigorous contribution to the field that has the potential to advance knowledge. However, I suggest that the author consider professional proofreading before publication to ensure that the final version is free of errors.

Reviewer C:

The IJERE form to evaluate submitted papers
Content:
Very good

Significance:
Excellent

Originality:
Very good

Relevance:
Very good

Presentation:
Very good

Recommendation:
Excellent

Comments to the Author

This comment will be visible to the Author
:
The authors already revised based on the given comments and satisfy the reviewer.

International Journal of Evaluation and Research in Education (IJERE)
http://ijere.iaescore.com

7. Bukti Resubmit atikel revisi ketiga (21 Oktober 2024)

International Journal of Evaluation and Research in Education (IJERE)
Vol. 99, No. 1, Month 2099, pp. 1~1x
ISSN: 2252-8822, DOI: 10.11591/ijere.v99i1.paperID

Evaluating the effectiveness of intervention on professional and pedagogical skills among prospective Physics teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2], Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]
[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia
[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia
[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. The research involved an experimental group that reveived the intervention and a control group that did not. The research subjects in the experimental and control groups were 120 each. To rigorously assess the impact, Whitney and Wilcoxon's statistical tests were employed to compare pretest and posttest outcomes. Additionally, Wright map analysis was used to visualizes kill development. The results revealed a significant improvement in the professional and pedagogical skills of the experimental group compared to the control group, as indicated by Mann-Whitney test ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This study contributes to the field by demonstrating the effectiveness of interventions in improving the skills of prospective Physics teachers, offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research provides valuable insights that can inform the design and implementation of more effective teacher training strategies.

Corresponding Author:

Dian Artha Kusumaningtyas
Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

1. INTRODUCTION

In Indonesia, teacher professional development continues to face various challenges, including limited access to quality training, lack of incentives, and inadequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social skills [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore has a robust mentoring system in which junior teachers receive guidance from experienced senior educators [7]. Many schools in the U.S. allocate time and resources for teachers to engage in professional development, including teacher-to-teacher collaboration and school-based initiatives [8], [9].

While Indonesia has implemented efforts to enhance teacher competencies, considerable enhancements are still required regarding accessibility, continuity, and support. Experiences from developed countries show that sustainable investment in teacher professional development is essential to achieve high-quality education and become an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional skills serve as the fundamental basis in education [11]. Pedagogical skills encompass the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional skills include in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without these skills, a teacher may struggle to effectively deliver content, facilitate constructive discussions, and foster critical thinking skills in students.

Physics teacher professional education in Indonesia currently faces major challenges in enhancing teachers' pedagogical and professional competence. Recent studies indicate that many Physics teachers in Indonesia struggle with mastering innovative, technology-based learning methods and integrating Physics concepts into everyday life [14]. In addition, ever-changing education policies complicate teachers' efforts to adapt to dynamic national curriculum standards [15]. hile teacher professional education programs are in place, the lack of ongoing training and periodic performance evaluations has hindered the improvement of teaching quality [16]. Furthermore, there is an urgent need to enhance professional skills, particularly in the use of laboratories and digital learning tools, to support more effective Physics instruction in the digital age [17]. Therefore, a

comprehensive reform of the teacher professional curriculum along with targeted infrastructure and training improvement is mandatory.

When teachers lack sufficient pedagogical and professional skills, significant challenges can arise. Students may experience difficulties in understanding lesson material, resulting in low learning outcomes and motivation [18], [19]. Therefore, improving teachers' pedagogical and professional competence is imperative to ensure high-quality education and optimal academic achievement for students [20]. The novelty of this research lies in its evaluative approach to assessing the effectiveness of teacher pedagogical and professional competency development programs. This research compares the pedagogical and professional skills of prospective Physics teachers who have participated in a professional teacher education program with those who have not [21]. This research is expected to provide a clear picture of the impact of improved teacher competence on the transformation of education in Indonesia. Additionally, the results of this research may serve as a foundation for policymakers in designing more effective and sustainable strategies for teacher professional development.

2. METHOD

This research employed a quantitative approach to evaluate the effectiveness of a pedagogical and professional competency development program for prospective Physics teachers. This research involved two groups: an experimental group (n= 120) and a control group (n= 120). The experimental group comprised prospective Physics teachers from two Educational Personnel Education Institutes (LTPK) that offer Teachers Professional Education (PPG) in Physics Education and participated in a competency development program. On the other hand, the control group consisted of prospective Physics teachers from the same two LTPKs who had not participated in the program. The involvement of control and experimental groups along with random group division was aimed at enhancing the internal validity of the experimental results.

Data collection was carried out using a pretest and posttest to measure the pedagogical and professional skills of prospective teachers. These tests were adminitered both before and after the implementation of the competency development program. Data collection instruments in this research were pedagogical and professional tests, each comprising 45 items. The instruments demonstrated both validity and reliability, indicating their effectiveness in measuring the intended skills. The validity for the pedagogical test ranged from 0.321 to 0.65,1 while those for the professional test ranged from 0.351 to

0.541. The reliability of the pedagogical test was 0.931, and that of the professional test was 0.891, both falling within the very good category.

The Mann-Whitney test was carried out to determine whether significant differences existed between the two independent groups: the experimental group and control group [22]. Additionally, the Wilcoxon test was utilized to test changes in two paired sets of data, namely pretest and posttest scores in groups, to assess whether there was a significant increase in teachers' pedagogical and professional skills after participating in the development program [23], [24]. Following the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map [24]. This visualization tool allows a clear visualization of the enhancement in teachers' pedagogical and professional competence after their participation in the development program [25].

3. RESULTS AND DISCUSSION

3.1. RESULTS

Professional and pedagogical skills are two critical aspects of the teaching profession and play an important role in enhancing the quality of education [26]. Professional competence includes in-depth knowledge of subject matter, the ability to design relevant and engaging learning experiences, and proficiency in using technology and other supporting resources [27]. Teachers with good professional skills can deliver material comprehensively and inspire students to engage in independent learning. Table 1 presents the results of the identification of professional and pedagogical skills.

Table 1. Fit Statistics of Professional Skills and Pedagogical Skills

	Professional Skills		**Pedagogical Skills**	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test for professional and pedagogical skills, as shown in Table 1, indicate a high level of quality based on various statistical indicators. The average values (mean) for items and persons are 0.00 and 0.36, respectively, reflecting a balanced distribution of values across the measured abilities. The range of measures for items spans from -1.89 to 1.61, while that for persons is from -1.62 to 3.23,

demonstrating that this instrument effectively measures wide-scope variations in abilities. The standard deviations for items (0.69) and for persons (0.97) suggests relatively consistent variations in the level of expertise assessed. The Mean Outfit MnSq index for items is 1.02 and for persons, it is -0.04. The Mean Outfit ZStd is 0.06 for items and 1.02 for persons, indicating that the data from this instrument is in accordance with the expected model and does not exhibit any significant deviations. Additionally, the Separation values for items and persons are 4.42 and 3.07, respectively, demonstrating the instrument's effectiveness in distinguishing between different levels of ability. The high reliability of the instrument is further supported by a Cronbach's alpha value of 0.91 for items and 0.90 for persons, confirming its consistency in accurately measuring the professional skills of prospective Physics teachers.

The instrument for measuring the pedagogical skills of prospective Physics teachers demonstrates high quality, as indicated by the results of the statistical analysis. The average values (mean) for item and person measures are 0.00 and 0.82, respectively, reflecting a balanced distribution of values with a positive tendency in the measured abilities. The range of items spans from -2.73 to 1.20, while the range for persons is from -1.09 to 3.96, indicating that this instrument effectively measures a broad spectrum of abilities. The standard deviation for items (0.68) and for persons (0.88) suggest consistent variation in the levels of expertise assessed. The Mean Outfit MnSq index for items is 1.00 and for persons, it is 0.21, while the Mean Outfit ZStd is -0.11 for items and for 0.92 persons, showing that the data from this instrument aligns well with the expected model and does not exhibit any significant deviations. The high separation values of 4.17 for items and 2.10 for persons demonstrate the instrument's ability to distinguish between differebt levels of pedagogical ability effectively. A good level of reliability is indicated by the Cronbach alpha value of 0.81 for items and 0.81 for persons, suggesting that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

3.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for prospective Physics teachers, statistical analyses were performed on the pretest and posttest data from the experimental and control groups [28]. The goal of these analyses was to determine whether there were significant differences in skill improvement following the intervention. The Mann-Whitney test was used to compare the

score distributions between two unpaired groups, the experimental and control groups, both before (pretest) and after (posttest) the intervention [29]. The Wilcoxon test was applied to examine changes in pretest and posttest scores within each group, ensuring that any observed improvements in skills were statistically significant [30]. The results of this statistical analysis offer valuable insights into the impact of the competence development program on enhancing the professional skills of prospective Physics teachers. The results of this analysis are presented in Table 2 and Table 3.

Table 2. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pretest	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Posttest	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 3. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pretest	Posttest	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test, presented in Table 2, indicate a statistically significant difference between the pretest and posttest scores of the prospective Physics teachers in the experimental and control groups. In the pretest results, the U value was 1347.500 ($p <0.05$), suggesting a significant difference between the two groups before the intervention. After the intervention, the posttest results revealed a U value of 183.500 ($p <0.05$), indicating that the intervention had a significant impact on improving the professional skills of the experimental group compared to the control group.

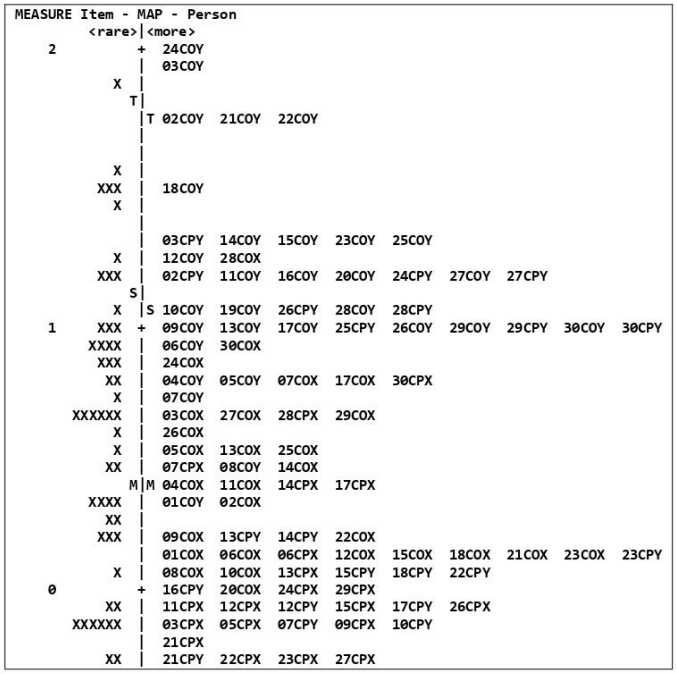
The Wilcoxon test results, as shown in Table 3, further supported the finding that there was a significant difference between the pretest and posttest results in both groups. In the experimental group, the Z-value was -6.736 ($p < 0.05$), and in the control group, the Z-value was -6.435, with the same p-value. These results indicated that there was a significant improvement in professional skills for prospective Physics teachers in both groups after the intervention.

However, the more pronounced significant difference observed in the experimental group indicates that the competency development program was more effective in enhancing the professional skills of prospective Physics teachers. The professional skills of the experimental group showed higher gains after the intervention than those of the control group. This underscores the positive impact of the competency development program on participants, highlighting its effectiveness in fostering teacher development. These findings

emphasize the importance of sustained competency development programs in improving teaching quality and advancing teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

To evaluate the effectiveness of the professional skills development program for prospective Physics teachers, an in-depth analysis of the pretest and posttest data was conducted. One of the tools used for this analysis was the Wright map, which visualizes and compares the skill levels of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear depiction of the distribution of abilities both the control group and the experimental group. By mapping the pretest and posttest results of the two groups, significant differences in professional skill attainment between the groups could be identified. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur after the intervention, offering a more comprehensive insight into the effectiveness of the implemented training program [31]. The results of this analysis for both the control and experimental groups are illustrated in Figures 1 and 2.



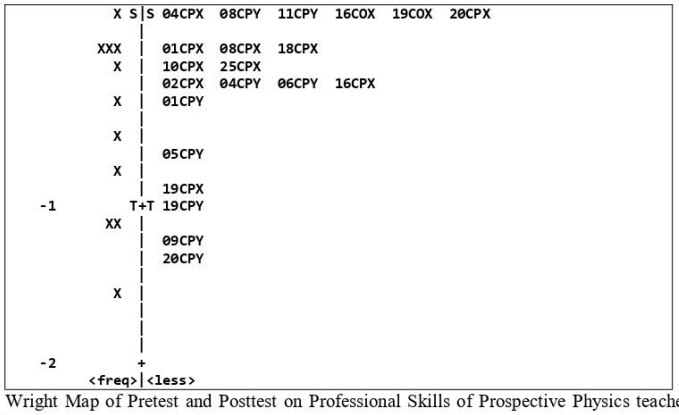
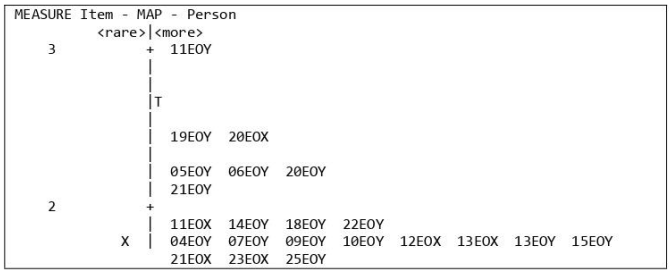


Figure 1. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) illustrates the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. The map shows that both items and people are distributed across a fairly wide range. Most values cluster around the means with some items and persons being less or more frequent than that value. For example, 24COY, which has the highest measure, indicates that only a few prospective Physics teachers demonstrated very high professional skills prior to the intervention. In contrast, there are many persons have measure values between -1 and 0, indicating lower to moderate professional skills before the intervention. This distribution reflects significant variation in the skill levels among the control group.

Following the intervention, the Wright map reveals a noticeable shift in person's scores towards higher values, though some remain at lower skill levels. This shows that despite the general improvement in professional skills, some prospective Physics teachers did not achieve the expected level of progress. Nevertheless, the overall shift suggests that the intervention had a positive impact, albeit not uniformly across all participants.



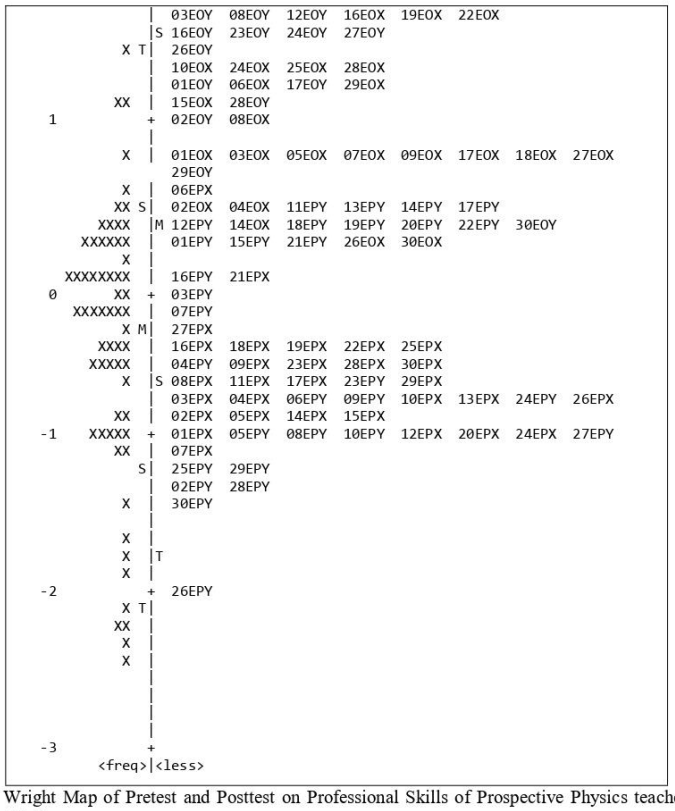


Figure 2. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group reveals a more pronounced difference between the pretest and posttest scores compared to the control group. While the item and person measures in the experimental group are also spread across a wide range, there is a higher concentration of scores at the upper end after the intervention. This indicates that a greater number of prospective Physics teachers in the experimental group demonstrated significant improvements in professional skills [32].

In the pretest, persons such as 11EOY had high professional skills prior to the intervention. However, after the intervention, a substantial increase in measure values was observed for many persons, with some achieving higher measure values than before, including 29EOX and 30EOY. These results suggest that the competency development

program implemented in the experimental group was more effective in enhancing the professional skills of prospective Physics teachers compared to the control group [33].

This Wright map indicates that the intervention applied to the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group demonstrates the effectiveness of the competency development program. The significant difference in score distribution between these two groups reinforces that the approach applied in the experimental group was more successful in enhancing the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in enhancing the pedagogical skills of prospective Physics teachers, statistical analyses were carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare the distribution of scores between the experimental group, which received the intervention, and the control group, which did not [34]. This test allowed us to determine whether significant differences in pedagogical skills existed between the two groups. On the other hand, the Wilcoxon test was used to assess within-group changes over two time points—before and after the intervention [35]. Together, these analyses provided a comprehensive understanding of the impact of the intervention on the development of pedagogical skills in prospective Physics teachers. The results of both statistical tests are presented in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pretest	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Posttest	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 5. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pretest	Posttest	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) reveal a statistically significant difference in the pretest ($U=1274.500$, $p < 0.05$) and posttest ($U=421.500$, $p < 0.05$) results between the experimental and control groups of prospective Physics teachers. The Mann-Whitney test, a non-parametric statistical method for comparing two independent groups, demonstrates that the intervention applied to the experimental group led to a significant

improvement in pedagogical skills compared to the control group. The significant results suggest that the targeted intervention had a tangible positive impact on the pedagogical development of the experimental group.

The Wilcoxon test results (Table 5) further support these findings by revealing a significant difference between the pretest and posttest scores for prospective Physics teachers in both the experimental group ($Z=-6.729$, $p < 0.05$) and the control group ($Z =-2.721$, $p < 0.05$). As a non-parametric statistical method, the Wilcoxon test is used to compare two sets of paired data: the pretest and posttest results from the same individual. These results indicate that there was a significant increase in pedagogical skills following the intervention in both groups. However, the increase in the experimental group was higher than in the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. The greater gains in the experimental group underscore the effectiveness of the intervention. The higher pedagogical skills in the experimental group indicate that the training program or method was successful in significantly increasing the pedagogical competence of prospective Physics teachers. These findings highlight the critical importance of structured and sustainable training programs to elevate the quality of teaching and teacher professionalism [36]. Through appropriate and evidence-based approaches, pedagogical skill development can make a significant positive impact on improving the overall education quality [37].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual representation of the distribution of participants' abilities and the difficulty of the test items. This facilitates the identification of changes in skill levels before and after the intervention. The Wright Map analysis was conducted on pretest and posttest data on the pedagogical skills of prospective Physics teachers in both the control and experimental groups. Interpreting these results is crucial for determining the effectiveness of the implemented interventions. The following detailed analysis of the Wright Map for the pretest and posttest of the pedagogical skills provides insights into the improvements or changes in pedagogical abilities after the intervention. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.

```
MEASURE Item - MAP - Person
          <rare>|<more>
    2           +  02COY
                |
                |  01COY  05COY
                |
                |T 03COY  06COY
              X T|
                |  04COY  27COY
                |
                |
                |
                |
                |  02COX  03CPY  05COX  24COX  26CPX
    1         X +S
          XXXXX |  01COX  04CPY  06COX  07COY  13COX  22CPY  25COX  26COX  27CPX
                   27CPY
             XX |  03COX  03CPX  06CPY  15COX  22CPX  24COY  25CPX  26CPY  27COX
                   28COX  28COY  28CPX  28CPY
             XX S|
              X |  02CPX  04COX  04CPX  05CPY  15CPY  22COX  24CPX  24CPY
                |  05CPX  06CPX  07COX  07CPX  15CPX  25COY  25CPY  26COY
              X |
              X |  01CPX  13CPX  13CPY  20COX  20COY  23COY  23CPX  23CPY
             XX |M 15COY  17COX
             XX |  07CPY  16CPY  18COX  19CPY  23COX
              X |
              X |  02CPY  08COX  08COY  12COY  14CPX  14CPY  17CPX  17CPY  19COX
                   20CPX  20CPY  21COX
                |  18CPY  19CPX
    0        XX M+ 01CPY  16COY  16CPX  17COY  18CPX  22COY  29COX  29COY  29CPX
                   29CPY  30COX  30COY  30CPX  30CPY
             XX |  12COX  12CPX  12CPY  14COX  16COX
             XX |
            XXX |  08CPX  09COY  21CPX  21CPY
              X |S 10COY
              X |  19COY
                |
             XX |  21COY
              X |  08CPY  11COY
            XXX |  09COX  09CPY  10CPY  11CPY  13COY  14COY  18COY
                S|
                |  10COX  10CPX
   -1        XX +T
              X |
                |  09CPX
                |
                |  11COX  11CPX
              X |
                |
              X |
              X T|
              X |
                |
                |
                |
   -2         X +
          <freq>|<less>
```

Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group

```
MEASURE Item - MAP - Person
          <rare>|<more>
    4           +  17EOY  18EOY
                |
                |
                |
                |
                |
                |  17EOX  18EOX  19EOY  26EOY
```

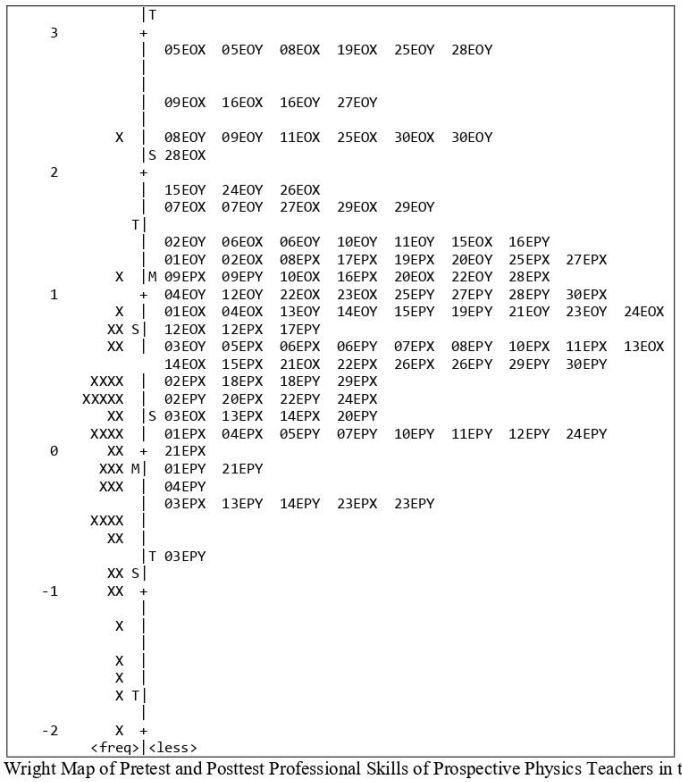


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest of pedagogical skills in both the control and experimental group offers a detailed visualization of ability distribution and item difficulty. In the Wright Map of the control group, the distribution of persons and items revealed that the pedagogical skills of the majority of prospective Physics varied, with some items proving to be more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY occupied higher positions, indicating better pedagogical skills, while the remaining were dispersed along the scale, with the majority clustered around the middle of the scale (measure=1), signifying moderate variability in pedagogical abilities. This distribution highlights the diversity in pedagogical competency within the control group and suggests that certain test items presented notable difficulties for the prospective Physics teachers.

In contrast, the distribution of persons and items in the Wright Map for experimental group showed a more significant increase in pedagogical skills after the

intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX were at higher measures (measure=3 and 4), signifying that the intervention effectively enhanced their pedagogical skills. A larger number of participants from the experimental group are positioned at higher levels compared to those in the control group, indicating the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers. Although certain items remain challenging for many participants, the overall distribution reflects that persons in the experimental group demonstrated superior abilities compared to those in the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group resulted in significantly greater improvements in the pedagogical skills of prospective Physics teachers compared to the control group [38]. The Wright Map provides a clear visualization of both ability distribution and item difficulty, providing valuable insights into the effectiveness of the intervention. These results underscore the importance of structured and evidence-based training programs to enhance the pedagogical quality of prospective Physics teachers [39].

3.2. Discussion

3.2.1. Professional Skills of Prospective Physics Teachers

Professional skills are an integral aspect for prospective Physics teachers, equipping them to meet the demands of their future teaching roles. These skills extend beyond mastery of academic materials, encompassing the ability to adapt to diverse work environments, engage effectively with students, and manage classroom dynamics [40], [41]. A prospective Physics teacher with strong professional skills can employ innovative teaching strategies, administer fair and objective assessments, and foster positive relationships with students, colleagues, and other educational stakeholders [42], [43].

Moreover, professional skills are reflected in a teacher's commitment to continuous learning and self-development, whether through additional training, workshops or independent study. This capacity enables prospective teachers to incorporate the latest advancements in education into their teaching practices, ultimately enhancing the quality of student learning experiences [5], [44]. The evaluation aspect of these professional skills often involves the use of measurement tools, such as validity and reliability tests, alongside competency mapping, to assess the degree to which prospective Physics teachers have met the required standards in their field [45].

Academically, the professional skills of prospective Physics teachers can be assessed using various indicators, such as test scores, peer evaluations, and their ability to design and implement effective learning strategies [46]. The development of these skills is crucial not only for enhancing teaching effectiveness but also for fostering an inclusive learning environment that supports the intellectual and emotional growth of students.

3.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers serve as the foundation of their ability to effectively convey subject matter, fostering both interest and comprehension among students [47]. Key components of these skills encompass the ability to design a curriculum that aligns with educational standards, select apptopriate teaching methods to accommodate students' diverse learning styles, and adeptly utilize educational technology and other resources throughout the learning process [48].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning objectives [49]. By developing robust pedagogical skills, prospective Physics teachers can become effective agents of change, enhancing the quality of education within their communities and preparing future generations with relevant knowledge and skills needed to navigate global challenges [50], [51], [52].

The assessment of pedagogical skills typically encompasses direct classroom observations, analyses of instructional plans, and evaluations of portofolios that demonatrate success in meeting educational objectives [53], [54], [55]. By cultivating strong pedagogical skills, prospective Physics teachers can serve as effective agents of change in improving the quality of education in their communities and equipping future generations with knowledge and skills relevant to address global challenges [56], [57], [58].

4. CONCLUSION

This study demonstrated a significant difference between the pretest and posttest results for both experimental and control groups, highlighting the effectiveness of the intervention in enhancing the teaching preparation of prospective Physics teachers. The Wright's map analysis of pedagogical skills indicated that the experimental group experienced a more regular and significant increase than the control group, suggesting that the intervention program had a positive and consistent impact on the development of teaching skills. This study contributes to the existing literature on the development of prospective Physics teachers by showing that a specifically designed intervention program

can significantly improve pedagogical skills. Additionally, the application of Wright Map analysis—an approach that is relatively rare in educational research in Indonesia— serves as a tool for deeper evaluation of teaching skill development.

Based on these findings, it is recommended that educational practitioners consider implementing similar intervention programs to enhance the quality of teacher preparation across various regions. This program can serve as a model for developing pedagogical skills among prospective Physics teachers in Indonesia. In addition, practitioners should continuously evaluate the program's effectiveness, allowing for necessary adaptations and improvements that align with local needs and evolving global challenges.

Further research is needed to evaluate the program's success on a national scale, considering the limited number of research subjects that do not fully represent all regions of Indonesia. Therefore, this study not only provides novel insights into improving teaching quality, but also encourages further discussion regarding the implementation of broader intervention programs.

ACKNOWLEDGEMENTS

We would like to express our gratitude toward Universitas Ahmad Dahlan for their support and funding of this work under the supported proffesorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, "The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States," *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, "Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States," *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, "The Human Teacher, the AI Teacher and the AIed-Teacher Relationship," *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, "Pedagogies of embodiment in physical education – a literature review," *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, "Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy," *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, "Indonesian teacher performance: Professional and Character," *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. Hidayat, 'Developing and validating a Technological Pedagogical Content Knowledge (TPACK) instrument for secondary Physics preservice teachers in Indonesia', *Unnes Sci. Educ. J.*, vol. 8, no. 1, pp. 31–40, 2019, doi: 10.15294/usej.v8i1.23087.

[15] R. Pribudhiana, Y. Bin Don, and M. R. Bin Yusof, 'Determining the influence of teacher quality toward teacher readiness in implementing Indonesian education policy', *Eurasian J. Educ. Res.*, vol. 93, pp. 373–390, 2021, doi: 10.14689/ejer.2021.93.18.

[16] N. Sulaeman, S. Efwinda, and P. D. A. Putra, 'Teacher readiness in STEM education: Voices of Indonesian Physics teachers', *J. Technol. Sci. Educ.*, vol. 12, no. 1, pp. 68–82, 2022, doi: https://doi.org/10.3926/jotse.1191.

[17] F. Novitra, 'Networked-based inquiry: An effective Physics learning in the new normal Covid-19 era in Indonesia', *Int. J. Instr.*, vol. 15, no. 2, pp. 997–1016, 2022, doi: https://doi.org/10.29333/iji.2022.15255a.

[18] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, "The Effects of Students' Perception of the School Environment and Students' Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[19] G. B. Gudmundsdottir and O. E. Hatlevik, "Newly qualified teachers' professional digital competence: implications for teacher education," *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[20] D. Ramandanis and S. Xinogalos, "Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review," *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[21] P. S. Lisenbee and C. M. Ford, "Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children's Experiences," *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[22] T. Lin, T. Chen, J. Liu, and X. M. Tu, "Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks," *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[23] Y. Fong and Y. Huang, "Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null," *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[24] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, "An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome," *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[25] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, "Wright-Map to investigate the actual abilities on math test of elementary students," *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[26] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, "The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia," *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

[27] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, "Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being," *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[28] S. Handayani, L. Peddell, and T. Yeigh, "Participants' Experiences in Heutagogy Teacher Professional Education in Indonesia," *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[29] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, "The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians," *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[30] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, "A Wilcoxon-Mann-Whitney spatial scan statistic for functional data," *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[31] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, "A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[32] F. J. Rodríguez Muñoz, "Pretest and structural analysis of the pragmatic awareness questionnaire destined to teachers' communicative instruction," *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[33] M.-Y. Chen, S.-M. Huang, and W. Chou, "Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19," *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[34] L. Mao, "Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance," *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[35] R. Wilcox, "Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions," *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[36] M. Mawarto, W. Widodo, and S. Sulistiasih, "The Antecedence of Teacher's Professional Performance: Evidence from Indonesia," *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[37] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, "The professional development of higher education-based teacher educators: needs and realities," *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[38] Y. Cheng, W. Jia, R. Chi, and A. Li, "A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing," *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[39] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, "Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling," *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[40] L. Lukman *et al.*, "Effective teachers' personality in strengthening character education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[41] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, "The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches," *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[42] A. H. Abdulrazzaq, "Teacher Appraisers' Perceptions of Teacher Appraisal," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[43] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, "Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement," *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[44] N. Ishartono *et al.*, "The Role of Instructional Design in Improving Pre-Service and In-Service Teacher's Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[45] M. A. Flores, "Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education," *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[46] H. T. Yusuf, "Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[47] M. Mu'arifin and B. S. Narmaditya, "Professional development program for physical education teachers in Indonesia," *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[48] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, "Makerspaces in early childhood education: Principles of pedagogy and practice," *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[49] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, "Community-based teacher professional development in remote areas in Indonesia," *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[50] Rusdiana, "Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif," 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[51] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[52] J. M. Ramdani and X. (Andy) Gao, "Exploratory practice for teacher professional development in Indonesia," *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[53] M. Portuguez Castro and M. G. Gómez Zermeño, "Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education," *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[54] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[55] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in Physics education', in *The international handbook of Physics education research: Teaching Physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[56] T. Karakose *et al.*, 'Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling', *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

[57] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[58] I. Setianingrum and A. Da Costa, 'Mapping research on Indonesian professional teacher: The bibliometric analysis', *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

BIOGRAPHIES OF AUTHORS

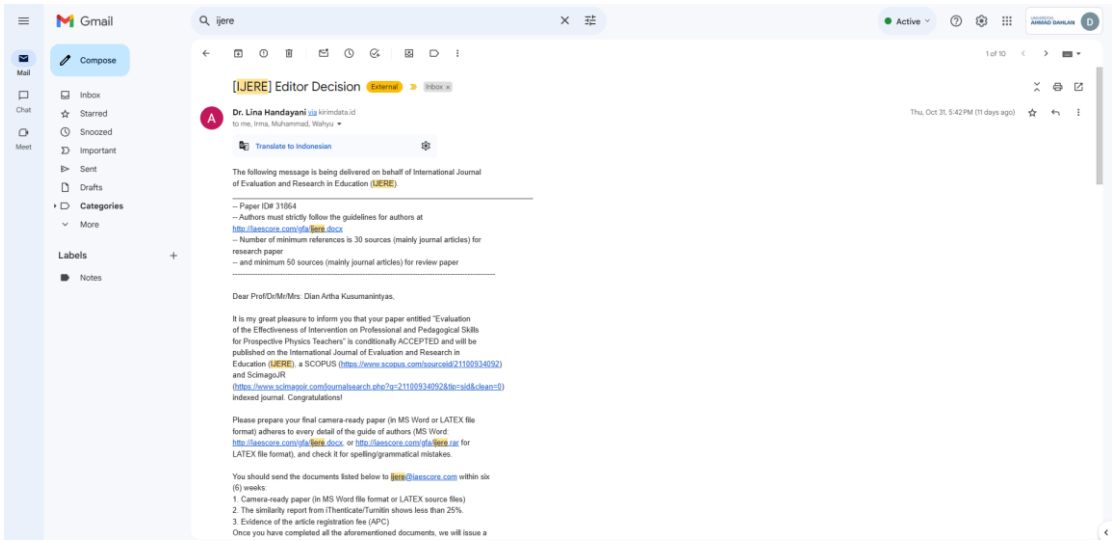
Dian Artha Kusumaningtyas is a senior lecturer in the Physics Education Program at Universitas Ahmad Dahlan in Yogyakarta, where she also serves as the Program Coordinator for Character Education and as an Academic Advisor. With a strong commitment to enhancing educational practices, Dian's research interests focus on science learning, learning assessment, and the development of schools in suburban areas. For inquiries or potential collaborations, she can be reached at (email: dian.artha@pfis.uad.ac.id)

Moh Irma Sukarelawan is an Assistant Professor at Universitas Ahmad Dahlan, in the Department of Physics Education within the Faculty of Teacher Training and Education. He obtained his Doctoral degree in Educational Science from the Graduate School of Universitas Negeri Yogyakarta (UNY) in 2023. His research interests encompass Physics education, misconceptions, metacognition, and Rasch modeling. For inquiries or collaborations, he can be reached at irma.sukarelawan@pfis.uad.ac.id

Muhammad Syahriandi Adhantoro is an information technology enrhusiast who has created various works in the field of education, including educational games and learning information systems. He has a keen interest in Educational Informatics research. For inquiries or collaborations, he can be reached at m.syahriandi@ums.ac.id

Wahyu Nanda Eka Saputra is a Ph.D. and Lecturer at the Department of Guidance and Counseling, Universitas Ahmad Dahlan. ndonesia. His research interests include peace education, counseling intervention strategies, counseling based on local wisdom, and counseling through creative arts. For inquiries or collaboration, he can be contacted at wahyu.saputra@bk.uad.ac.id.

8.Bukti konfirmasi hasil review keempat dan artikel yang diresubmit (31 Oktober 2024)


Gmail
ijere
Active
Compose
Inbox
Starred
Snoozed
Important
Sent
Drafts
Categories
More
Labels
Notes
[IJERE] Editor Decision
External
Inbox ×
Dr. Lina Handayani via kirimdata.id
to me, Irma, Muhammad, Wahyu
Thu, Oct 31, 5:42 PM (11 days ago)
Translate to Indonesian
The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).
-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/ofa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper
Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,
It is my great pleasure to inform you that your paper entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" is conditionally ACCEPTED and will be published on the International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ScimagoJR (https://www.scimagojr.com/journalsearch.php?q=21100934092&tip=sid&clean=0) indexed journal. Congratulations!
Please prepare your final camera-ready paper (in MS Word or LATEX file format) adheres to every detail of the guide of authors (MS Word: http://iaescore.com/ofa/ijere.docx, or http://iaescore.com/ofa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.
You should send the documents listed below to ijere@iaescore.com within six (6) weeks:
1. Camera-ready paper (in MS Word file format or LATEX source files)
2. The similarity report from iThenticate/Turnitin shows less than 25%.
3. Evidence of the article registration fee (APC)
Once you have completed all the aforementioned documents, we will issue a

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Editor Decision

2 messages

Dr. Lina Handayani <ijere@iaescore.com> Thu, Oct 31, 2024 at 5:42 PM
Reply-To: "Dr. Lina Handayani" <ijere@iaesjournal.com>
To: Dian Artha Kusumanintyas <dian.artha@pfis.uad.ac.id>
Cc: Irma Sukarelawan <irma.sukarelawan@pfis.uad.ac.id>, Muhammad Syahriandi Adhantoro <m.syahriandi@ums.ac.id>, Wahyu Nanda Eka Saputra <wahyu.saputra@bk.uad.ac.id>

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID# 31864
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper

---

Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumanintyas,

It is my great pleasure to inform you that your paper entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" is conditionally ACCEPTED and will be published on the International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100934092) and ScimagoJR (https://www.scimagojr.com/journalsearch.php?q=21100934092&tip=sid&clean=0) indexed journal. Congratulations!

Please prepare your final camera-ready paper (in MS Word or LATEX file format) adheres to every detail of the guide of authors (MS Word: http://iaescore.com/gfa/ijere.docx, or http://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.

You should send the documents listed below to ijere@iaescore.com within six (6) weeks:
1. Camera-ready paper (in MS Word file format or LATEX source files)
2. The similarity report from iThenticate/Turnitin shows less than 25%.
3. Evidence of the article registration fee (APC)
Once you have completed all the aforementioned documents, we will issue a certificate of acceptance (CoA).

I look forward to hearing from you.

Thank you

Best Regards,
Dr. Lina Handayani
ijere@iaesjournal.com

URGENT!! Pay attention to the following instructions carefully! YOU MUST DO!!

1). PLEASE ADHERE STRICTLY THE GUIDE OF AUTHORS

http://iaescore.com/gfa/ijere.docx (Use this file as your paper template!!) and pay attention to the checklist for preparing your FINAL paper for publication:
http://ijere.iaescore.com/index.php/IJERE/about/editorialPolicies#custom-2

2). It is mandatory to present your final paper according to "IMRADC style" format, i.e.:
1. INTRODUCTION
2. The Proposed Method/Framework/Procedure specifically designed (optional)
3. METHOD
4. RESULTS AND DISCUSSION
5. CONCLUSION
See http://iaescore.com/gfa/ijere.docx

3). Add biographies of authors as our template (include links to the 4 authors' profiles, do not delete any icons in the template).
--> Provide links for all authors to the 4 icons (Scholar, Scopus, Publons and ORCID). It is mandatory!! See http://iaescore.com/gfa/ijere.docx

4). Use different PATTERNS for presenting different results in your figures/graphics (instead of different colors). It is mandatory!! See http://iaescore.com/gfa/ijere.docx

5). Please ensure that all references have been cited in your text. Use a tool such as EndNote, Mendeley, or Zotero for reference management and formatting, and choose IEEE style. Each citation should be written in the order of appearance in the text in square brackets. For example, the first citation [1], the second citation [2], and the third and fourth citations [3], [4]. When citing multiple sources at once, the preferred method is to list each number separately, in its own brackets, using a comma or dash between numbers, as such: [1], [3], [5]. It is not necessary to mention an author's name, pages used, or date of publication in the in-text citation [6]-[8]. Instead, refer to the source with a number in a square bracket, e.g. [9], that will then correspond to the full citation in your reference list. Examples of in-text citations:
This theory was first put forward in 1970 [9].
Zadeh [10] has argued that ...
Several recent studies [7], [9], [11]-[15] have suggested that....
... end of the line for my research [16].

6). Please present all references as complete as possible and use IEEE style (include information of DOIs, volume, number, pages, etc). If it is available, DOI information is mandatory!! See http://iaescore.com/gfa/ijere.docx

---

Each accepted paper is charged USD 355 to help cover some of the publication costs. This fee covers the standard eight-page manuscript (including the list of references but excluding the authors' biographies), and any published manuscript that exceeds eight pages will incur an additional fee of USD 50 per page. For USD to IDR currency conversion, Indonesian authors should use xe.com.

The payment should be made by bank transfer (T/T):

Bank Account name/Beneficiary (please be exact): LINA HANDAYANI
Bank Name: CIMB NIAGA Bank
Branch Office: Kusumanegara Yogyakarta
City: Yogyakarta
Country: Indonesia
Bank Account: 760164155700
SWIFT Code: BNIAIDJAXXX

or as alternative, you can pay by using PayPal to email:
info@iaesjournal.com

IMPORTANT!!!
- Within 6 weeks, send your payment evidence (along with your camera-ready paper and a similarity report from iThenticate/Turnitin that is less than 25%) to ijere@iaescore.com.
- All correspondence should be addressed to the email addresses (phone support is not available).

International Journal of Evaluation and Research in Education (IJERE)
http://ijere.iaescore.com

International Journal of Evaluation and Research in Education (IJERE)
Vol. 99, No. 1, Month 2099, pp. 1~1x
ISSN: 2252-8822, DOI: 10.11591/ijere.v99i1.paperID

Evaluating the effectiveness of intervention on professional and pedagogical skills among prospective Physics teachers

Dian Artha Kusumaningtyas[1*], Irma Sukarelawan[2], Muhammad Syahriandi Adhantoro[2], Wahyu Nanda Eka Saputra[3]
[1] Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia
[2] Department of Master of Informatics, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Indonesia
[3] Department of Guidance and Counseling, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan, Indonesia

Article Info

Article history:

Received mm dd, yyyy
Revised mm dd, yyyy
Accepted mm dd, yyyy

Keywords:

Professional skills
Pedagogical skills
Teacher competency
Mann-Whitney test
Wilcoxon test

ABSTRACT

This study evaluates the effectiveness of a targeted intervention designed to enhance the professional and pedagogical skills of prospective Physics teachers, addressing a key gap in teacher education. The research involved an experimental group that reveived the intervention and a control group that did not. The research subjects in the experimental and control groups were 120 each. To rigorously assess the impact, Whitney and Wilcoxon's statistical tests were employed to compare pretest and posttest outcomes. Additionally, Wright map analysis was used to visualizes kill development. The results revealed a significant improvement in the professional and pedagogical skills of the experimental group compared to the control group, as indicated by Mann-Whitney test ($U=1274.500$, $p < 0.05$ and $U=421.500$, $p < 0.05$). The Wright map analysis further demonstrated that the experimental group experienced more consistent and substantial gains in pedagogical skills. This study contributes to the field by demonstrating the effectiveness of interventions in improving the skills of prospective Physics teachers, offering educational policy recommendations, and filling important gaps in the literature. Moreover, it emphasizes the critical role of ongoing evaluation in the continuous development of teacher training programs. By addressing these areas, this research provides valuable insights that can inform the design and implementation of more effective teacher training strategies.

Corresponding Author:

Dian Artha Kusumaningtyas
Department of Physics Education, Faculty of Teacher Training and Education, Universitas Ahmad Dahlan
Jl. Ringroad Selatan, Kragilan, Tamanan, Kec. Banguntapan, Kabupaten Bantul, Daerah Istimewa Yogyakarta 55191
Email: dian.artha@pfis.uad.ac.id

1. INTRODUCTION

In Indonesia, teacher professional development continues to face various challenges, including limited access to quality training, lack of incentives, and inadequate facilities. Teacher professional development in Indonesia often focuses on improving pedagogical, personality, professional, and social skills [1], [2], [3]. In contrast, in developed countries such as Finland, Singapore, and the United States, teacher professional development is carried out systematically and continuously [4], [5], [6]. Singapore has a robust mentoring system in which junior teachers receive guidance from experienced senior educators [7]. Many schools in the U.S. allocate time and resources for teachers to engage in professional development, including teacher-to-teacher collaboration and school-based initiatives [8], [9].

While Indonesia has implemented efforts to enhance teacher competencies, considerable enhancements are still required regarding accessibility, continuity, and support. Experiences from developed countries show that sustainable investment in teacher professional development is essential to achieve high-quality education and become an inspiration for improving the system in Indonesia [10]. A teacher's pedagogical and professional skills serve as the fundamental basis in education [11]. Pedagogical skills encompass the teacher's ability to design, implement, and evaluate learning processes that are adaptive and responsive to student needs [12]. Professional skills include in-depth knowledge of subject matter, professional ethics, and the ability to innovate in teaching [13]. Without these skills, a teacher may struggle to effectively deliver content, facilitate constructive discussions, and foster critical thinking skills in students.

Physics teacher professional education in Indonesia currently faces major challenges in enhancing teachers' pedagogical and professional competence. Recent studies indicate that many Physics teachers in Indonesia struggle with mastering innovative, technology-based learning methods and integrating Physics concepts into everyday life [14]. In addition, ever-changing education policies complicate teachers' efforts to adapt to dynamic national curriculum standards [15]. hile teacher professional education programs are in place, the lack of ongoing training and periodic performance evaluations has hindered the improvement of teaching quality [16]. Furthermore, there is an urgent need to enhance professional skills, particularly in the use of laboratories and digital learning tools, to support more effective Physics instruction in the digital age [17]. Therefore, a

comprehensive reform of the teacher professional curriculum along with targeted infrastructure and training improvement is mandatory.

When teachers lack sufficient pedagogical and professional skills, significant challenges can arise. Students may experience difficulties in understanding lesson material, resulting in low learning outcomes and motivation [18], [19]. Therefore, improving teachers' pedagogical and professional competence is imperative to ensure high-quality education and optimal academic achievement for students [20]. The novelty of this research lies in its evaluative approach to assessing the effectiveness of teacher pedagogical and professional competency development programs. This research compares the pedagogical and professional skills of prospective Physics teachers who have participated in a professional teacher education program with those who have not [21]. This research is expected to provide a clear picture of the impact of improved teacher competence on the transformation of education in Indonesia. Additionally, the results of this research may serve as a foundation for policymakers in designing more effective and sustainable strategies for teacher professional development.

2. METHOD

This research employed a quantitative approach to evaluate the effectiveness of a pedagogical and professional competency development program for prospective Physics teachers. This research involved two groups: an experimental group (n= 120) and a control group (n= 120). The experimental group comprised prospective Physics teachers from two Educational Personnel Education Institutes (LTPK) that offer Teachers Professional Education (PPG) in Physics Education and participated in a competency development program. On the other hand, the control group consisted of prospective Physics teachers from the same two LTPKs who had not participated in the program. The involvement of control and experimental groups along with random group division was aimed at enhancing the internal validity of the experimental results.

Data collection was carried out using a pretest and posttest to measure the pedagogical and professional skills of prospective teachers. These tests were adminitered both before and after the implementation of the competency development program. Data collection instruments in this research were pedagogical and professional tests, each comprising 45 items. The instruments demonstrated both validity and reliability, indicating their effectiveness in measuring the intended skills. The validity for the pedagogical test ranged from 0.321 to 0.65,1 while those for the professional test ranged from 0.351 to

0.541. The reliability of the pedagogical test was 0.931, and that of the professional test was 0.891, both falling within the very good category.

The Mann-Whitney test was carried out to determine whether significant differences existed between the two independent groups: the experimental group and control group [22]. Additionally, the Wilcoxon test was utilized to test changes in two paired sets of data, namely pretest and posttest scores in groups, to assess whether there was a significant increase in teachers' pedagogical and professional skills after participating in the development program [23], [24]. Following the Mann-Whitney test and Wilcoxon test, the teacher's abilities in the pretest and posttest were visualized using the Wright map [24]. This visualization tool allows a clear visualization of the enhancement in teachers' pedagogical and professional competence after their participation in the development program [25].

3. RESULTS AND DISCUSSION

3.1. RESULTS

Professional and pedagogical skills are two critical aspects of the teaching profession and play an important role in enhancing the quality of education [26]. Professional competence includes in-depth knowledge of subject matter, the ability to design relevant and engaging learning experiences, and proficiency in using technology and other supporting resources [27]. Teachers with good professional skills can deliver material comprehensively and inspire students to engage in independent learning. Table 1 presents the results of the identification of professional and pedagogical skills.

Table 1. Fit Statistics of Professional Skills and Pedagogical Skills

	Professional Skills		**Pedagogical Skills**	
	Item	**Person**	**Item**	**Person**
Mean	0.00	0.36	0.00	0.82
Measure	-1.89 - 1.61	-1.62 - 3.23	-2.73 - 1.20	-1.09 - 3.96
SD	0.69	0.97	0.68	0.88
Mean Outfit MnSq	1.02	-0.04	1.00	0.21
Mean Outfit ZStd	0.06	1.02	-0.11	0.92
Separation	4.42	3.07	4.17	2.10
Reliability	0.95	0.90	0.95	0.81
Cronbach alpha	**0.91**		**0.81**	

The results of the statistical fit test for professional and pedagogical skills, as shown in Table 1, indicate a high level of quality based on various statistical indicators. The average values (mean) for items and persons are 0.00 and 0.36, respectively, reflecting a balanced distribution of values across the measured abilities. The range of measures for items spans from -1.89 to 1.61, while that for persons is from -1.62 to 3.23,

demonstrating that this instrument effectively measures wide-scope variations in abilities. The standard deviations for items (0.69) and for persons (0.97) suggests relatively consistent variations in the level of expertise assessed. The Mean Outfit MnSq index for items is 1.02 and for persons, it is -0.04. The Mean Outfit ZStd is 0.06 for items and 1.02 for persons, indicating that the data from this instrument is in accordance with the expected model and does not exhibit any significant deviations. Additionally, the Separation values for items and persons are 4.42 and 3.07, respectively, demonstrating the instrument's effectiveness in distinguishing between different levels of ability. The high reliability of the instrument is further supported by a Cronbach's alpha value of 0.91 for items and 0.90 for persons, confirming its consistency in accurately measuring the professional skills of prospective Physics teachers.

The instrument for measuring the pedagogical skills of prospective Physics teachers demonstrates high quality, as indicated by the results of the statistical analysis. The average values (mean) for item and person measures are 0.00 and 0.82, respectively, reflecting a balanced distribution of values with a positive tendency in the measured abilities. The range of items spans from -2.73 to 1.20, while the range for persons is from -1.09 to 3.96, indicating that this instrument effectively measures a broad spectrum of abilities. The standard deviation for items (0.68) and for persons (0.88) suggest consistent variation in the levels of expertise assessed. The Mean Outfit MnSq index for items is 1.00 and for persons, it is 0.21, while the Mean Outfit ZStd is -0.11 for items and for 0.92 persons, showing that the data from this instrument aligns well with the expected model and does not exhibit any significant deviations. The high separation values of 4.17 for items and 2.10 for persons demonstrate the instrument's ability to distinguish between differebt levels of pedagogical ability effectively. A good level of reliability is indicated by the Cronbach alpha value of 0.81 for items and 0.81 for persons, suggesting that this instrument can be relied on to measure the pedagogical skills of prospective Physics teachers accurately and consistently.

3.1.1. Differences on Professional Skills Abilities of Prospective Physics Teachers

To evaluate the effectiveness of the pedagogical and professional competence development program for prospective Physics teachers, statistical analyses were performed on the pretest and posttest data from the experimental and control groups [28]. The goal of these analyses was to determine whether there were significant differences in skill improvement following the intervention. The Mann-Whitney test was used to compare the

score distributions between two unpaired groups, the experimental and control groups, both before (pretest) and after (posttest) the intervention [29]. The Wilcoxon test was applied to examine changes in pretest and posttest scores within each group, ensuring that any observed improvements in skills were statistically significant [30]. The results of this statistical analysis offer valuable insights into the impact of the competence development program on enhancing the professional skills of prospective Physics teachers. The results of this analysis are presented in Table 2 and Table 3.

Table 2. Mann-Whitney U Test Results on Professional Skills in Experimental and Control Groups ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pretest	-0.17 (-1.52 – 0.90)	-0.40 (-1.62 – 0.90)	**1347.500**	**0.017**
Posttest	1.65 (0.59 – 3.23)	0.36 (-0.74 – 1.62)	**183.500**	**0.000**

Table 3. Wilcoxon Test Results on Professional Skills in Experimental and Control Groups ($P < 0.05$)

Group	Pretest	Posttest	Z	p
Experimental	-0.17 (-1.52 – 0.90)	1.65 (0.59 – 3.23)	**-6.736**	**0.000**
Control	-0.40 (-1.62 – 0.90)	0.36 (-0.74 – 1.62)	**-6.435**	**0.000**

The results of statistical analysis using the Mann-Whitney test, presented in Table 2, indicate a statistically significant difference between the pretest and posttest scores of the prospective Physics teachers in the experimental and control groups. In the pretest results, the U value was 1347.500 ($p < 0.05$), suggesting a significant difference between the two groups before the intervention. After the intervention, the posttest results revealed a U value of 183.500 ($p < 0.05$), indicating that the intervention had a significant impact on improving the professional skills of the experimental group compared to the control group.

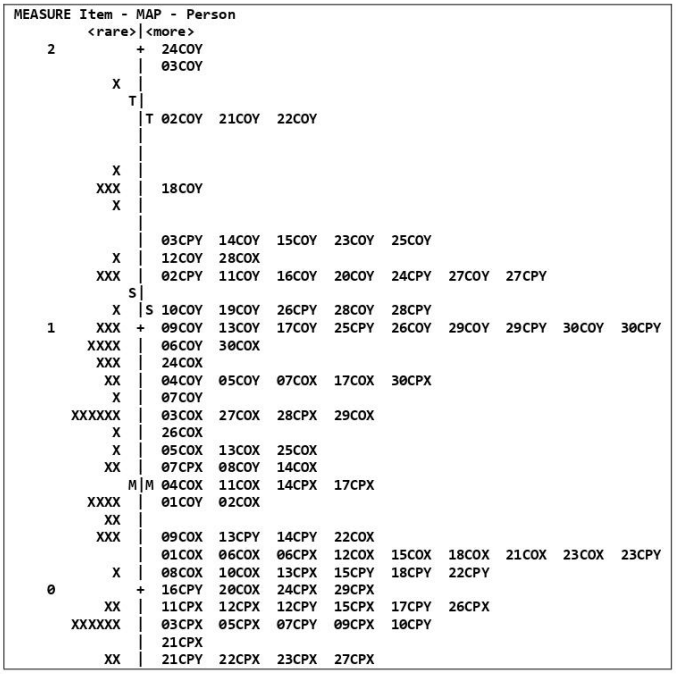
The Wilcoxon test results, as shown in Table 3, further supported the finding that there was a significant difference between the pretest and posttest results in both groups. In the experimental group, the Z-value was -6.736 ($p < 0.05$), and in the control group, the Z-value was -6.435, with the same p-value. These results indicated that there was a significant improvement in professional skills for prospective Physics teachers in both groups after the intervention.

However, the more pronounced significant difference observed in the experimental group indicates that the competency development program was more effective in enhancing the professional skills of prospective Physics teachers. The professional skills of the experimental group showed higher gains after the intervention than those of the control group. This underscores the positive impact of the competency development program on participants, highlighting its effectiveness in fostering teacher development. These findings

emphasize the importance of sustained competency development programs in improving teaching quality and advancing teacher professionalism.

3.1.2. Professional Skills of Prospective Physiscs Teachers Based on Control and Experimental Class

To evaluate the effectiveness of the professional skills development program for prospective Physics teachers, an in-depth analysis of the pretest and posttest data was conducted. One of the tools used for this analysis was the Wright map, which visualizes and compares the skill levels of prospective Physics teachers before and after the intervention [21]. The Wright map provides a clear depiction of the distribution of abilities both the control group and the experimental group. By mapping the pretest and posttest results of the two groups, significant differences in professional skill attainment between the groups could be identified. This analysis not only helps understand the distribution of abilities but also highlights the changes that occur after the intervention, offering a more comprehensive insight into the effectiveness of the implemented training program [31]. The results of this analysis for both the control and experimental groups are illustrated in Figures 1 and 2.



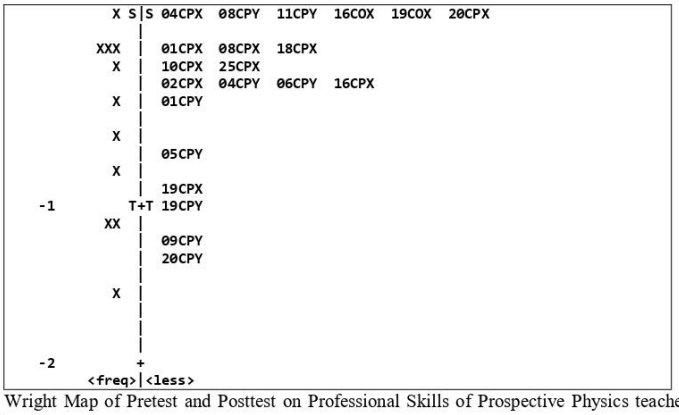
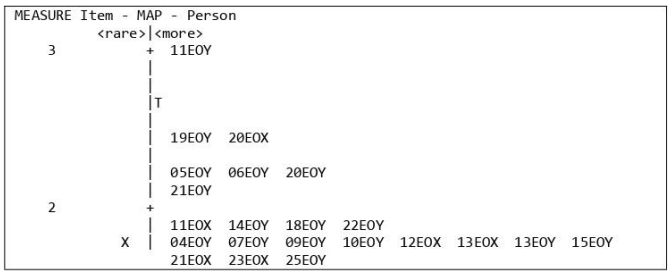


Figure 1. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Control Group

The Wright map for the control group (Figure 1) illustrates the distribution of pretest and posttest scores for the professional skills of prospective Physics teachers. The map shows that both items and people are distributed across a fairly wide range. Most values cluster around the means with some items and persons being less or more frequent than that value. For example, 24COY, which has the highest measure, indicates that only a few prospective Physics teachers demonstrated very high professional skills prior to the intervention. In contrast, there are many persons have measure values between -1 and 0, indicating lower to moderate professional skills before the intervention. This distribution reflects significant variation in the skill levels among the control group.

Following the intervention, the Wright map reveals a noticeable shift in person's scores towards higher values, though some remain at lower skill levels. This shows that despite the general improvement in professional skills, some prospective Physics teachers did not achieve the expected level of progress. Nevertheless, the overall shift suggests that the intervention had a positive impact, albeit not uniformly across all participants.



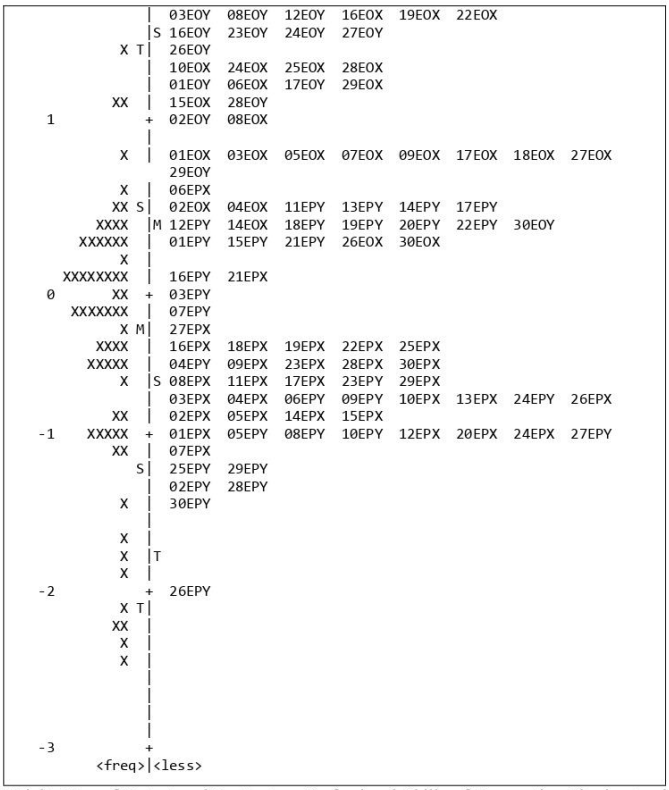


Figure 2. Wright Map of Pretest and Posttest on Professional Skills of Prospective Physics teachers in the Experimental Group

The Wright map for the experimental group reveals a more pronounced difference between the pretest and posttest scores compared to the control group. While the item and person measures in the experimental group are also spread across a wide range, there is a higher concentration of scores at the upper end after the intervention. This indicates that a greater number of prospective Physics teachers in the experimental group demonstrated significant improvements in professional skills [32].

In the pretest, persons such as 11EOY had high professional skills prior to the intervention. However, after the intervention, a substantial increase in measure values was observed for many persons, with some achieving higher measure values than before, including 29EOX and 30EOY. These results suggest that the competency development

program implemented in the experimental group was more effective in enhancing the professional skills of prospective Physics teachers compared to the control group [33].

This Wright map indicates that the intervention applied to the experimental group succeeded in improving professional skills significantly better than the control group. The distribution of higher scores and higher person concentration on measures after the intervention in the experimental group demonstrates the effectiveness of the competency development program. The significant difference in score distribution between these two groups reinforces that the approach applied in the experimental group was more successful in enhancing the professional skills of prospective Physics teachers.

3.1.3. Differences on the Pedagogical Skills of Prospective Physics Teachers

To understand the effectiveness of the intervention in enhancing the pedagogical skills of prospective Physics teachers, statistical analyses were carried out using two non-parametric tests: the Mann-Whitney test and the Wilcoxon test. The Mann-Whitney test was used to compare the distribution of scores between the experimental group, which received the intervention, and the control group, which did not [34]. This test allowed us to determine whether significant differences in pedagogical skills existed between the two groups. On the other hand, the Wilcoxon test was used to assess within-group changes over two time points—before and after the intervention [35]. Together, these analyses provided a comprehensive understanding of the impact of the intervention on the development of pedagogical skills in prospective Physics teachers. The results of both statistical tests are presented in Table 4 and Table 5.

Table 4. Mann-Whitney U Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Test	Experimental Group	Control Group	U	p
Pretest	0.64 (-0.72–1.68)	0.31 (-1.27–1.14)	1274.500	0.006
Posttest	1.90 (0.27–4.16)	0.48 (-1.29–2.12)	421.500	0.000

Table 5. Wilcoxon Test Results on Professional Skills of the Experimental and Control Group ($p < 0.05$)

Group	Pretest	Posttest	Z	p
Experimental	0.64 (-0.72–1.68)	1.90 (0.27–4.16)	**-6.729**	**0.000**
Control	0.31 (-1.27–1.14)	0.48 (-1.29–2.12)	**-2.721**	**0.006**

The results of the Mann-Whitney test (Table 4) reveal a statistically significant difference in the pretest ($U=1274.500$, $p < 0.05$) and posttest ($U=421.500$, $p < 0.05$) results between the experimental and control groups of prospective Physics teachers. The Mann-Whitney test, a non-parametric statistical method for comparing two independent groups, demonstrates that the intervention applied to the experimental group led to a significant

improvement in pedagogical skills compared to the control group. The significant results suggest that the targeted intervention had a tangible positive impact on the pedagogical development of the experimental group.

The Wilcoxon test results (Table 5) further support these findings by revealing a significant difference between the pretest and posttest scores for prospective Physics teachers in both the experimental group ($Z=-6.729$, $p < 0.05$) and the control group ($Z = -2.721$, $p < 0.05$). As a non-parametric statistical method, the Wilcoxon test is used to compare two sets of paired data: the pretest and posttest results from the same individual. These results indicate that there was a significant increase in pedagogical skills following the intervention in both groups. However, the increase in the experimental group was higher than in the control group.

Overall, these findings indicate that the pedagogical skills of prospective Physics teachers improved after the intervention. The greater gains in the experimental group underscore the effectiveness of the intervention. The higher pedagogical skills in the experimental group indicate that the training program or method was successful in significantly increasing the pedagogical competence of prospective Physics teachers. These findings highlight the critical importance of structured and sustainable training programs to elevate the quality of teaching and teacher professionalism [36]. Through appropriate and evidence-based approaches, pedagogical skill development can make a significant positive impact on improving the overall education quality [37].

3.1.4. Pedagogical Skills of Prospective Physics Teachers Based on Control Class and Experimental Class

This mapping of prospective Physics teachers' pedagogical skills provides a visual representation of the distribution of participants' abilities and the difficulty of the test items. This facilitates the identification of changes in skill levels before and after the intervention. The Wright Map analysis was conducted on pretest and posttest data on the pedagogical skills of prospective Physics teachers in both the control and experimental groups. Interpreting these results is crucial for determining the effectiveness of the implemented interventions. The following detailed analysis of the Wright Map for the pretest and posttest of the pedagogical skills provides insights into the improvements or changes in pedagogical abilities after the intervention. Analysis of the pedagogical skills of prospective Physics teachers in the control group and experimental group is illustrated in Figure 3 and Figure 4.

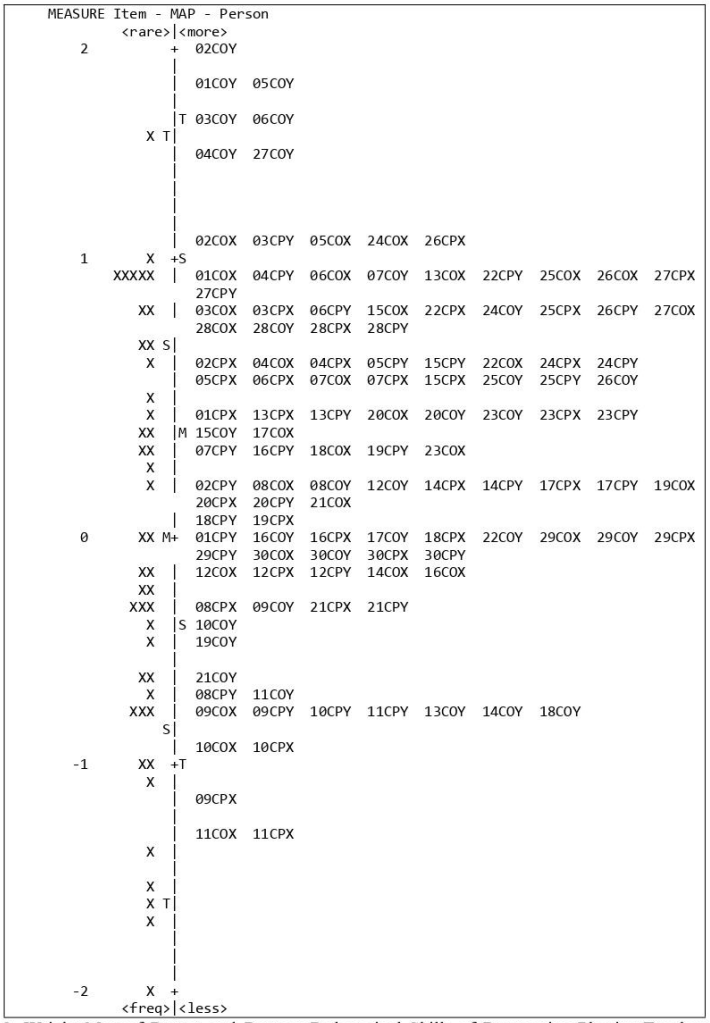
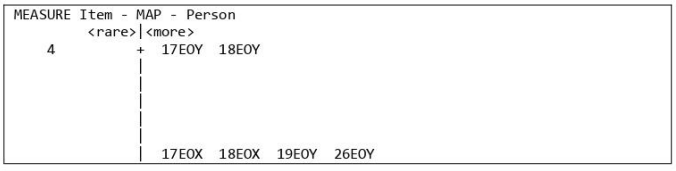


Figure 3. Wright Map of Pretest and Posttest Pedagogical Skills of Prospective Physics Teachers in the Control Group



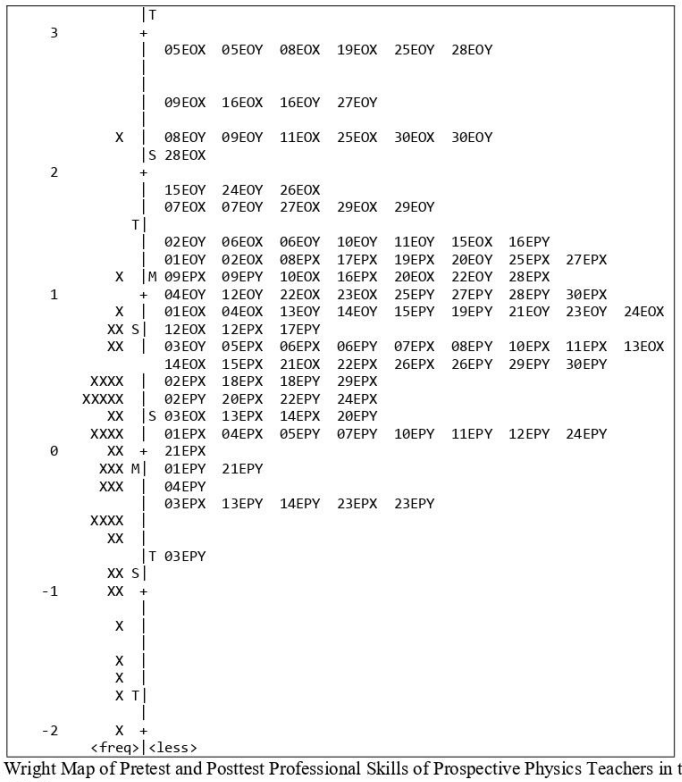


Figure 4. Wright Map of Pretest and Posttest Professional Skills of Prospective Physics Teachers in the Experimental Group

Wright Map analysis for pretest and posttest of pedagogical skills in both the control and experimental group offers a detailed visualization of ability distribution and item difficulty. In the Wright Map of the control group, the distribution of persons and items revealed that the pedagogical skills of the majority of prospective Physics varied, with some items proving to be more difficult than others. Persons with codes such as 02COY, 01COY, and 05COY occupied higher positions, indicating better pedagogical skills, while the remaining were dispersed along the scale, with the majority clustered around the middle of the scale (measure=1), signifying moderate variability in pedagogical abilities. This distribution highlights the diversity in pedagogical competency within the control group and suggests that certain test items presented notable difficulties for the prospective Physics teachers.

In contrast, the distribution of persons and items in the Wright Map for experimental group showed a more significant increase in pedagogical skills after the

intervention. Persons with codes such as 17EOY, 18EOY, 17EOX, and 18EOX were at higher measures (measure=3 and 4), signifying that the intervention effectively enhanced their pedagogical skills. A larger number of participants from the experimental group are positioned at higher levels compared to those in the control group, indicating the effectiveness of the intervention in improving the pedagogical skills of prospective Physics teachers. Although certain items remain challenging for many participants, the overall distribution reflects that persons in the experimental group demonstrated superior abilities compared to those in the control group.

From this analysis, it can be concluded that the intervention applied to the experimental group resulted in significantly greater improvements in the pedagogical skills of prospective Physics teachers compared to the control group [38]. The Wright Map provides a clear visualization of both ability distribution and item difficulty, providing valuable insights into the effectiveness of the intervention. These results underscore the importance of structured and evidence-based training programs to enhance the pedagogical quality of prospective Physics teachers [39].

3.2. Discussion

3.2.1. Professional Skills of Prospective Physics Teachers

Professional skills are an integral aspect for prospective Physics teachers, equipping them to meet the demands of their future teaching roles. These skills extend beyond mastery of academic materials, encompassing the ability to adapt to diverse work environments, engage effectively with students, and manage classroom dynamics [40], [41]. A prospective Physics teacher with strong professional skills can employ innovative teaching strategies, administer fair and objective assessments, and foster positive relationships with students, colleagues, and other educational stakeholders [42], [43].

Moreover, professional skills are reflected in a teacher's commitment to continuous learning and self-development, whether through additional training, workshops or independent study. This capacity enables prospective teachers to incorporate the latest advancements in education into their teaching practices, ultimately enhancing the quality of student learning experiences [5], [44]. The evaluation aspect of these professional skills often involves the use of measurement tools, such as validity and reliability tests, alongside competency mapping, to assess the degree to which prospective Physics teachers have met the required standards in their field [45].

Academically, the professional skills of prospective Physics teachers can be assessed using various indicators, such as test scores, peer evaluations, and their ability to design and implement effective learning strategies [46]. The development of these skills is crucial not only for enhancing teaching effectiveness but also for fostering an inclusive learning environment that supports the intellectual and emotional growth of students.

3.2.2. Pedagocial Skills of Prospective Physics Teachers

The pedagogical skills of prospective Physics teachers serve as the foundation of their ability to effectively convey subject matter, fostering both interest and comprehension among students [47]. Key components of these skills encompass the ability to design a curriculum that aligns with educational standards, select apptopriate teaching methods to accommodate students' diverse learning styles, and adeptly utilize educational technology and other resources throughout the learning process [48].

Academically, evaluation of pedagogical skills often involves direct classroom observations, analysis of teaching plans, and portfolio assessments that reflect success in achieving learning objectives [49]. By developing robust pedagogical skills, prospective Physics teachers can become effective agents of change, enhancing the quality of education within their communities and preparing future generations with relevant knowledge and skills needed to navigate global challenges [50], [51], [52].

The assessment of pedagogical skills typically encompasses direct classroom observations, analyses of instructional plans, and evaluations of portofolios that demonatrate success in meeting educational objectives [53], [54], [55]. By cultivating strong pedagogical skills, prospective Physics teachers can serve as effective agents of change in improving the quality of education in their communities and equipping future generations with knowledge and skills relevant to address global challenges [56], [57], [58].

4. CONCLUSION

This study demonstrated a significant difference between the pretest and posttest results for both experimental and control groups, highlighting the effectiveness of the intervention in enhancing the teaching preparation of prospective Physics teachers. The Wright's map analysis of pedagogical skills indicated that the experimental group experienced a more regular and significant increase than the control group, suggesting that the intervention program had a positive and consistent impact on the development of teaching skills. This study contributes to the existing literature on the development of prospective Physics teachers by showing that a specifically designed intervention program

can significantly improve pedagogical skills. Additionally, the application of Wright Map analysis—an approach that is relatively rare in educational research in Indonesia— serves as a tool for deeper evaluation of teaching skill development.

Based on these findings, it is recommended that educational practitioners consider implementing similar intervention programs to enhance the quality of teacher preparation across various regions. This program can serve as a model for developing pedagogical skills among prospective Physics teachers in Indonesia. In addition, practitioners should continuously evaluate the program's effectiveness, allowing for necessary adaptations and improvements that align with local needs and evolving global challenges.

Further research is needed to evaluate the program's success on a national scale, considering the limited number of research subjects that do not fully represent all regions of Indonesia. Therefore, this study not only provides novel insights into improving teaching quality, but also encourages further discussion regarding the implementation of broader intervention programs.

ACKNOWLEDGEMENTS

We would like to express our gratitude toward Universitas Ahmad Dahlan for their support and funding of this work under the supported proffesorship candidate research grant 2024 (U7/405/Und-UAD/V/2024).

REFERENCES

[1] R. Asih, D. Alonzo, and T. Loughland, "The critical role of sources of efficacy information in a mandatory teacher professional development program: Evidence from Indonesia's underprivileged region," *Teach Teach Educ*, vol. 118, p. 103824, Oct. 2022, doi: 10.1016/j.tate.2022.103824.

[2] I. G. A. L. P. Utami and S. Prestridge, "How english teachers learn in indonesia: tension between policy-driven and self-driven professional development," *TEFLIN Journal - A publication on the teaching and learning of English*, vol. 29, no. 2, p. 245, Jul. 2018, doi: 10.15639/teflinjournal.v29i2/245-265.

[3] U. Bergmark, "Teachers' professional learning when building a research-based education: context-specific, collaborative and teacher-driven professional development," *Professional Development in Education*, vol. 49, no. 2, pp. 210–224, Mar. 2023, doi: 10.1080/19415257.2020.1827011.

[4] I. S. Jenset, K. Klette, and K. Hammerness, "Grounding Teacher Education in Practice Around the World: An Examination of Teacher Education Coursework in Teacher Education Programs in Finland, Norway, and the United States," *J Teach Educ*, vol. 69, no. 2, pp. 184–197, Mar. 2018, doi: 10.1177/0022487117728248.

[5] I. Rissanen, E. Kuusisto, E. Hanhimäki, and K. Tirri, "Teachers' Implicit Meaning Systems and Their Implications for Pedagogical Thinking and Practice: A Case Study from Finland," *Scandinavian Journal of Educational Research*, vol. 62, no. 4, pp. 487–500, Jul. 2018, doi: 10.1080/00313831.2016.1258667.

[6] N. X. Tou, Y. H. Kee, K. T. Koh, M. Camiré, and J. Y. Chow, "Singapore teachers' attitudes towards the use of information and communication technologies in physical education," *Eur Phy Educ Rev*, vol. 26, no. 2, pp. 481–494, May 2020, doi: 10.1177/1356336X19869734.

[7] Y. H. Leong, L. P. Cheng, W. Y. K. Toh, B. Kaur, and T. L. Toh, "Teaching students to apply formula using instructional materials: a case of a Singapore teacher's practice," *Mathematics Education Research Journal*, vol. 33, no. 1, pp. 89–111, Mar. 2021, doi: 10.1007/s13394-019-00290-1.

[8] M. Hopkins, P. Bjorklund, and J. P. Spillane, "The social side of teacher turnover: Closeness and trust among general and special education teachers in the United States," *Int J Educ Res*, vol. 98, pp. 292–302, 2019, doi: 10.1016/j.ijer.2019.08.020.

[9] Z. Oberfield, "Unionization and Street-Level Bureaucracy: An Examination of Public School Teachers in the United States," *Rev Public Pers Adm*, vol. 41, no. 3, pp. 419–446, Sep. 2021, doi: 10.1177/0734371X19894376.

[10] J. Koh, M. Cowling, M. Jha, and K. N. Sim, "The Human Teacher, the AI Teacher and the AIed-Teacher Relationship," *Journal of Higher Education Theory and Practice*, vol. 23, no. 17, Nov. 2023, doi: 10.33423/jhetp.v23i17.6543.

[11] I. Aartun, K. Walseth, Ø. F. Standal, and D. Kirk, "Pedagogies of embodiment in physical education – a literature review," *Sport Educ Soc*, vol. 27, no. 1, pp. 1–13, Jan. 2022, doi: 10.1080/13573322.2020.1821182.

[12] S.-C. Kong, M. Lai, and D. Sun, "Teacher development in computational thinking: Design and learning outcomes of programming concepts, practices and pedagogy," *Comput Educ*, vol. 151, p. 103872, Jul. 2020, doi: 10.1016/j.compedu.2020.103872.

[13] N. Baety, "Indonesian teacher performance: Professional and Character," *AKADEMIK: Jurnal Mahasiswa Humanis*, vol. 1, no. 3, pp. 95–103, Sep. 2021, doi: 10.37481/jmh.v1i3.459.

[14] A. Hidayat, 'Developing and validating a Technological Pedagogical Content Knowledge (TPACK) instrument for secondary Physics preservice teachers in Indonesia', *Unnes Sci. Educ. J.*, vol. 8, no. 1, pp. 31–40, 2019, doi: 10.15294/usej.v8i1.23087.

[15] R. Pribudhiana, Y. Bin Don, and M. R. Bin Yusof, 'Determining the influence of teacher quality toward teacher readiness in implementing Indonesian education policy', *Eurasian J. Educ. Res.*, vol. 93, pp. 373–390, 2021, doi: 10.14689/ejer.2021.93.18.

[16] N. Sulaeman, S. Efwinda, and P. D. A. Putra, 'Teacher readiness in STEM education: Voices of Indonesian Physics teachers', *J. Technol. Sci. Educ.*, vol. 12, no. 1, pp. 68–82, 2022, doi: https://doi.org/10.3926/jotse.1191.

[17] F. Novitra, 'Networked-based inquiry: An effective Physics learning in the new normal Covid-19 era in Indonesia', *Int. J. Instr.*, vol. 15, no. 2, pp. 997–1016, 2022, doi: https://doi.org/10.29333/iji.2022.15255a.

[18] A. K. Wingard, H. D. Hermawan, and V. R. Dewi, "The Effects of Students' Perception of the School Environment and Students' Enjoyment in Reading towards Reading Achievement of 4th Grades Students in Hong Kong," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 2, no. 2, pp. 68–74, Jan. 2020, doi: 10.23917/ijolae.v2i2.9350.

[19] G. B. Gudmundsdottir and O. E. Hatlevik, "Newly qualified teachers' professional digital competence: implications for teacher education," *European Journal of Teacher Education*, vol. 41, no. 2, pp. 214–231, Mar. 2018, doi: 10.1080/02619768.2017.1416085.

[20] D. Ramandanis and S. Xinogalos, "Investigating the Support Provided by Chatbots to Educational Institutions and Their Students: A Systematic Literature Review," *Multimodal Technologies and Interaction*, vol. 7, no. 11, p. 103, Nov. 2023, doi: 10.3390/mti7110103.

[21] P. S. Lisenbee and C. M. Ford, "Engaging Students in Traditional and Digital Storytelling to Make Connections Between Pedagogy and Children's Experiences," *Early Child Educ J*, vol. 46, no. 1, pp. 129–139, Jan. 2018, doi: 10.1007/s10643-017-0846-x.

[22] T. Lin, T. Chen, J. Liu, and X. M. Tu, "Extending the Mann-Whitney-Wilcoxon rank sum test to survey data for comparing mean ranks," *Stat Med*, vol. 40, no. 7, pp. 1705–1717, Mar. 2021, doi: 10.1002/sim.8865.

[23] Y. Fong and Y. Huang, "Modified Wilcoxon–Mann–Whitney Test and Power Against Strong Null," *Am Stat*, vol. 73, no. 1, pp. 43–49, Jan. 2019, doi: 10.1080/00031305.2017.1328375.

[24] R. A. Matsouaka, A. B. Singhal, and R. A. Betensky, "An optimal Wilcoxon–Mann–Whitney test of mortality and a continuous outcome," *Stat Methods Med Res*, vol. 27, no. 8, pp. 2384–2400, Aug. 2018, doi: 10.1177/0962280216680524.

[25] H. Hilaliyah, Y. Agustin, S. Setiawati, S. N. Hapsari, I. B. Rangka, and M. Ratodi, "Wright-Map to investigate the actual abilities on math test of elementary students," *J Phys Conf Ser*, vol. 1318, no. 1, p. 012067, Oct. 2019, doi: 10.1088/1742-6596/1318/1/012067.

[26] M. Musthofa, Nasikhin, M. Junaedi, and S. Hasanah, "The influence of online learning on student professionalism Teacher professional Education Program: Studies in Islamic higher Education in Indonesia," *Cogent Education*, vol. 10, no. 2, Dec. 2023, doi: 10.1080/2331186X.2023.2276025.

[27] A. Huber, C. Strecker, T. Kachel, T. Höge, and S. Höfer, "Character Strengths Profiles in Medical Professionals and Their Impact on Well-Being," *Front Psychol*, vol. 11, Dec. 2020, doi: 10.3389/fpsyg.2020.566728.

[28] S. Handayani, L. Peddell, and T. Yeigh, "Participants' Experiences in Heutagogy Teacher Professional Education in Indonesia," *Australian Journal of Teacher Education*, vol. 48, no. 6, Jan. 2023, doi: 10.14221/1835-517X.5739.

[29] G. W. Divine, H. J. Norton, A. E. Barón, and E. Juarez-Colunga, "The Wilcoxon–Mann–Whitney Procedure Fails as a Test of Medians," *Am Stat*, vol. 72, no. 3, pp. 278–286, Jul. 2018, doi: 10.1080/00031305.2017.1305291.

[30] Z. Smida, L. Cucala, A. Gannoun, and G. Durif, "A Wilcoxon-Mann-Whitney spatial scan statistic for functional data," *Comput Stat Data Anal*, vol. 167, p. 107378, Mar. 2022, doi: 10.1016/j.csda.2021.107378.

[31] S. Sulistiawati, Y. S. Kusumah, J. A. Dahlan, D. Juandi, and H. Vos, "A Bibliometric Analysis: Trend of Studies in Self-Regulated Learning Over The Past Three Decades," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 2, pp. 178–197, May 2023, doi: 10.23917/ijolae.v5i2.21381.

[32] F. J. Rodríguez Muñoz, "Pretest and structural analysis of the pragmatic awareness questionnaire destined to teachers' communicative instruction," *Acta Scientiarum. Language and Culture*, vol. 40, no. 1, p. 34181, Mar. 2018, doi: 10.4025/actascilangcult.v40i1.34181.

[33] M.-Y. Chen, S.-M. Huang, and W. Chou, "Using Rasch Wright map to identify hospital employee satisfaction during and before COVID-19," *Medicine*, vol. 102, no. 51, p. e36490, Dec. 2023, doi: 10.1097/MD.0000000000036490.

[34] L. Mao, "Wilcoxon-Mann-Whitney statistics in randomized trials with non-compliance," *Electron J Stat*, vol. 18, no. 1, Jan. 2024, doi: 10.1214/23-EJS2209.

[35] R. Wilcox, "Bivariate Analogs of the Wilcoxon–Mann–Whitney Test and the Patel–Hoel Method for Interactions," *Journal of Modern Applied Statistical Methods*, vol. 18, no. 1, pp. 2–14, Feb. 2020, doi: 10.22237/jmasm/1556669880.

[36] M. Mawarto, W. Widodo, and S. Sulistiasih, "The Antecedence of Teacher's Professional Performance: Evidence from Indonesia," *Universal Journal of Educational Research*, vol. 8, no. 10, pp. 4760–4768, Oct. 2020, doi: 10.13189/ujer.2020.081047.

[37] A. MacPhail, M. Ulvik, A. Guberman, G. Czerniawski, H. Oolbekkink-Marchand, and Y. Bain, "The professional development of higher education-based teacher educators: needs and realities," *Professional Development in Education*, vol. 45, no. 5, pp. 848–861, Oct. 2019, doi: 10.1080/19415257.2018.1529610.

[38] Y. Cheng, W. Jia, R. Chi, and A. Li, "A Clustering Analysis Method With High Reliability Based on Wilcoxon-Mann-Whitney Testing," *IEEE Access*, vol. 9, pp. 19776–19787, 2021, doi: 10.1109/ACCESS.2021.3053244.

[39] D. Alderman, R. Narro Perez, L. E. Eaves, P. Klein, and S. Muñoz, "Reflections on operationalizing an anti-racism pedagogy: teaching as regional storytelling," *Journal of Geography in Higher Education*, vol. 45, no. 2, pp. 186–200, Apr. 2021, doi: 10.1080/03098265.2019.1661367.

[40] L. Lukman *et al.*, "Effective teachers' personality in strengthening character education," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 10, no. 2, p. 512, Jun. 2021, doi: 10.11591/ijere.v10i2.21629.

[41] R. Scherer, J. Tondeur, F. Siddiq, and E. Baran, "The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches," *Comput Human Behav*, vol. 80, pp. 67–80, Mar. 2018, doi: 10.1016/j.chb.2017.11.003.

[42] A. H. Abdulrazzaq, "Teacher Appraisers' Perceptions of Teacher Appraisal," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 3, pp. 233–245, Sep. 2022, doi: 10.23917/ijolae.v4i3.18779.

[43] B. E. Wood, R. Taylor, R. Atkins, and M. Johnston, "Pedagogies for active citizenship: Learning through affective and cognitive domains for deeper democratic engagement," *Teach Teach Educ*, vol. 75, pp. 259–267, Oct. 2018, doi: 10.1016/j.tate.2018.07.007.

[44] N. Ishartono *et al.*, "The Role of Instructional Design in Improving Pre-Service and In-Service Teacher's Mathematics Learning Sets Skills: A Systematic Literature Review in Indonesian Context," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 5, no. 1, pp. 13–31, Dec. 2022, doi: 10.23917/ijolae.v5i1.20377.

[45] M. A. Flores, "Feeling like a student but thinking like a teacher: a study of the development of professional identity in initial teacher education," *Journal of Education for Teaching*, vol. 46, no. 2, pp. 145–158, Mar. 2020, doi: 10.1080/02607476.2020.1724659.

[46] H. T. Yusuf, "Teachers Evaluation of Concurrent and Consecutive Teacher Education Models in South-west, Nigeria," *Indonesian Journal on Learning and Advanced Education (IJOLAE)*, vol. 4, no. 2, pp. 107–117, May 2022, doi: 10.23917/ijolae.v4i2.17599.

[47] M. Mu'arifin and B. S. Narmaditya, "Professional development program for physical education teachers in Indonesia," *Jurnal Cakrawala Pendidikan*, vol. 41, no. 3, pp. 665–675, Sep. 2022, doi: 10.21831/cp.v41i3.49636.

[48] J. Marsh, E. Wood, L. Chesworth, B. Nisha, B. Nutbrown, and B. Olney, "Makerspaces in early childhood education: Principles of pedagogy and practice," *Mind Cult Act*, vol. 26, no. 3, pp. 221–233, Jul. 2019, doi: 10.1080/10749039.2019.1655651.

[49] I. Harjanto, A. Lie, D. Wihardini, L. Pryor, and M. Wilson, "Community-based teacher professional development in remote areas in Indonesia," *Journal of Education for Teaching*, vol. 44, no. 2, pp. 212–231, Mar. 2018, doi: 10.1080/02607476.2017.1415515.

[50] Rusdiana, "Pendidikan profesi keguruan; menjadi guru inspiratif dan inovatif," 2015. [Online]. Available: https://api.semanticscholar.org/CorpusID:218408531

[51] J. Sargent and A. Casey, "Flipped learning, pedagogy and digital technology: Establishing consistent practice to optimise lesson time," *Eur Phy Educ Rev*, vol. 26, no. 1, pp. 70–84, Feb. 2020, doi: 10.1177/1356336X19826603.

[52] J. M. Ramdani and X. (Andy) Gao, "Exploratory practice for teacher professional development in Indonesia," *TESOL Journal*, vol. 15, no. 2, Jun. 2024, doi: 10.1002/tesj.775.

[53] M. Portuguez Castro and M. G. Gómez Zermeño, "Challenge Based Learning: Innovative Pedagogy for Sustainability through e-Learning in Higher Education," *Sustainability*, vol. 12, no. 10, p. 4063, May 2020, doi: 10.3390/su12104063.

[54] R. A. Shahjahan, A. L. Estera, K. L. Surla, and K. T. Edwards, "'Decolonizing' Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts," *Rev Educ Res*, vol. 92, no. 1, pp. 73–113, Feb. 2022, doi: 10.3102/00346543211042423.

[55] A. I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'A review of the literature for designing and developing a framework for adaptive gamification in Physics education', in *The international handbook of Physics education research: Teaching Physics*, M. F. Taşar and P. R. L. Heron, Eds., AIP Publishing LLC, 2023, pp. 5–1. https://doi.org/10.1063/9780735425712

[56] T. Karakose *et al.*, 'Assessment of the relationships between prospective mathematics teachers' classroom management anxiety, academic self-efficacy beliefs, academic amotivation and attitudes toward the teaching profession using structural equation modelling', *Mathematics*, vol. 11, no. 2, p. 449, 2023, doi: https://doi.org/10.3390/math11020449.

[57] A.-I. Zourmpakis, M. Kalogiannakis, and S. Papadakis, 'Adaptive gamification in science education: An analysis of the impact of implementation and adapted game elements on students' motivation', *Computers*, vol. 12, no. 7, p. 143, 2023, doi: https://doi.org/10.3390/computers12070143.

[58] I. Setianingrum and A. Da Costa, 'Mapping research on Indonesian professional teacher: The bibliometric analysis', *Journal of Professional Teacher Education*, vol. 1, no. 2, pp. 60–71, 2023, doi: https://doi.org/10.12928/jprotect.v1i2.638.

BIOGRAPHIES OF AUTHORS

Dian Artha Kusumaningtyas is a senior lecturer in the Physics Education Program at Universitas Ahmad Dahlan in Yogyakarta, where she also serves as the Program Coordinator for Character Education and as an Academic Advisor. With a strong commitment to enhancing educational practices, Dian's research interests focus on science learning, learning assessment, and the development of schools in suburban areas. For inquiries or potential collaborations, she can be reached at (email: dian.artha@pfis.uad.ac.id)

Moh Irma Sukarelawan is an Assistant Professor at Universitas Ahmad Dahlan, in the Department of Physics Education within the Faculty of Teacher Training and Education. He obtained his Doctoral degree in Educational Science from the Graduate School of Universitas Negeri Yogyakarta (UNY) in 2023. His research interests encompass Physics education, misconceptions, metacognition, and Rasch modeling. For inquiries or collaborations, he can be reached at irma.sukarelawan@pfis.uad.ac.id

Muhammad Syahriandi Adhantoro is an information technology enrhusiast who has created various works in the field of education, including educational games and learning information systems. He has a keen interest in Educational Informatics research. For inquiries or collaborations, he can be reached at m.syahriandi@ums.ac.id

Wahyu Nanda Eka Saputra is a Ph.D. and Lecturer at the Department of Guidance and Counseling, Universitas Ahmad Dahlan. ndonesia. His research interests include peace education, counseling intervention strategies, counseling based on local wisdom, and counseling through creative arts. For inquiries or collaboration, he can be contacted at wahyu.saputra@bk.uad.ac.id.

9.Bukti Konfirmasi article accepted (10 April 2025)

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Editor Decision

2 messages

Dr. Lina Handayani <ijere@iaescore.com>
Reply-To: "Dr. Lina Handayani" <ijere@iaesjournal.com>
To: Dian Artha Kusumaningtyas <dian.artha@pfis.uad.ac.id>
Cc: Irma Sukarelawan <irma.sukarelawan@pfis.uad.ac.id>, Muhammad Syahriandi Acharloo <m.syahriandi@ums.ac.id>, Wahyu Nanda Eka Saputra <wahyu.saputra@bk.uad.ac.id>

The following message is being delivered on behalf of International Journal of Evaluation and Research in Education (IJERE).

-- Paper ID# 31664
-- Authors must strictly follow the guidelines for authors at http://iaescore.com/gfa/ijere.docx
-- Number of minimum references is 30 sources (mainly journal articles) for research paper
-- and minimum 50 sources (mainly journal articles) for review paper

---

Dear Prof/Dr/Mr/Mrs: Dian Artha Kusumaningtyas,

It is my great pleasure to inform you that your paper entitled "Evaluation of the Effectiveness of Intervention on Professional and Pedagogical Skills for Prospective Physics Teachers" is conditionally ACCEPTED and will be published on the International Journal of Evaluation and Research in Education (IJERE), a SCOPUS (https://www.scopus.com/sourceid/21100834092) and ScimagoJR (https://www.scimagojr.com/journalsearch.php?q=21100834092&tip=sid&clean=0) indexed journal. Congratulations!

Please prepare your final camera-ready paper (in MS Word or LATEX file format) adheres to every detail of the guide of authors (MS Word: http://iaescore.com/gfa/ijere.docx, or http://iaescore.com/gfa/ijere.rar for LATEX file format), and check it for spelling/grammatical mistakes.

You should send the documents listed below to ijere@iaescore.com within six (6) weeks:
1. Camera-ready paper (in MS Word file format or LATEX source files)
2. The similarity report from iThenticate/Turnitin shows less than 25%.
3. Evidence of the article registration fee (APC)
Once you have completed all the aforementioned documents, we will issue a certificate of acceptance (CoA).

I look forward to hearing from you.

Thank you

Best Regards,
Dr. Lina Handayani
ijere@iaesjournal.com

URGENT! Pay attention to the following instructions carefully! YOU MUST DO!

1). PLEASE ADHERE STRICTLY THE GUIDE OF AUTHORS

10. Bukti Konfirmasi artikel publish online (19 Mei 2025)

UNIVERSITAS
AHMAD DAHLAN

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id>

[IJERE] Vol.14, No.3 June 2025 has been published

2 messages

editorialijere@gmail.com <editorialijere@gmail.com> Mon, May 19, 2025 at 9:00 AM
To: dian.artha@pfis.uad.ac.id

Dear author(s),

Thank you for being a part of IJERE's author!
Your paper entitled "Evaluating the effectiveness of intervention on professional and pedagogical skills among prospective physics teachers" has been published in IJERE Vol.14, No.3 June 2025 issue.
Kindly visit our web archive to check your paper at: https://ijere.iaescore.com/index.php/IJERE/issue/view/586

We encourage authors to share their published articles to make it more visible to others and may increase your chances of citation!
Promoting your research is now easy thanks to sharing capabilities on social media websites, where you may already have numerous academic and industry connections, like on Twitter, Facebook, Instagram, LinkedIn, Google Scholar, Orcid, Mendeley, ResearchGate, or Academia.edu.

We are very thankful to publish your paper. We hope you will publish more papers in the future and spread the journal among your community.

Regards,
Niko Firman
IJERE Editorial Staff
on behalf of Editor-in-Chief, International Journal of Evaluation and Research in Education
http://ijere.iaescore.com/

DIAN ARTHA KUSUMANINGTYAS <dian.artha@pfis.uad.ac.id> Mon, May 19, 2025 at 7:06 PM
To: IJERE Editorial <editorialijere@gmail.com>

Dear Mr. Niko Firman,
Editorial Staff of IJERE,

I would like to express my sincere gratitude for the opportunity to publish my article titled "Evaluating the Effectiveness of Interventions on Professional and Pedagogical Skills Among Pre-Service Physics Teachers" in IJERE Vol.14, No.3, June 2025 Edition.

It is truly an honor to be part of IJERE. I will share the published article through various academic platforms and social media, as suggested, to help expand its reach and potential for citation within the educational research community.

Thank you once again for your support and collaboration. I look forward to contributing more works to IJERE in the future.

Best regards,
Dian Artha K
[Quoted text hidden]