DEVELOPING TEACHER COMPETENCIES OF PROSPECTIVE TEACHER STUDENTS IN THE FACULTY OF EDUCATION BASED ON A STATISTICAL MINI-RESEARCH PROJECT

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ABSTRACT

The Faculty of Education is dedicated to preparing teacher candidates. Ideally, every course students take should contribute to developing their teaching competencies. Within this framework, Educational Research Statistics is one of the mandatory courses for candidates at the Faculty of Education, Pelita Harapan University. In this course, students are expected to work collaboratively on a mini-research project for 1 semester, where they are trained to identify and solve problems through statistical procedures. At the end of the project, students are then expected to present the obtained outputs to their classmates. Therefore, this study aimed to carry out the following objectives: 1) Examine the level of differences in teacher competencies among students before and after the implementation of the mini-research project, and 2) Analyze the effectiveness of the project in strengthening teacher competencies of students. A mixed-method approach was implemented in this case, with 47 students employed as the experimental sample. This study used teacher competency tests and questionnaires as instruments. The processing of the results was also analyzed quantitatively and qualitatively. This research provides results: 1) there are significant differences between teacher competencies in students before and after the implementation of mini-research projects, and 2) the implementation of mini-research projects effectively strengthens the competence of student teachers. Therefore, every course must consider the best learning strategy to strengthen student teachers' competence.
Keywords : Mini-Research Project, Teacher Competencies, Statistics.

PRELIMINARY

Although the COVID-19 pandemic has officially ended, its lasting impact on the education sector remains evident. The emergency shift to online learning brought both positive and negative consequences. On the positive side, it introduced greater flexibility in learning processes (Danchikov et al., 2021; Müller & Mildenberger, 2021), allowing students to access education anytime and from anywhere (Soesanto & Dirgantoro, 2021). However, the long-term challenges are also significant, particularly the persistence of learning loss (Engzell et al., 2021; Moscoviz & Evans, 2022), which continues to affect students at both primary and higher education levels (Donnelly & Patrinos, 2021). These consequences underline the urgency for innovative and competency-based approaches in

teacher education to address post-pandemic learning gaps and prepare future educators more effectively.

The development of 21st-century skills, particularly the "4Cs" (critical thinking, collaboration, creativity, and communication), is crucial for preparing students for the future workforce in the era of digital technology 4.0 (González-pérez & Ramírez-montoya, 2022; Stanikzai, 2023). These skills should be integrated across all educational levels, from primary to higher education, to enhance workforce readiness (Thornhill-Miller et al., 2023). Education must target cognitive, affective, and skill development, although emotional and psychomotor components pose challenges during emergency learning situations (González-pérez & Ramírez-montoya, 2022). To foster these skills, educational institutions should adopt comprehensive frameworks for assessment and certification, such as the "International Institute for Competency Development's 21st Century Skills Framework" (Thornhill-Miller et al., 2023). Teacher preparation programs should also provide opportunities for future educators to develop and practice these skills, integrating them into coursework and training situations (Cretu, 2017). This approach ensures that teachers are equipped to cultivate 21st-century skills in their students.

Teacher competencies are crucial for effective education, encompassing four key areas: professional, pedagogical, social, and personal skills (Andayani et al., 2022; Dirgantoro, 2018). So, in teacher education, students must be adequately prepared to meet the expectations of possessing the four teaching competencies. Professional competence involves mastering the subject matter and staying updated with current knowledge (Mayasari & Syarif, 2024). Pedagogical competence focuses on understanding students and managing learning processes (Helmi, 2015). Social competency emphasizes the teacher's ability to interact effectively with students, parents, and other subjects in the learning environment (Wijaya et al., 2023) . Personal competence relates to the teacher's personality and role as a behavioural and linguistic model for their students (Helmi, 2015).

Based on these descriptions, teachers with good competencies commonly carry out meaningful learning and holistically guide students. Teachers' abilities are crucial for developing students' potential, character, communication abilities, and learning results (Parahita, 2022). Subsequently, these competencies must be continuously trained and developed when they have taught in school and are still teaching candidates. Competent teachers can also guide students and establish meaningful and enjoyable learning activities. According to Nur & Fatonah (2022), quality teachers produce valuable students. Dirgantoro (2018) also stated that teacher competencies influenced students' proficiency

achievement. This statement shows that teacher competencies are very important factors in futuristically determining the quality of education in Indonesia. This means that to improve education quality, teachers must continuously reinforce their competencies, including pedagogical, personality, professional, and social skills (Fakhruddin et al., 2023; Zaini, 2020). Given this background, competencies should be continuously strengthened through the various courses students study. In this case, developing teacher competencies in students is still necessary, even in emergency learning.

Educational Research Statistics is one of the mandatory courses studied by students in the Faculty of Education at Pelita Harapan University. This course invites students to observe the principle of truth in various analyses, specifically in educational events. They are also expected to become study experts sensitive to existing problems and have honesty and integrity in their experimental performances. Furthermore, the material coverage of this course is related to statistical theories and their experimental applications, including the following comprehension: (1) various statistical terminologies, (2) types of data, (3) kinds of data distributions, (4) data processing, (5) data analysis, (6) conclusion drafting, and (8) interpretation of the educational study, involving the hypothesis test. This course prepares students to apply logical, critical, systematic, and innovative thinking in developing or implementing the knowledge concepts acquired within various fields. They are also expected to demonstrate independent, high-quality, and measurable performance holistically. Therefore, this study aims to conduct a mini-research project through the collaboration of students for 1 semester. This mini assignment is the initial step to train students toward the initial analysis on a small scale before the actual experimentation, such as a final project (Simanihuruk & Simanihuruk, 2019). Based on Simanihuruk & Simanihuruk (2019), a mini-research could train students to think critically and analytically about present issues. In this project, they were also able to select the analyzed problem to obtain the following outputs independently: 1) understand and connect the concepts learned (professional competence), 2) be honest and responsible in conducting experiments (personal competency), 3) adequately present results (pedagogical competency), and 4) accurately collaborate and interact within the group (social competency).

Based on these considerations and assumptions, the problem formulations in this study are as follows: 1) Is a difference observed in teacher competencies among students before and after the implementation of a mini-research project? Moreover, 2) How effective is the implementation of the project in strengthening the teacher competencies of

students? The results are expected to demonstrate the urgency of managing courses to prepare students to become professional teachers.

METHODS

This study was conducted at the Faculty of Education, Pelita Harapan University, and employed a purposive sampling technique to select participants. These participants were students studying the Educational Research Statistics course in the odd semester of 2022/2023. Students from the 2020 Education Programs of Elementary School Teacher (n = 15), Indonesian Language (n = 32), and Economics (n = 1) were also selected, leading to a total of 47 samples. These participants worked on a mini-research project in groups of 4-5 members, with each class free to select a different topic from the other. Table 1 shows the titles of the mini-projects conducted by each group.

Table 1. Students' Mini-research Title

Group	Title
1	Comparison of the regeneration rates of Student Organizations, as well as Activity and Service Units for 2021/2022 and 2022/2023
2	Comparison of using the dorm wi-fi network and personal internet data quota on the case study scores for high-class Physical Learning, Sports, and Health courses specifically for 2020 Elementary School Teacher Education students
3	The influence of the adequacy of drinking water consumption on the physical health of Teachers College (TC)-Pelita Harapan University (UPH) students
4	The influence of using social media on the sleep hours of the 2020 TC-UPH students
5	The effectiveness of online and offline learning for 2019-2021 TC-UPH students
6	Comparison of learning time in Pelita Harapan University students through social media on weekends
7	The comparison of the nutritional health level in TC-UPH students when at home and in the dorm
8	Comparison of the nutritional health level in TC-UPH students when at home and in the dorm
9	Comparative analysis of spending on male and female residents in dorm building G of Pelita Harapan University
10	The learning motivation of Indonesian Language Education (PBI) students at Pelita Harapan University through the lecture method
11	Comparison of the number of books read by TC-PBI and non-TC-PBI students

This study employed a mixed-method approach, with the results quantitatively and qualitatively analyzed. From this context, a dependent t-test method was used to quantitatively analyze the differences in teacher competencies scores among students

before and after conducting the mini-research project. Meanwhile, students' responses to open-ended questions in the questionnaire were qualitatively examined to assess the effectiveness of the project in strengthening teacher competencies. In this approach, the results are expected to be more accurate toward providing opportunities for subsequent reports.

This study was divided into three stages: planning, implementing, and reporting. The following instruments were considered in the planning stage: 1) a teacher competencies test and 2) a questionnaire on implementing the mini-research project. Based on the teacher competencies test, various assessments were conducted before and after the project performance. Meanwhile, the questionnaire was used to assess the effectiveness of the project in strengthening students' teacher competencies. The instrument was prepared by considering the four teacher competencies that are the focus of this study: pedagogy, professional, social, and personality competencies. Two educational experts then validated these instruments. The test and questionnaire were distributed to the participants for the implementation stage. For the competencies test, distribution was performed before and after the implementation of the project, namely at the beginning (week 1) and end (week 16) of the semester. All the data obtained from both instruments were also processed and analyzed to obtain valid outputs.

RESULT AND DISCUSSION

This section presents the quantitative and qualitative outputs of the analysis as follows,

A. Quantitative Results

Table 2 shows the descriptive statistics for teacher competencies of students before and after carrying out the mini-research project.

Table 2. Descriptive Statistics for Teacher Competencies of Students Before and After Carrying Out the Mini-research Project

	Before	After
Mean	68.12	77.07
Maximum	88.2	100
Minimum	41.8	54
Standard deviation	10.15	9.30

Based on Table 2, an increase was explicitly observed in teacher competency scores among students. A statistical test, namely a paired sample t-test, was performed to determine the significance of this increase. This t-test started with the normality analysis, where the normal distribution of both groups' populations emphasized the advancement to the variance homogeneity test. When only one or both samples do not originate from a normally distributed population, the independent t-test uses a non-parametric test. The SPSS program was used to conduct the statistical test, with Table 3 providing the outputs obtained.

Table 3. Kolmogorov-Smirnov Normality Test Results

	Statistic	df	Sig.
Pre-Test Score	.128	47	.051
Post-Test Score	.058	47	.200[*]

From Table 3, both sample groups (pre-test and post-test) originated from a normally distributed population because the Sig. value was > 0.05. This result led to the performance of the variance homogeneity test, with the results shown in Table 4.

Table 4. Variance Homogeneity Test Results

Levene's Test for Equality of Variances	
F	Sig.
.451	.504

Based on Table 4, both sample groups' variance was homogenous because of the Sig. value was > 0.05. This result indicated that the independent sample t-test was eligible to proceed with the formula for homogenous variance.

Table 5. Independent Sample T-test Results

t-test for Equality of Means		
t	df	Sig.
-4.457	92	<.001

Since the Sig. Value was < 0.001 < 0.05, and the independent sample t-test showed a significant difference between teacher competency scores before and after the mini-research project.

B. Qualitative Results

The qualitative findings presented in this section are derived from students' responses to an open-ended questionnaire designed to explore their experiences with the implementation of a mini-research project. The open format allowed students to freely express their thoughts, leading to rich and diverse insights. Through thematic analysis, several dominant themes were identified across the responses, reflecting how the mini-research project contributed to the development of various teacher competencies. These themes are outlined in the following synthesis, supported by illustrative examples from student answers.

1. Holistic Development of Pre-Service Teachers

To explore how the mini-research project contributed to the holistic development of pre-service teachers, the first question asked students to reflect on the benefits they gained from the experience.

Question 1: How do you benefit from working on a mini-research project?

The answers of students to this question were divided into the following domains:

- Cognitive: (1) Students become open to knowledge about new things obtained from the mini-research project, (2) their understanding of statistical concepts/theories deepens due to practice, and (3) students are trained in scientific report writing.
- Affective: (1) Students learn to be responsible, collaborative in a team, appreciative of each other's opinions, as well as practice patience and build exemplary communication, and (2) they become more disciplined and structured in completing tasks according to the provided timeline.
- Skills: (1) Students are equipped with the research skills valuable for future final project preparation and teacher-researcher role development, and (2) they are trained in developing ideas and critical thinking skills.

2. Enhancement of Teacher's Competence

A key objective of the mini-research project was to support the development of core teacher competencies as outlined in national and institutional standards. To explore this dimension, several questions specifically asked students to reflect on how the project contributed to their pedagogical, professional, social, and personal competencies. The following section presents students' responses to each competency domain, including which were most and least developed, as perceived by the participants.

Question 2: Does the mini-research project help develop your teacher competencies?

All students (100%) provided positive answers to the project's usefulness in developing teacher competencies.
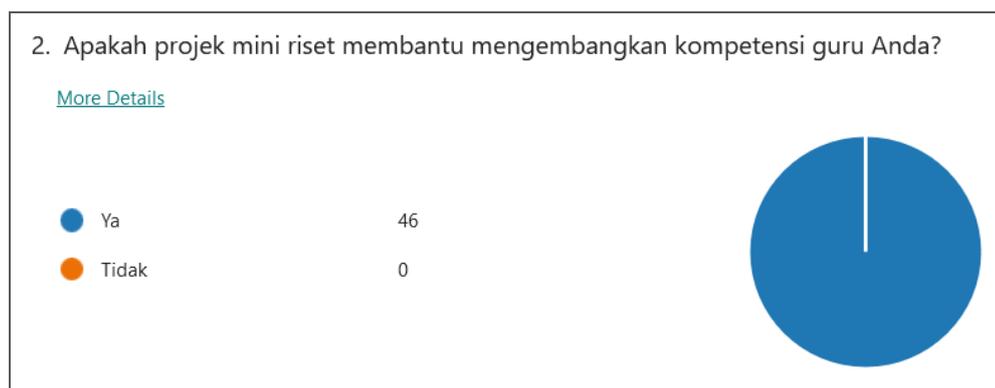

Figure 1. Students' response

Question 3: How does the mini-research project help you develop pedagogical competency?

Based on this question, students felt the project helped their pedagogical competency. In this case, the following examples emphasized the usefulness of the mini-research project, according to the answers provided:

- Training of skills in delivering and explaining material through group discussions and class presentations,

- Providing an overview regarding the evaluation and improvement of teaching quality through simple research,

- Understanding students' characteristics by initially mastering group members,

- Applying scientific thinking in future teaching activities,

- Providing an overview concerning the design and implementation of reasonable and systematic learning for students,

- Assisting the acquisition of concrete examples of good task assignments and the patterns by which lecturers provide installation opportunities. In this case, students are not rushed when approaching the deadline. Lecturers do not also allow students to work alone, although they provide guidance as well as correctness and incorrectness assessments,

- To carry out the project, students, as experts, should adequately present and provide objective outputs. This method trains teachers to produce objective assessments for students.

Question 4: How does the mini-research project help you develop professional competency?

From the questions, students felt that the project helped their professional competency, with the following reasons provided:

- The mini-research project hones thinking and analytical skills,
- It helps to understand the application of statistical concepts in daily life,
- It assists in the mastering and integration of continuous material, leading to incessant knowledge,
- It sharpens the ability to work on every calculation and develop mathematical potential,
- It helps to understand statistics and its components,
- It assists in thinking skills, self-preparation, and decision-making,
- Although statistics are not the main content of the study program, this course helps students have a broad perspective, accompanied by the provision of structured and gradual materials. This provision aids the ability of students to learn and master the materials deeply.

Question 5: How does the mini-research project help you develop social competency?

Based on the question, some of the answers provided are as follows:

- The mini-research project helps in learning socializing patterns through data collection (determining research subjects),
- It helps in collaborative performances in a group, even during the occurrence of different perceptions causing inadequate discussions. In this case, the ignorance of the differences is very important based on truth for the adequate alignment of perceptions,
- It trains students to initiate group discussions and distribute group tasks,
- It helps in communication with senior individuals during professor consultations,
- It aids in learning to accept and listen to the opinions of others without rapidly becoming angry due to personal pressure. It also trains the ability to remind one another and care about the development of shared tasks,
- It helps in developing social competency when exchanging ideas, discussing, providing opinions, and assisting fellow group members,
- It aids the maintenance of communication with people having different personalities, leading to the adoption and development of good relationships during the mini-research project,
- It subsequently helps in learning adequate communication patterns among group members, respecting and not forcing different opinions, and maintaining good interaction abilities.

- It is very useful when futuristically becoming a teacher, where communication is adequately performed with students, accompanied by the respect and indiscrimination of their opinions,
- It helps to lower egos, as well as listen and understand people,
- It also assists in analyzing the surroundings. Moreover, it is sensitive to the surroundings for a teacher to blend into society, enhancing progressive distribution according to the needs of the community and environment.

Question 7: What are teacher competencies most developed by the mini-research project?

Based on this question, the participants provided and explained different answers, which are summarized as follows,

Table 6. Percentage of Subjects' Answers

Competencies	Percentage
Professional	30,2 %
Pedagogical	13,2 %
Social	20,8 %
Personal	15,1 %
All (Four competencies)	17,0 %
No answer	3,7 %

From the table, students feel the benefits of the mini-research project for developing their competencies, especially in professional and social competencies.

Question 8: Which teaching competencies have been least developed through this mini-research project?

Researchers grouped students' answers based on the open answers given. From these results, it was found that the majority of students (78.7%) did not provide an answer. This result indicated that they only considered the project's benefits in developing the four teacher competencies. In this case, approximately 12.8% of the participants focused on pedagogical competency because they perceived that the project was not directly related to the learning process with students. Approximately 6.4% also emphasized professional competency due to the struggle to understand the studied statistical material. Meanwhile, 2.1% of students prioritized social competency because they felt inferior in group discussions.

3. Growth in Personal Discipline and Integrity

In addition to cognitive, social, and professional growth, the mini-research project also fostered significant development in students' personal competencies, which are foundational to their identity and reliability as future educators. These qualities are not

only essential for academic success but also serve as the ethical backbone of a professional teaching career. The following responses illustrate how students internalized these values through their engagement in the project.

Question 6: How does the mini-research project help you develop personal competency?

The following are some students' answers regarding the influence of the mini-research project on personal competency:

- The project helps a person become more disciplined,
- It enhances the regular performance of activities,
- The mini-research aids in the management of time,
- It also teaches a person to be honest because a scholar needs to be truthful without manipulating obtained data to fit their desires,
- This project trains the prompt performance of tasks, instead of waiting for the deadline,
- It develops integrity, honesty, diligence, and perseverance,
- The mini-research also helps in the practice of patience when revising work,
- It trains an individual to be responsible for the provided tasks and persevere in understanding challenging materials,
- The mini-research project also teaches students to be more aware and timely in completing and submitting the report related to the assigned portion,
- This project helps in training self-control and the patience to learn materials and solve difficult methods,
- It also teaches students to be mature and responsible in completing tasks, even when challenging. Subsequently, the research trains the humility of an individual seeking help from group members when confused and unable to work due to difficulties,
- The project aids in performing work effectively, using time efficiently, not prioritizing individualism, and avoiding blaming others for task errors.
- It teaches students to respect and care for others, as well as make wise decisions that are valuable when becoming a teacher in the future. During this period, a mature personality is mainly needed, accompanied by responsibility for task provision and not becoming easily angry due to a problem.
- The mini-research project also helps students be more thorough, responsible as group leaders, and more daring to evaluate each member privately.

4. Recommendations for Future Implementation

To support the continuous improvement of the mini-research project and its role in shaping well-rounded future educators, students were asked to provide suggestions for future implementations. These recommendations reflect students' critical awareness of the learning process and their desire to deepen both individual and collaborative competencies. The following are some of the suggestions raised by the participants.

Question 9: What suggestions should be provided for developing subsequent mini-research projects in developing teacher competencies?

Based on the question, most subjects did not provide suggestions because the project and the mentoring provided by the lecturers were good. Some of the suggestions obtained are as follows,

- Conduct group evaluations to assess each member's competencies,
- Repeat the research multiple times to ensure that all steps are clearly understood,
- Require task consultation in the future because some students do not often understand the work provided,
- Extend the time allotted for data analysis and observation,
- Please provide examples of good mini-research papers completed to give students an idea of a well-structured report and the patterns of adapting it to different outputs.

C. Discussion

Based on the results, teachers must inform students about the mini-research project at the beginning of the meeting (meeting 1). In this stage, the patient production of adequate task performances is highly promoted. From this context, teachers provide weekly directions to students regarding the tasks that should be prepared and carried out. These tasks align with the statistics material/topics discussed during the week's meeting. In this case, the internalization of statistics topics is encouraged by conducting the project, leading to a more meaningful learning process (Ausubel, 1963).

Each group must complete a research logbook to aid in the ongoing assessment of the mini-research project. This logbook was developed through MS Excel and uploaded to MS Teams for joint accessibility. When discussion/meeting activities are asynchronously, synchronously, or directly observed, the groups are expected to present these activities in their logbooks orthographically. An example of a mini-research logbook is shown as follows,
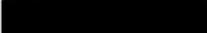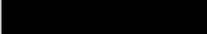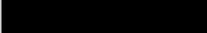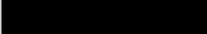
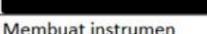| Hari:	Senin
Tanggal:	12 Agustus 2022
Kegiatan:	Diskusi
Peserta: (Tuliskan nama anggota kelompok yang hadir)	1. 2. 3. 4. 5.
Uraian Kegiatan:	1. Membuat instrumen 2. Menyusun kerangka pertanyaan kuesioner
Dokumentasi: (Lampirkan dokumentasi pertemuan tatap muka atau tatap maya, atau chat grup)	

Figure 2. Example of a mini-research logbook

The completion of the mini-research project has been found to help teacher candidates improve their competencies. This result is in line with Arianto et al. (2021), where the completion of the project enhanced teacher competencies.

Besides teaching, the expected skills of teachers also involved processing students' grade data and performing administrative tasks. Teachers also must undergo self-development by conducting classroom action research (CAR). By engaging in CAR, teachers can improve their teaching practices, better understand students' learning problems, and contribute to their personal and professional growth (Prabandari et al., 2024). In this case, the quality of learning practices is sustainably improved and/or enhanced (Aqib & Hotibuddin, 2018). Moreover, the mini-research project in the Educational Research Statistics course can equip students with professional competencies.

According to Kosasih (2017), teachers could learn more effectively and systematically through project assignments. This statement was because the process directly emphasized the real problems and needs encountered in the field. For example, students often determine their desired topics by linking them to existing phenomena. Another example emphasizes the performance of tasks to compare the effectiveness of online and offline learning. From this context, a better learning system is commonly determined by using statistical techniques.

Siregar (2022) also stated that the collaboration of professional teacher competencies with project assignments was conducted through workshops or academic supervision. Although the study participants were teacher candidates, providing mini-research project assignments to students was still specifically valid. Students were also eligible to conduct workshops with the direct practice of small research before the future performance of real classroom projects as teachers.

The provision of the mini-research project ultimately has positive implications for students in supporting four teacher competencies. This implication includes the opportunity to hone and develop pedagogical, professional, social, and personal competencies.

CONCLUSION

Based on the results, the mini-research project was capable of helping students in the Faculty of Education to improve their four teacher competencies, namely professional, pedagogical, personal, and social skills. This result was evidenced by the statistical test outputs, where a significant difference was found in teacher competencies scores before and after the project implementation. Some open-ended questions also showed that all students considered the project's benefits in developing their competencies as teacher candidates. Despite these results, some limitations were still observed. Given the importance of preparing teacher candidates for the professional world, every course should develop a learning process that supports the improvement of teaching competencies within the Faculty of Education. The 4-year undergraduate education process should also be well-managed to achieve quality learning in Indonesia, focusing on the development of future teachers.

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