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Integration of Learning Technology in Physical Education: A Technological Pedagogical Content Knowledge (TPACK) Theoretical Framework

Romi Cendra[a,1,*] , Novri Gazali[a,2] , Zein Mubarok [a,3]

[a] Physical Education Study Program, Riau Islamic University, Pekanbaru 28284, Indonesia
[1]**romicendra@uir.ac.id, novri.gazali@edu.uir.ac.id*[2], zeinmubarok@student.uir.ac.id**

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ABSTRACT

The demand to integrate technology in education is imperative, where teachers are expected to adapt their pedagogical approaches and teaching strategies in line with the optimal level of technology usage to enhance students' learning achievements. The involvement of technology particularly has a significant impact in the context of physical education. This study aims to evaluate teachers' abilities to integrate technology in physical education, referring to the concept of Technological Pedagogical Content Knowledge (TPACK). The applied methodology is cross-sectional, involving 77 prospective physical education teachers from the Physical Education Program at the Faculty of Teacher Training and Education, Riau Islamic University. The sampling was conducted using purposive sampling, involving physical education students who have participated in educational field practice (KPLP). The research instrument utilized a Likert-scale questionnaire, consisting of seven indicators of TPACK theory skills: (1) technological knowledge, (2) pedagogical knowledge, (3) content knowledge, (4) technological pedagogical knowledge, (5) technological content knowledge, (6) pedagogical content knowledge, and (7) technological pedagogical content knowledge. The results of data analysis indicate that the abilities of prospective physical education teachers at FKIP UIR in integrating TPACK during the teaching and learning processes, as reflected in the seven indicators, fall into the categories of good and very good.

Kata kunci
Integrasi Teknologi
TPACK
Pengajaran

Abstract

Tuntutan untuk mengintegrasikan teknologi dalam pembelajaran menjadi suatu keharusan, dimana guru diharapkan mampu mengadaptasi pendekatan pedagogis dan strategi pengajaran mereka sesuai dengan tingkat optimal penggunaan teknologi untuk meningkatkan pencapaian pembelajaran peserta didik. Keterlibatan teknologi ini terutama memberikan dampak signifikan dalam konteks pendidikan jasmani. Penelitian ini bertujuan untuk mengevaluasi kemampuan guru dalam mengintegrasikan teknologi dalam pendidikan jasmani dengan merujuk pada konsep Technological Pedagogical Content Knowledge (TPACK). Metodologi yang diterapkan adalah *cross-sectional* dengan melibatkan 77 mahasiswa calon guru dari Program Studi Pendidikan Jasmani di Fakultas Keguruan dan Ilmu Pendidikan Universitas Islam Riau. Pengambilan sampel dilakukan secara purposive sampling, yaitu melibatkan mahasiswa pendidikan jasmani yang telah mengikuti kuliah praktik lapangan pendidikan (KPLP). Instrumen penelitian menggunakan kuesioner dengan skala Likert, yang terdiri dari tujuh indikator kemampuan teori TPACK, yakni: *(1) technological knowledge (2) pedagogical knowledge (3) content knowledge (4) technological pedagogical knowledge (5) technological content knowledge (6) pedagogical content knowledge (7) technological pedagogical content knowledge*. Hasil analisis data menunjukkan bahwa kemampuan mahasiswa calon guru Pendidikan Jasmani FKIP UIR dalam mengintegrasikan TPACK selama proses pengajaran dan pembelajaran pada ketujuh indikator tersebut masuk dalam kategori baik dan sangat baik.

INTRODUCTION

The role of education in improving human resources (HR) has an important role in realizing HR who have skills in the 21st century or known as 4C *(Creativity, Critical Thingking, Communication, Collaboration).* The demand for technology integration in learning is inevitable, teachers must be able to modify their pedagogical approaches and teaching strategies to determine the extent to which the use of technology improves learners' cognitive outcomes. (Talis, 2019). The quality of technology integration can be operationalized by the extent to which technology is used to transform and redefine learning activities and the level of teaching quality that comprehends task-specific strategies and task-general strategies. Thus, to understand how technology is integrated in learning requires the implementation of measurement tools that assess teaching and learning activities in which technology is integrated (Backfisch et al., 2019). (Backfisch et al., 2021).. This demand for technology integration has a real impact in physical education. Technology is considered to facilitate physical education teachers in the learning process which includes: preparation of teaching plans, classroom management, communication with parents and students, creation of instructions and feedback, and assessment (Adkins. (Adkins, Megan, Matthew R. Bice, Vicki Worrell, 2017)..

Integrating technology into physical education teaching can be considered as one of the important efforts to support students' learning and enable them to participate in the digital society. (Deepika et al., 2021; Dukuzumuremyi & Siklander, 2018).. In the context of teaching, technology integration generally refers to the adoption of educational technologies by teachers during classroom teaching, such as the use of different hardware (e.g., mobile technology, tablets). (Fraillon et al., 2014), or software applications (Hamizi et al., 2022) to realize a specific teaching process (Koekoek & Hilvoorde, 2018; Krause et al., 2020; Krauskopf et al., 2012)..

For this reason, it is necessary to investigate the types of physical education learning activities supported by technology will be a more appropriate benchmark for assessing technology integration, with a focus on knowing the teacher's ability to integrate technology in physical education in learning. Therefore, researchers refer to the theory of *technological pedagogical content knowledge* (TPACK). The TPACK framework can provide insight into teachers' ability to integrate technology in teaching and learning activities, as it can differentiate activities supported by the use of technology based on the level of students' cognitive engagement (Deepika et al., 2021). (Deepika et al., 2021).

It is increasingly important for future educators or teachers to have strong technological knowledge, skills and competencies to integrate technology in the learning process efficiently and effectively. (Hanik et al., 202; Yulisman et al., 2019). To provide teaching that is in line with the demands of the 21st century in the era of Society 5.0, educators must have abilities in problem solving, teamwork, global citizenship, entrepreneurship, emotional intelligence, communication, digital literacy, and leadership (Khoirul Antony & Paolo, 2019). (Khoirul Antony & Paidi, 2019). These combined skills are known as Technological Content Pedagogical Knowledge or TPACK. The change in term

from TPCK to TPACK reflects the relationship between pedagogical and technological knowledge (Amrina et al., 2019). (Amrina et al., 2022; Khoirul Antony & Paidi, 2019). TPACK learning activities utilize seven interrelated frameworks of insight, the first of which is mastery of material or content knowledge, which refers to a deep understanding of the material or field of study. Second, pedagogical knowledge of learning strategies and processes. Third, technological knowledge on the use of digital technology. Fourth, pedagogical and content knowledge, combining an understanding of learning materials or subject areas with learning strategies and processes. Fifth, technological and content knowledge, which is an understanding of digital technology relevant to learning materials and subject areas. Sixth, knowledge of technology and pedagogy, which is an understanding of the use of digital technology for learning processes and strategies. Seventh, knowledge of technology, pedagogy, and content refers to an integrated understanding of the use of digital technology, linkages to learning processes and strategies, and materials or subject areas. (Nugraheni et al., 2022; Setiawan et al., 2018).

These seven elements are very important components for an educator as they cover all aspects of a learning activity. This involves the ability to master learning concepts or materials, expertise in the teaching process or pedagogy, and the use of technology as a tool to facilitate the understanding of concepts by learners. It can be argued that TPACK acts as a marker of a teacher's professionalism, as two of the competencies required for professional teachers, in accordance with Law No 14 of 2005 on teachers and lecturers, namely pedagogical and professional competencies, are reflected in their respective TPACK. TPACK skills are crucial for prospective physical education teachers as they are expected to teach a wide range of knowledge about movement and healthy lifestyles. (Surayya & Asrobi, 2020; Ammade et al., 2020).

Teaching activities are the main aspect of the duties of a physical education teacher in a school environment. (Ananda et al., 2022).. Through these activities, physical education teachers interact with students in the teaching-learning process. Therefore, teachers need to demonstrate optimal performance and utilize their strengths to be able to interact with students effectively, creating a productive learning environment. This teaching activity also plays a role in shaping the personality of a teacher. The efforts of universities in producing quality prospective teachers include the delivery of educational science lectures, which are ultimately implemented through direct teaching practice in schools. (Rahayu, 2019)

METHODS

This study adopted a cross-sectional research method, which involved field observations using a questionnaire based on seven indicators of the TPACK theoretical framework, namely; *(1) technological knowledge (2) pedagogical knowledge (3) content knowledge (4) technological pedagogical knowledge (5) technological content knowledge (6) pedagogical content knowledge (7) technological pedagogical content knowledge*. The questionnaire that has been prepared is adjusted to the seven indicators to assess the integration of technology in teaching and learning activities in physical

education subjects. This research was conducted at the Physical Education Study Program, Faculty of Teacher Training and Education, Riau Islamic University, with 77 respondents selected by purposive sampling based on the criteria of students who have attended educational field practice courses (KPLP). This research instrument uses a questionnaire with a Likert scale, which includes answer options from "strongly disagree", "disagree", "agree", to "strongly agree".

The data analysis method applied in this study refers to a conceptual framework (Campbell et al., 2011)which is known as an interactive model consisting of three steps, namely: Data Reduction, Data Presentation, and Conclusion Drawing (Verification). In this study, the researchers classified the seven indicators of TPACK theory based on the scores of prospective teachers' attitude scale questionnaire answers. The score assessment for each option in the student attitude scale statement was determined based on the distribution of respondents' answers or in other words, determining the scale value using normal deviation (Azwar, 2007). The following are the category criteria used:

Table 1. Category Norms of prospective teachers' ability to integrate technology in physical education learning

Norma	Category
3,20 - 4,00	Very good
2,80 - 3,19	Good
2.40 - 2,79	Simply
< 2.40	Less

RESULTS AND DISCUSSION

Data obtained from filling out questionnaires by 77 prospective Physical Education teacher students of FKIP UIR, related to their ability to integrate technology in the teaching process, will be analyzed based on seven indicators that have been designed and this analysis also includes classical aspects of all TPACK indicators).

1. Technological Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) towards *Technological Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 15 respondents were in the strongly agree category, 57 respondents in the agree category, 3 respondents in the disagree category, and 3 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 92.72% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Technological Knowledge*. A recapitulation of the data analysis results can be seen in Table 2 below:

Table 2. *Technological Knowledge*

Norma	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	15 people	18.98 %
2,80 - 3,19	Agree	57 people	73.74 %
2.40 - 2,79	Disagree	3 people	3.64 %
< 2.40	Strongly Disagree	3 people	3.64 %
	Total	77 people	100%

The researcher also presents the data in the form of diagram 1.

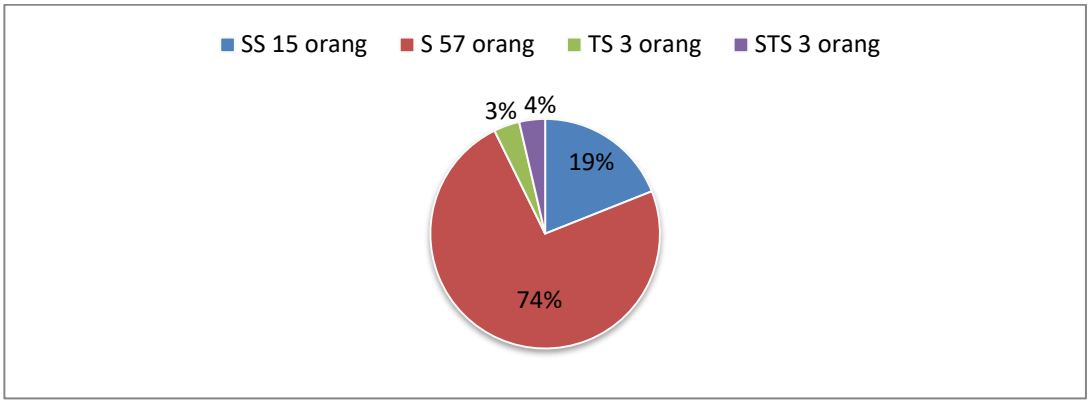

Diagram 1. *Technological Knowledge*

2. Pedagogical Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) towards *Pedagogical Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 17 respondents were in the strongly agree category, 56 respondents in the agree category, 1 respondent in the disagree category, and 3 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 95% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Pedagogical Knowledge*. A recapitulation of the data analysis results can be seen in Table 3 below:

Table 3. *Pedagogical Knowledge*

Table 3. *Pedagogical Knowledge* Norm	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	17 people	23 %
2,80 - 3,19	Agree	56 people	72 %
2.40 - 2,79	Disagree	1 person	2 %
< 2.40	Strongly Disagree	3 people	3 %
	Total	77 people	100%

The researcher also presents the data in the form of diagram 2.

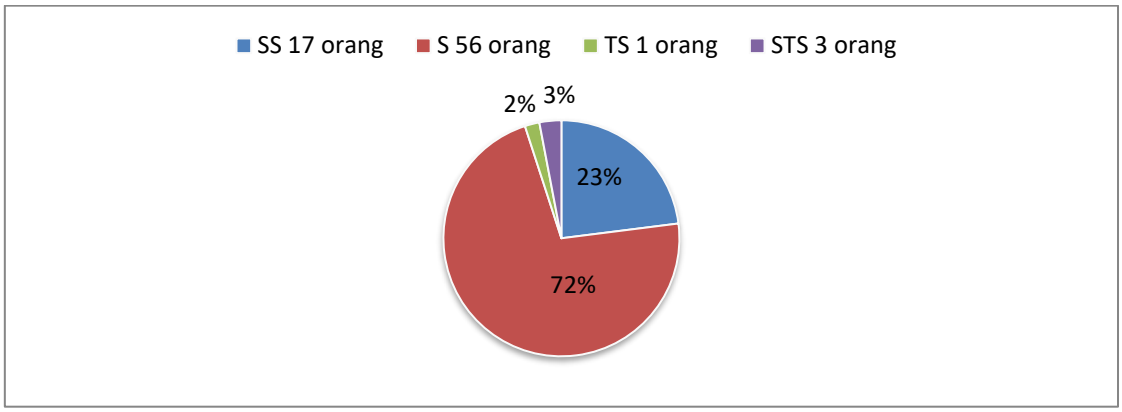

Diagram 2. *Pedagogical Knowledge*

3. Content Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) on *Content Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of a questionnaire distributed to 77 student teachers, it was found that 13 respondents were in the strongly agree category, 60 respondents in the agree category, 1 respondent in the disagree category, and 3 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 96% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Content Knowledge*. A recapitulation of the data analysis results can be seen in Table 4 below:

Table 4. *Content Knowledge*

***Table 4. Content* KnowledgeNorm**	**Category**	**Frequency**	**Percentage**
3,20 - 4,00	Strongly Agree	13 people	18 %
2,80 - 3,19	Agree	60 people	78 %
2.40 - 2,79	Disagree	1 person	1 %
< 2.40	Strongly Disagree	3 people	3 %
	Total	77 people	100%

The researcher also presents the data in the form of diagram 3.

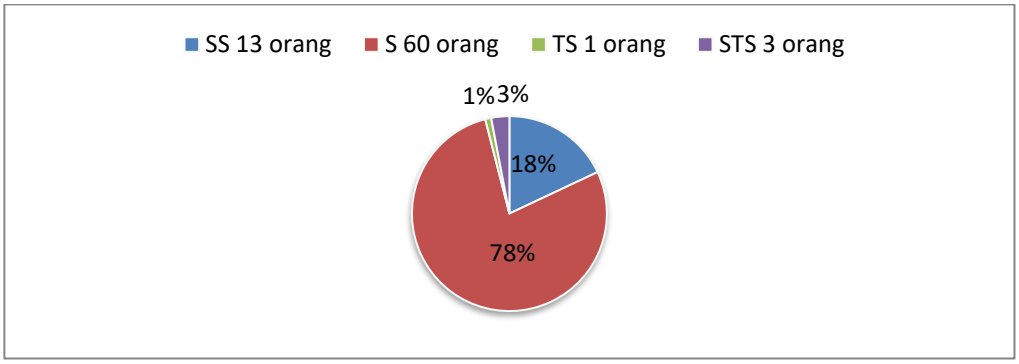

Diagram 3. *Content Knowledge*

4. Technological Pedagogical Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) towards *Technological Pedagogical Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 14 respondents fell into the strongly agree category, 57 respondents in the agree category, 3 respondents in the disagree category, and 3 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 93% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Technological Pedagogical Knowledge*. A recapitulation of the data analysis results can be seen in Table 5 below:

Table 5. *Technological Pedagogical Knowledge*

Norma	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	14 people	19 %
2,80 - 3,19	Agree	57 people	74 %
2.40 - 2,79	Disagree	3 people	3 %
< 2.40	Strongly Disagree	3 people	4 %
Total		77 people	100%

The researcher also presents the data in the form of diagram 4.

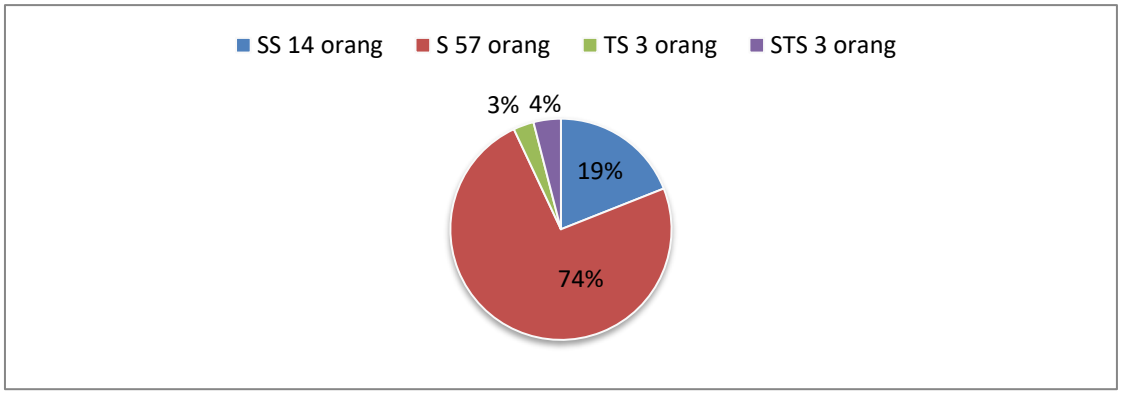

Diagram 4. *Technological Pedagogical Knowledge*

5. Technological Content Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) on *Technological Content Knowledge Knowledge* aims to evaluate their ability to integrate technology in the teaching

process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 16 respondents were in the strongly agree category, 57 respondents in the agree *category*, 3 respondents in the disagree category, and 2 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 94% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Technological Content Knowledge*. A recapitulation of the data analysis results can be seen in Table 6 below:

Table 6. *Technological Content Knowledge*

Norma	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	16 people	20 %
2,80 - 3,19	Agree	57 people	74 %
2.40 - 2,79	Disagree	3 people	3 %
< 2.40	Strongly Disagree	2 people	3 %
	Total	77 people	100%

The researcher also presents the data in the form of diagram 5.

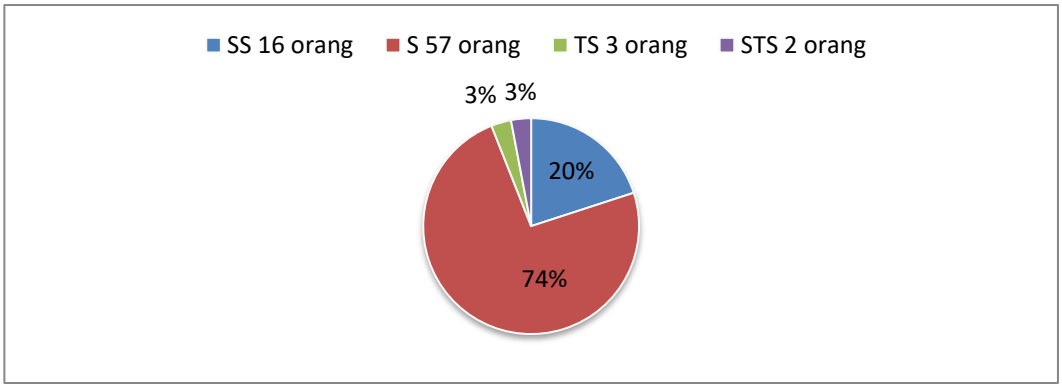

Diagram 5. *Technological Content Knowledge*

6. Pedagogical Content Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) towards *Pedagogical Content Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been *determined* by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 10 respondents were in the strongly agree category, 64 respondents in the agree category, 2 respondents in the disagree category, and 1 respondent in the strongly disagree category. Therefore, it can be concluded that as many as 96% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Pedagogical Content Knowledge*. The recapitulation of the data analysis results can be seen in Table 7 below:

Table 7. *Pedagogical Content Knowledge*

Norma	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	10 people	13 %
2,80 - 3,19	Agree	64 people	83 %
2.40 - 2,79	Disagree	2 people	2 %
< 2.40	Strongly Disagree	1 person	2 %
Total		77 people	100%

The researcher also presents the data in the form of diagram 6.

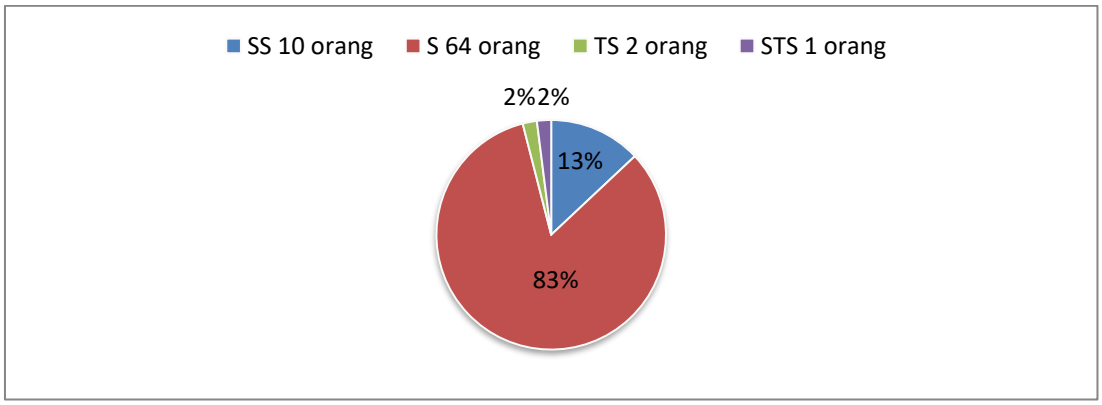

Diagram 6. *Pedagogical Content Knowledge*

7. Technological Pedagogical Content Knowledge

The analysis of the understanding of prospective Physical Education teacher students at the Faculty of Teacher Training and Education (FKIP) of Riau Islamic University (UIR) on *Technological Pedagogical Content Knowledge* aims to evaluate their ability to integrate technology in the teaching process of physical education subjects when conducting Field Practice Lectures (KPLP) in schools that have been determined by the faculty. Based on the results of the questionnaire distributed to 77 student teachers, it was found that 10 respondents were in the strongly agree category, 63 respondents in the agree category, 2 respondents in the disagree category, and 2 respondents in the strongly disagree category. Therefore, it can be concluded that as many as 95% of prospective Physical Education teacher students of FKIP UIR are in the good and very good categories in terms of *Technological Pedagogical Content Knowledge*. The recapitulation of the data analysis results can be seen in Table 8 below:

Table 8. *Technological Pedagogical Content Knowledge*

Norma	Category	Frequency	Percentage
3,20 - 4,00	Strongly Agree	10 people	13 %
2,80 - 3,19	Agree	63 people	82 %
2.40 - 2,79	Disagree	2 people	2 %
< 2.40	Strongly Disagree	2 people	3 %
Total		77 people	100%

Researchers also presented the data in the form of diagram 7.

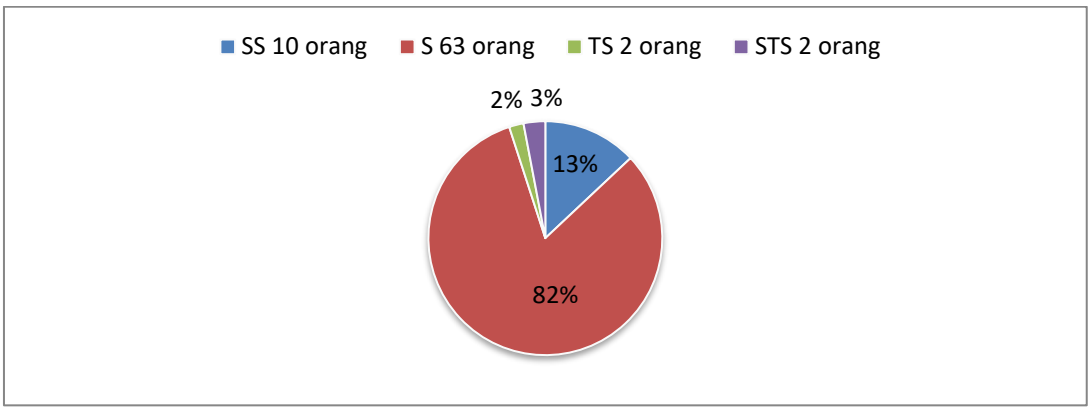

Diagram 7. *Technological Pedagogical Content Knowledge*

After inspecting and analyzing the questionnaire, it can be concluded that the ability of prospective Physical Education teachers at the Faculty of Teacher Training and Education, Riau Islamic University in integrating Technological Pedagogical Content Knowledge (TPACK) in the teaching and learning process is declared good and very good. This shows that prospective Physical Education teachers at FKIP UIR have the ability to keep up with technological developments in the context of teaching in schools. This finding also reflects that students of the Physical Education study program at FKIP UIR enthusiastically utilize technological advances to improve their scientific understanding, both in searching for information, participating in online discussions, uploading assignments, and improving their skills in using technology-based learning media. (Cendra et al., 2020).

This discovery is in line with the direction of the Law of the Republic of Indonesia Number 12 of 2012 concerning Higher Education, which emphasizes the importance of universities and lecturers as educators to continue to develop science and technology in various fields. The aim is to create students who are not left behind in terms of mastery of technology (gaptek) and improve the nation's competitiveness in the era of globalization. Article 1, Chapter 1 of the law also confirms that the application and utilization of technology from various disciplines aims to meet the needs and improve the quality of human life. Therefore, it is clear that the government pays serious attention to the utilization of technology, especially in higher education, as an effort to improve the quality of lecturers and students, especially in the context of technology integration in education, especially in teaching and learning.

CONCLUSIONS

Based on the results of field findings, it shows that prospective teachers of Physical Education students at the Faculty of Teacher Training and Education, Riau Islamic University in integrating

technology in teaching are included in the good category, meaning that they are able to utilize technology during the teaching process at school when students conduct educational field practice lectures (KPLP). For further research, researchers recommend gender, age, and geographical comparisons in integrating teaching technology in physical education.

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