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TPACK Prospective Biology Teacher at Muhammadiyah University of Palembang

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ABSTRACT

21st Century Learning requires prospective biology teachers to be able to integrate technology, pedagogical abilities, and mastery of material well. The three knowledges interact and together form Technological, Pedagogical, And Content Knowledge (TPACK). The purpose of this study is to describe the TPACK ability of prospective biology teacher students in the biology learning process through School Field Experience (PLP) activities. Data were collected on prospective biology teachers who carried out PLP activities in eight schools in Palembang City. The instruments used were RPP validation sheets, learning process observation sheets, and questionnaires. The pedagogical ability of the prospective biology teacher is in the good category. Students are able to apply teaching skills in delivering material and facilitating the learning process. The students' content mastery ability is categorized as quite good. Students present material systematically according to curriculum demands. Students' technological mastery abilities are in the poor category, they have not been able to carry out an integrated learning process with technology to achieve learning objectives.

Keywords: TPACK, prospective biology teacher, learning tools

INTRODUCTION

Education is something that is needed by individuals to develop abilities to be useful for themselves and others. The education needed to develop individual abilities is quality education. Improving the quality of education in higher education is marked by the development of a KKNI-based curriculum (Anggisari et.al, 2018). The KKNI-based Higher Education curriculum requires prospective teachers to take a School Field Experience (PLP) course which consists of three parts, namely PLP one which focuses on observing the implementation of learning in schools, PLP two which focuses on making learning tools, and PLP three which is teaching practice. directly. Prior to the implementation of the IQF-based curriculum, prospective biology

teachers carried out teaching practices using direct teaching, so they did not focus too much on the correctness of content, learning methods, and mastery of technology. This can cause difficulties in understanding biological concepts which have an impact on low mastery of biological concepts and problem solving skills.

The success of 21st Century learning involves understanding material or content, teaching methods, and using information technology in a synergistic manner (Baya'a & Daher, 2015). The learning tools developed must be adapted to the curriculum used and adapted to the needs of students in the classroom, namely syllabus, lesson plans, teaching materials, worksheets, learning media, and assessment of learning outcomes (Kurniyasari et al., 2019). Learning tools are a guide or direction for a teacher. This is important because the learning process is something systematic and patterned (Hapsari et al., 2018). The idea of TPACK also has a close relationship with increasing creativity, collaboration, and accountability in learning. The learning model based on Technological Pedagogical and Content Knowledge in this study will be used to improve material mastery skills, pedagogical mastery, and technological literacy in learning for prospective biology teachers. This research was conducted because empirically prospective biology teachers have a tendency in biology learning which is less able to combine methods, technology as well as biological material content.

Knowledge of TPACK is a synthesis and integration between ICT in the learning process in the classroom. As knowledge, TPACK is described as a form of multi-integration and transformation (Holland & Piper, 2016). As the TPACK conceptual framework has been used to study integrated ICT, teachers work with ICT in designing syllabus, lesson plans and supporting learning tools, designing the use of ICT in the classroom as a learning resource and literature resource (Polly et al., 2010).

The importance of TPACK analysis is to identify content mastery, pedagogical knowledge and the use of technology that can be implemented by prospective biology teacher students as a preparation for student teacher candidates to teach in schools. To be able to integrate technology well, prospective biology teachers must master the knowledge of biological material content, pedagogy, and technology. The three knowledges interact and together form Technological, Pedagogical, Content Knowledge (TPACK). With these considerations, the purpose of this study is to describe the Technological, Pedagogical, and Content Knowledge (TPACK) abilities of prospective biology teacher students which in the process will provide many facilities for students to combine technology, pedagogy, and technology. Thus there is hope and opportunity for improving learning skills.

RESEARCH METHODS

This research is a qualitative descriptive study with four stages, namely planning, implementation, evaluation, and revision (Creswell, 2012). The implementation of this research was carried out for five months, starting from July to November 2020. The research location was

at FKIP Muhammadiyah University of Palembang and the school that was used as the location for the School Field Experience (PLP) practice. two junior high schools.

The research was conducted in the form of observations on prospective biology teachers who were carrying out PLP 3 activities related to the analysis of learning tools consisting of lesson plans, learning media, teaching materials, and evaluation instruments, as well as the implementation of teaching practices in schools.

The research procedures are: (1) the planning stage consists of needs analysis and biological content analysis; biology learning device design; and preparation of observation instruments; (2) the implementation phase consists of analysis of lesson plans, teaching materials, learning media and evaluation tools; preparation of assessment rubrics, limited scale trials, and expert validation; (3) the evaluation stage, namely evaluating the results of the implementation stage; and (4) the revision stage, namely revising the biology learning tools containing TPACK.

Qualitative data obtained in this study is product validation data by a team of experts. Recommendations from material experts and media experts were analyzed for the improvement of TPACK-based biology learning tools as research products. The data from expert validation were analyzed qualitatively.

Observation data on teaching practice using TPACK-based biology learning tools, the observer's assessment was given a range of observations from very bad, not good, good and very good. The observation assessment criteria are in accordance with the TPACK skill rubric that appears. Data analysis in research is based on stages in qualitative research. The stages of qualitative research according to the Spradley Model (Sugiyono, 2014) are: (a) choosing social situations (place, actor, activity); (b) conducting participant observation; (c) record the results of observations and interviews; (d) make descriptive observations; (e) perform a domain analysis; (f) Conducting focused observations; (g) carry out taxonomic analysis; (h) make selected observations; (i) perform a componential analysis; (j) conducting theme analysis; (k) findings. Analysis of the questionnaire responses of prospective biology teacher students was analyzed using qualitative descriptive data analysis.

RESULTS AND DISCUSSION

Results of Needs Analysis and Biological Content Analysis

Preliminary study in the form of needs analysis obtained from the analysis of learning tools for prospective biology teachers during peerteaching activities. The result of this activity is that the use of technology is still minimal in the learning process in the classroom. Of the total 37 biology students who took part in peerteaching, only 17 people integrated technology into their learning activities. Or in other words, only about 46% of prospective biology teachers integrate technology into learning. The rest used direct teaching with the help of props or a blackboard. Whereas a professional teacher must have four basic competencies, namely professional

competence, personality competence, social competence, and pedagogic competence (Harfian, 2018).

Learning Device Design Results

Based on the preliminary studies that have been carried out, the researchers then design learning tools including learning implementation plans, teaching materials, learning media and evaluation tools. The design of learning devices that have been made can then be used as role models by prospective biology teachers in designing learning tools that contain material, pedagogical skills and the use of ICT in planning and implementing these learning tools. One of the things that must be mastered by a teacher is pedagogic competence in which there is the ability to use technology in learning (Harfian, 2017).

Preparation of Observation Instruments

In order to obtain the results of observing the implementation of learning practices in schools, it is necessary to make an observation instrument. Observation instruments consist of lesson plans assessment instruments and learning practice assessment instruments. Aspects of observations are arranged in accordance with Permendikbud No. 22 of 2016. This is a form of implementation of the 2013 curriculum. Implementation of the 2013 curriculum is largely determined by the teacher's readiness factor because the teacher as a facilitator must facilitate students in the learning process, such as sufficient books, various media that support the learning process, and understanding various learning models. Teachers must also be able to take advantage of all existing facilities to support the learning process (Harfian & Fadilah, 2018).

Expert Validation

Expert validation is carried out by two expert lecturers on learning tools and a practitioner, namely the teacher. The results of the RPP validation can be seen in Table 1.

Table 1. RPP Validation Results

Num	Validated Element	Expert Lecturer		Practitioner
		1	**2**	
1	Development of statements according to indicators	Very good	Very good	Very good
2	The formulation of the observed aspects is in accordance with the guidelines for the preparation of the RPP in Permendikbud Number 81A of 2013	Very good	Very good	Very good
3	Formulation of statements briefly, clearly, and firmly	Very good	Good	Very good
4	Compilation of only the required aspect statements	Good	Good	Very good

Num	Validated Element	Expert Lecturer		Practitioner
		1	**2**	
5	The formulation of the description of the observed aspects is clear	Very good	Very good	Very good
6	The use of language in the observed aspects is clear and concise	Good	Good	Good
7	Use of language that is good and correct and in accordance with the variety of languages	Good	Very good	Good
8	Use does not lead to multiple interpretations	Good	Very good	Good
9	Use of common language or verbs (not local language)	Very good	Good	Very good
10	The use of language does not contain words that offend the respondent	Good	Very good	Very good

The validator provides recommendations for using TPACK-loaded biology learning tools. Content knowledge and pedagogical knowledge are contained in the observation stage and trained in the learning process. However, knowledge of technology must be trained so that prospective biology teachers are able to apply technological knowledge in biology learning. The use of technology in learning can improve students' knowledge and critical thinking skills (Putri et al., 2018).

Furthermore, the results of the validation of the Learning Practice Observation Instrument can be seen in Table 2.

Table 2. Results of Validation of Learning Practice Observation Instruments

Num	Validated Element	Expert Lecturer		Practitioner
		1	2	
1	Development of statements according to indicators	Very good	Very good	Very good
2	The formulation of the observed aspects is in accordance with the activities of prospective teachers in implementing the 2013 Curriculum in the classroom	Very good	Very good	Very good

Num	Validated Element	Expert Lecturer		Practitioner
		1	2	
3	Formulation of statements briefly, clearly, and firmly	Very good	Good	Very good
4	Compilation of only the required aspect statements	Very good	Good	Good
5	The formulation of the description of the observed aspects is clear	Good	Very good	Very good
6	The use of language in the observed aspects is clear and concise	Good	Good	Very good
7	Use of language that is good and correct and in accordance with the variety of languages	Good	Good	Very good
8	Use does not lead to multiple interpretations	Very good	Good	Very good
9	Use of common language or verbs (not local language)	Very good	Very good	Good
10	The use of language does not contain words that offend the respondent	Baik	Very good	Good

Learning Practice Observation Results

The average results of learning practice observations on 37 prospective teachers can be seen in Table 3.

Table 3. Average Learning Practice Observation Results

Num	Validated Element	Average Observation Results
1	Prepare students psychologically and physically to take part in the learning process.	Very good
2	Motivating students to learn contextually according to the benefits and application of teaching materials in everyday life	Very good
3	Do apperception	Very good

Num	Validated Element	Average Observation Results
4	Delivering learning objectives and basic competencies to be achieved by students as well as the steps for learning activities	Very good
5	Ability to adapt material to learning objectives	Very good
6	Presenting a proper and complete discussion of learning material in accordance with the correct concept and reflecting the strengthening of character values	Very good
7	Presenting material systematically in accordance with the competencies that will be achieved by students	Very good
8	Carry out learning following the RPP framework	Very good
9	The learning carried out is interactive, interesting, and fun	Very good
10	The learning carried out motivates students to participate actively and meaningfully (meaningful), as well as foster independent thinking and acting	Very good
11	The practitioner gives questions to students with probing questions to encourage reasoning skills.	Very good
12	The practitioner encourages students to develop questioning skills to build the habit of finding out (inquisiveness).	Good
13	Accommodating the development of learning technology in accordance with the concepts and principles of Techno-Pedagogical Content Knowledge	Very good
14	Demonstrate skills in utilizing learning resources and learning media	Very good
15	The media and learning resources used are able to produce interesting and impressive messages	Very good
16	Involve students in the use of learning resources and learning media	Very good
17	Practicing Growing active participation of students through the interaction of teachers, students, and learning resources	Very good
18	Respond positively to student participation and be open to student responses	Very good
19	Demonstrate conducive and constructive personal relationships	Very good
20	Shows the joy and enthusiasm of students in learning	Very good

Num	Validated Element	Average Observation Results
21	Using good, correct, and contextual Indonesian	Very good
22	Using word choices that are easily understood by students	Very good
23	Doing reflection to evaluate	Very good
24	Provide feedback on the learning process and results	Very good
25	Carry out follow-up in the form of directives for follow-up activities / individual and group assignments	Very good
26	Inform the learning activity plan for the next meeting	Very good

The content knowledge aspect is categorized as very good. Biology teacher candidates present detailed and in-depth material for each of the sub-concepts of discussion. The pedagogical knowledge of students is in the good category. This can be seen at every stage of the learning process, the right teaching skills always appear. Furthermore, the use of technology in the implementation of the learning process is good. This is a form of classroom management skills. Class management skills are one of the basic teaching skills that aim to create and maintain an optimal learning atmosphere, meaning that this ability is closely related to the professional ability of teachers to create favorable conditions, delight students and create healthy learning disciplines (Sunhaji, 2014). The relationship between TPACK elements for prospective biology teachers can be seen in Table 4.

Table 4. The relationship between the elements of TPACK

Num	TPACK Element	Description
1	Linkage of Content and Pedagogy	Content knowledge strongly supports pedagogical knowledge, the choice of how to present the material is largely determined by the structure of the material to be studied.
2	Content and Technology Linkage	Content Knowledge greatly influences the appropriate technological knowledge to be integrated in biology learning.
3	Linkage of Pedagogy and Technology	Pedagogical knowledge can be supported by knowledge and ability to use and utilize technology in learning.

Num	TPACK Element	Description
4	TPACK	Elements of content knowledge, pedagogical knowledge and technological knowledge support each other to present systematic multidisciplinary subject matter in applied fields.

Results of Student Biology Teacher Candidate Responses

The results of the responses of prospective biology teacher students in the preparation of learning tools and biology teaching practices containing TPACK can be seen in Table 5.

Table 5. Results of Biology Teacher Candidate Student Responses

Num	Statement	Biology Teacher Candidate's Response
1	Learning contains student-centered activities	Pedagogical knowledge requires always involving students in learning activities
2	Ability to develop TPACK-based biology learning tools	The learning tools that are prepared must present the right content, the right learning strategies, the right assessment and integrate technology in learning.
3	Ability to present material systematically	Content knowledge requires studying the material in depth in compiling the teaching materials that will be used
4	Deeper content ability and mastery	Mastery of content from basic to applied in more detail
5	Increased pedagogical knowledge	Careful teaching skills always emerge.
6	Increased ability to use technology	The ability to use technology-laden learning media in every learning process.

The response of prospective teacher students to the preparation of biology learning tools containing TPACK and its implementation is in the good category. The results of the responses of prospective biology teacher students stated that biology content must be mastered well, teaching skills and other pedagogical elements must be mastered well and good debriefing to integrate technology in biology learning. This is in accordance with the opinion (Sari, 2018) which states that a teacher must be able to prepare learning well. so that the pedagogic competence of the teacher can be fulfilled (Susilo et al., 2016).

CONCLUSION

Based on the results of the study, it can be concluded that the description of students' pedagogical knowledge is in the good category. Students are able to apply teaching skills in delivering material and facilitating the learning process. The description of students' content knowledge is categorized as quite good. Students present the material systematically and contain higher order thinking. Description of student technology knowledge is in the poor category. Students have not yet delivered material in the integrated learning process with technology.

REFERENCES

Anggiasari, T., Hidayat, S., & Harfian, B. A. A. (2018). Analisis Keterampilan Berpikir Kritis Siswa SMA di Kecamatan Kalidoni dan Ilir Timur II. BIOMA: *Jurnal Ilmiah Biologi*, 7(2), 183–195.

Baya'a, N., & Daher, W. (2015). The Development of College Instructors' Technological Pedagogical and Content Knowledge. *Procedia - Social and Behavioral Sciences*, 174, 1166–1175. https://doi.org/10.1016/j.sbspro.2015.01.733

Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research (4th ed.).* Pearson Education, Inc.

Hapsari, T. R., Rambitan, V. M. M., & Tindangen, M. (2018). Analisis Permasalahan Guru Terkait Perangkat Pembelajaran Berbasis Model Examples Non Examples dan Permasalahan Siswa Terkait Hasil Belajar Biologi di SMA. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan,* 3(2), 204–209. http://journal.um.ac.id/index.php/jptpp/

Harfian, B. A. A. (2017). Kemampuan Guru Biologi dalam Pengimplementasian Kurikulum 2013 Ditinjau dari Kompetensi Pedagogik. *Jurnal Biologi Dan Pendidikan Biologi*, 2(2), 11–17.

Harfian, B. A. A. (2018). Implementasi Kurikulum 2013 Ditinjau dari Kompetensi Pedagogik Guru SMA Negeri di Kecamatan Ilir Barat I Palembang. *Edubiotik*, 3(1), 6–14.

Harfian, B. A. A., & Fadillah, E. N. (2018). Studi Keterlaksanaan Pendekatan Saintifik pada Proses Pembelajaran Biologi dalam Implementasi Kurikulum 2013 di SMA Negeri Kota Palembang. BIOMA: *Jurnal Ilmiah Biologi*, 7(2), 123–139.

Holland, D. D., & Piper, R. T. (2016). A Technology Integration Education (TIE) Model for Millennial Preservice Teachers: Exploring the Canonical Correlation Relationships Among Attitudes, Subjective Norms, Perceived Behavioral Controls, Motivation, and Technological, Pedagogical, and Content Knowledge (TPACK) Competencies. *Journal of Research on Technology in Education,* 48(3), 212–226. https://doi.org/10.1080/15391523.2016.1172448

Kurniyasari, H., Hidayat, S., & Harfian, B. A. A. (2019). Analisis Keterampilan Berpikir Kritis Siswa SMA di Kecamatan Sako dan Alang-Alang Lebar. *Bioma : Jurnal Biologi Dan Pembelajaran Biologi,* 4(1), 1–15. https://doi.org/10.32528/bioma.v4i1.2646

Polly, D., Mims, C., Shepherd, C. E., & Inan, F. (2010). Evidence of impact: Transforming teacher education with preparing tomorrow's teachers to teach with technology (PT3) grants. *Teaching and Teacher Education,* 26(4), 863–870. https://doi.org/10.1016/j.tate.2009.10.024

Putri, E. R., Hidayat, S., & Harfian, B. A. A. (2018). The Analyzing of Critical Thinking Skills on Students of High Schools Grade X in Plaju and Seberang Ulu II District. *Jurnal Pena Sains,* 5(2), 96–105.

Sari, K. N. (2018). *Pengembangan Lembar Kerja Siswa (LKS) Berbasis Moodle Sebagai Media Pembelajaran Interaktif pada Materi Archaebacteria dan Eubacteria.*

Sugiyono. (2014). *Metode Penelitian Kuantitatif, Kualitatif, dan R & D.* Alfabeta.

Sunhaji. (2014). Konsep Manajemen Kelas dan Implikasinya dalam Pembelajaran. *Jurnal Kependidikan,* II(2), 30–46.

Susilo, A., Siswandari, & Bandi. (2016). Pengembangan Modul Berbasis Pembelajaran Saintifik untuk Peningkatan Kemampuan Mencipta Siswa dalam Proses Pembelajaran Akuntansi Siswa Kelas XII SMA N 1 Slogohimo. *Jurnal Pendidikan Ilmu Sosial*, 26(1), 50–56.