Redesign of Technological Pedagogical Science Knowledge based on Local Culture

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Abstract—This research is a literature study and the method used is Systematic Literature Review (SLR). The advancement of the educational world demands a renewal of knowledge and skills in accordance with the demands of the development of 21st century education. Teachers must be able to integrate between content, pedagogy, and technology by lifting culture local in classroom learning practices. Local culture-based learning is used by teachers who must be adapted to the subject matter presented under the curriculum. The important thing here is how students are able to understand and master the concept of science through local culture using current technology. The design of the learning model begins with a redesign of TPSK integration indicators. Redesign of Technological Pedagogical Science Knowledge (TPSK) Based on existing Local Culture can be used by teachers as a reference in developing learning model that integrates technology, pedagogy, knowledge. TPSK in science learning should be tailored to the needs and facilities available in schools.

Keyword—redesign, tpsk, local culture.

I. BACKGROUND

Currently the demands in the world of education, students must be equipped with the science in accordance with the development of 21st century education. This becomes one of the teacher’s task that is part of the professionalism of a teacher. Koehler, et al. in [1] stated that the teacher's professional ability implies the content, pedagogy, and technology he possesses. The use of technology in science learning is emphasized to science teachers who are adapted to meaningful pedagogical frameworks in learning materials [2] and are expected to assist students in learning science [3].

The integration of content, pedagogy, and technology is packaged in Technological Pedagogical Content Knowledge (TPACK). The TPACK is currently regarded as an essential framework for promoting instructional competence of 21st century teachers [4]. One of the challenges of 21st century education is finding and developing efficient tools for learning. Therefore, a teacher needs to know the foundation in utilizing computer technology to be used in teaching. Teachers need to apply local culture-based learning using technology. Technology as a powerful tool for changing classroom teaching practices that are considered effective. In line with Awolaju's in [5] opinion, Abdu-Raheem in [6], Musa and Agwagah in [7] which states that projected learning using media will be better than without projected using instructional media.

Effective learning practices contribute to the quality of learning. According to Chen, Hendricks, & Archibald in [8] quality teaching practices need to apply appropriate strategies, make use of comprehensible language, encourage learners’ engagement, and be responsive to the needs of learners. Teachers and learners can use new technologies to collect, organize, and evaluate information to solve problems and innovate practical ideas in the real world [9]; [10]. According to Jimoyiannis in [10] Information and Communication Technology (ICT) is deemed inherent to the educational reform effort needed for 21st century society that can produce fundamental changes. Particularly in ICT-based science learning is potentially and highly effective as they provide opportunities for active learning, enabling learners to have higher cognitive levels, support constructive learning, and promote scientific inquiry and conceptual change. TPACK for science teachers according to Angeli & Valanides in [11] and Jimoyiannis in [10] includes knowledge of representation, science curriculum, learners’ understanding of science, various educational contexts, ICT tools capabilities, etc.

Implementation of education according to what the 21st century education aspires is not as easy as imagined. There are still some things that become obstacles in practice in the world of education today. In general, teachers recognize the importance of introducing ICTs in the learning process, but teachers tend to be less in applying ICT in the classroom and less sure of their potential to improve the learning process [12]; [13] This is in line with the views of Mumtaz [14] and Afshari, et al. in [15] which state that teachers’ lack of knowledge and trust in the use of ineffective technology in the classroom, along with common problems such as lack of good technological tools.

Teachers tend to use ICTs for the sake of academic tasks such as searching for information on the internet or for administrative purposes e.g. looking for examples of learning tools, etc. rather than being used as a classroom learning tool [13]. The ICT development tends to focus on the technological aspects of how to use various tools in learning while pedagogical and instructional problems are why and how the tools can be used to enhance learning are often considered ordinary or under-noticed.

The rest of this paper is organized as follow: Section II describes proposed research method of this work. Section III presents the obtained results and following by discussion IV. Finally, Section V concludes this work.

II. PROPOSED METHOD

The method used in this research is Systematic Literature Review (SLR) which according to Mulrow in [16]...
is one of scientific activities. This research is conducted by conducting systematic literature review by taking and integrating existing information. The resulting information integration results are then used to provide direction for the study effectively. A systematic literature review is used to (a) define, rationalize, and revise predetermined hypotheses, (b) understand and minimize previous assignments, (c) obtain estimates of numbers, and (d) identify important confounding effects and necessary covariates considered in future studies [16]. Literature can be analyzed in six components of interest i.e. the database is used to retrieve articles, theoretical perspectives used to conduct systematic integrated literature review, quality assessment tools, integration tables and contents, methods used to categorize articles, and methods used to synthesize findings which is obtained.

III. RESULTS AND DISCUSSION

TPACK in Local Science-Based Science Learning

Learning of the 21st century has launched significant changes in learning methods by involving students in every learning activity. In an effort to create sophisticated learning today, teachers should be able to act as facilitators who provide the greatest opportunities for students to express themselves in the learning process. TPACK is an integration of content, pedagogy, and technology. According to Rosenberg and Koehler in [17] there are still most who do not fully understand about TPACK. Koehler found an interest in something unique: the overlap between technology, pedagogical, content, and knowledge. The uniqueness is the inclusion to provide a unified experience in which a teacher can combine their knowledge with more specific content and then how to effectively teach the content (pedagogy) as well as what technology is used to provide an effective learning experience to learners.

According to the results of the survey proposed by O’Bannon and Thomas [18] found that preservice teachers recognize and use more features of smartphone, but they are not enthusiastic about using smartphones in learning. Further development, not limited to here but the use of technology must be integrated in learning between technology, pedagogic, content and knowledge. The purpose of this integration for future teacher education. This is in line with the opinion of Jen, et al. in [19] which suggests that not only how well teachers can teach with technology, but also a constructive direction for future teacher education. Niess, et al. in [20] argues that TPACK development of teachers usually begins by recognizing technology in learning and shaping attitudes and beliefs in accepting their values, especially when teachers motivate learners by providing technically supported instruction or properly guided in learning with using a particular technology.

Research on TPACK has previously been done focusing on content coverage and grade level with respect to practice [21] development of instrument measurement [22], teacher [23], focusing on theory [24], and research was undertaken at higher education [25], as well as further research into the processes and products of TPACK’s leadership diagnostic tool [25]. Currently seven TPACK construction components namely TK, PK, CK, TPK, TCK, PCK, and TPACK have been studied by educational technology researchers such as Angeli, et al. in [26]; Brantley-Dias & Ertmer in [27]; Voogt, et al. in [28]. They do research on TPACK by dividing it into seven components which then inter-component integrate into TPACK.

In addition, previous research has been done Aktas & Yurt in [29] which is about the influence of learning using digital story which gives effect of positive influence to the level of academic achievement of learners. This is also in line with many studies in the literature which show that digital storytelling in learning can increase the academic achievement level of learners because it allows them to conduct individual research, actively participate in learning and learning processes through experience [30], [32], [33], [34], [35], [36]; [37]; [38]; [39]; [40]. This proves that many have done research related to TPACK and success.

Research conducted Sato and Haegle in [41] stated that the involvement of educators in the online physical adaptation of professional development graduate education resulted that with the presence of instructors online, it can change their teaching style (pedagogical orientation). This suggests that instructions given online can be understood and performed by observers. Local science-based science learning is the creation of a learning environment and the design of a science-learning experience that integrates local culture as part of the learning process of science. In the process of learning based on local culture, it means that culture is integrated as a tool in the learning process.

Figure 2 describes the integration matrix of PSK and TSK. Meanwhile, Figure 3 depicts the integration matrix of PTSK and TPK.
Figure 2. Integration Matrix of PISK with TSK

![Figure 2](image-url)
From Figures 2 and 3, they can be described as follow:

A. PSK (Pedagogical Science Knowledge)

1. Scientific Knowledge
   - Structure of Science
   - Facts, Theories, and Practices
   - History and Philosophy / Paradigm of Science
   - Nature of Science
   - Relationship between Science, Technology, and Society

2. Science Curriculum
   - General Purpose of Science Education
   - Special Learning Objectives for Various Units
   - Philosophy of Science Education Curriculum
   - Available Resources

3. Transformation of Scientific Knowledge
   - Organizing Scientific Knowledge (facts, theories, practices)
   - Representation of Scientific Knowledge (images, graphics, vectors, mathematics)
   - Teaches Nature of Science
   - Teaches Science, Technology and Society

4. Difficulty Learning Students about Certain Fields
   - Early Knowledge of Students
   - Student Misconception
   - Student Cognitive Barriers
   - Skill of Scientific Method of Student
   - Student Learning Profile

5. Learning Strategy
   - Promote student motivation and involvement
   - Using practical / experimental work
   - Use of Scientific Inquiries
   - Use of Scientific Explanations

B. TSK (Technological Science Knowledge)

1. Resources and Tools Available for Science Subjects
   - Simulation
   - Props
   - Spreadsheets
   - Concept maps
   - MBL settings
   - Multimedia
   - Web app
   - Source Wb Scientific
   - Web 2.0 Application

2. Operational and Technical Skills Associated with Scientific Knowledge
   - Use of an effective simulation to model material
   - Use of an effective concept map to model material
   - Use of MBL settings to support specific material experiments

3. Transformation of Scientific Knowledge
   - Dynamic representations of specific scientific knowledge
Redesign of Technological Pedagogical Science Knowledge (TPSK) based on existing local culture can be used by teachers as a reference in developing learning model that integrates technology, pedagogy, knowledge. TPSK in science learning should be tailored to the needs and facilities available in schools.

REFERENCES


