The Application of Technology, Pedagogy, Content, Knowledge (TPACK) During The COVID-19 Pandemic

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Abstract

This study aims to explore the application of TPACK during the Covid-19 pandemic in online learning. This research used narrative interviewing to analysis data. The participants were students and lecture who participated in online learning, with data collection interview with some lecture and student. The student's participants in this study were willing to respond utilized Google Forms with open questions for collecting data. The research findings that students' responses to the learning plan, learning content, learning strategies, class management, learning assessments, and supporting skills. It can be seen that student responses to the application of TPACK were based on online learning during the pandemic. The results showed three issues i.e. pedagogy knowledge, content knowledge and technical knowledge which were described in several indicators i.e. lesson plan, content material, teaching strategies, assessment, class management, and supporting skills. The mastery of TPACK itself was still not fully understood and conducted by lecturers in integrating technology-based material due to time constraints, lack of creativity in designing, and lecturers are more comfortable using conventional methods in delivering material, namely PowerPoint. This

research implied that online learning changes not yet increased the lecturers' creativity in designing teaching materials. Even though they obtained knowledge from attending workshops on teaching material design, lecturers still need assistance designing teaching materials according to the TPACK consept.

Keywords: *TPACK application, Online learning, Covid-19 Pandemic*

Abstrak

Penelitian ini bertujuan untuk mengkaji penerapan TPACK pada masa pandemi Covid-19 dalam pembelajaran online. Penelitian ini menggunakan wawancara naratif untuk menganalisis data. Partisipannya adalah mahasiswa dan dosen yang mengikuti pembelajaran online, dengan pengumpulan data wawancara dengan beberapa dosen dan mahasiswa. Partisipan mahasiswa dalam penelitian ini bersedia menanggapi memanfaatkan Google Forms dengan pertanyaan terbuka untuk pengumpulan data. Hasil penelitian menemukan bahwa respon siswa terhadap rencana pembelajaran, isi pembelajaran, strategi pembelajaran, pengelolaan kelas, penilaian pembelajaran, dan keterampilan pendukung. Terlihat respon siswa terhadap penerapan TPACK berbasis pembelajaran online di masa pandemi. Hasil penelitian menunjukkan tiga hal yaitu pengetahuan pedagogi, pengetahuan isi dan pengetahuan teknis yang dijabarkan dalam beberapa indikator yaitu RPP, materi isi, strategi pengajaran, penilaian, pengelolaan kelas, dan keterampilan pendukung. Penguasaan TPACK sendiri masih belum sepenuhnya dipahami dan dilakukan oleh dosen dalam mengintegrasikan materi berbasis teknologi karena keterbatasan waktu, kurangnya kreativitas dalam mendesain, dan dosen lebih nyaman menggunakan cara konvensional dalam penyampaian materi yaitu PowerPoint. Penelitian ini menyiratkan bahwa perubahan pembelajaran online belum meningkatkan kreativitas dosen dalam merancang bahan ajar. Meskipun memperoleh ilmu dari mengikuti workshop desain bahan ajar, dosen tetap membutuhkan pendampingan merancang bahan ajar sesuai konsep TPACK.

Kata Kunci: *Penerapan TPACK, Pembelajaran Online, Pandemi Covid-19*

INTRODUCTION

In the beginning of 2020, the society in the world was being socked with the appearing the COVID-19 virus in China (Lee, 2020) as a pandemic on 11th March 2020

forwards spreading all over the world in a year. Education sector then removes from the face-to-face classroom interaction into online/virtual classroom using technology which is called as e-learning classroom. In the industry era 4.0, all citizens in this world are required to fulfill the mastery of technology in managing their works, activities, and way of life. Moreover, this pandemic outbreak make many people should be aware with their healthy as well as their process of educating for teachers and students (Cucinotta, and Vanelli, 2020). Even though, the COVID-19 hits the way of teachers and students' interaction in teaching and learning, they have to solve this problem by using technology to support the online/virtual classroom. This way of life is called as the new normal of life since it requires people to stay healthy by washing hands with soap, using face shield/masker, and keep distance each other. Additionally, to conduct the education in the pandemic period, the school and institution create a breakthrough beyond the online classroom using technology and applying it to support teachers in teaching the materials and students to have online learning at home. Based on that explanation, the writer thinks that using (TPACK) technology, pedagogy, content knowledge is a must as the way of solution in hosting the teaching and learning process during the pandemic outbreaks.

Learning in the 4.0 era is related to technology, humans, and the environment. These elements cannot be separated because they support one another and reinforce the learning process to be more interactive and innovative. In the 4.0 era, the community faced considerable challenges in encountering the Covid-19 pandemic, which impacted all fields, including education, where learning has to continue by utilizing technology through online learning (Kaur, 2020). By the COVID-19 Pandemic condition, the learning portrait has changed from face-to-face in conventional class to learning that uses information technology online (virtual) or e-learning. Pham (2020) described how this global pandemic had impacted higher education and institutions appreciate the benefits of e-learning and the technology-based education modalities among universities and policymakers while planning to adopt them in post-COVID-19 condition. Hammond (2020) identified students' academic and social-emotional needs by preparing for a combination of distance learning, blended learning, and classroom learning. These expectations, along with the need for a greater emphasis on fairness-focused teaching and learning, raise standards for educators' and lecturers' preparation. Cutri (2020) explained that online transition in the crisis context changes normal longitudinal perceptions of preparation and readiness. This new temporality feeling is linked to the unexpected benefit of bringing educators into partnership with their students. Then, Cutri (2020) showed that students are access to online learning and manage scholarship demands and university and academic community service assignments that require the attention of professional development designers and policymakers.

However, the integrated technology application as support was still not widely mastered. Conditions in the field indicated that the teaching assistance process is less intensive in developing technology-based teaching materials. Currently, assistance is

needed to the lecturers so they will have digital literacy competencies. The importance of using digital tools especially for pedagogical purposes, is needed in the field to create a digital learning and teaching environment. Therefore, it is highly significant to help educators improve technological competence. It explained that research contribution when educators can integrate technology, it will be an effective solution in achieving learning objectives, curriculum development, continuous assessment, and interventions based on student needs in developing 21st-century skills. The implications of research in online learning must enable teachers to integrate material with technology in pedagogy so that learners will be motivated to learn. This study explores the TPACK application in learning during a pandemic.

LITERATURE REVIEW

TPACK's work theory includes ontological aspects (the use of technology is the same as the use of teaching materials) and epistemological aspects (the need for students to learn through representation). Shulman (1987) initiated the concept of Technology, Pedagogy, Content, Knowledge (TPACK) in teaching. Then, it was further developed by Kohler & Mishra (2008) to become knowledge for educators in conducting learning that links content, pedagogy, and technology as an integral part of the learning process. The domains of technical knowledge and pedagogical knowledge explains how teachers can use technology for an educational purpose, the domains of technical knowledge and content knowledge explains how teachers can integrate technology into a particular subject content. Lastly, the domains of pedagogical knowledge and content knowledge explains how teachers can use content together with subject didactic knowledge in the students' teaching practice.

Harris et al. (2009) claimed that the integration of technology in classroom teaching is the main key of successful teaching beyond the curriculum and content materials at school. Judith et al. (2011) argued that problem solving in learning activity might use the collaboration between technology and lesson instruction go inline. Furthermore, teacher can use technology to support the way they deliver the materials through online teaching even though they do not consider a lot its teaching pedagogy and content knowledge within its process (Angeli, Valanides & Christodoulou; Schmidt-Crawford, & Slykhuis; Schmidt- Crawford, & Jin (2018). Technology, pedagogy and content knowledge (TPACK) is part of teaching sets which is dynamic, creative and active conducted by teachers in the classroom. By this case, it needs to explore more dealing with the setting of online classroom management (Koehler, Mishra, & Cain; Mishra & Koehler, 2013; Oyanagi dan Satake, 2016). The application of TPACK, teachers and students will collaborate each other to teach and learn during the pandemic using online technology (see this figure 1):
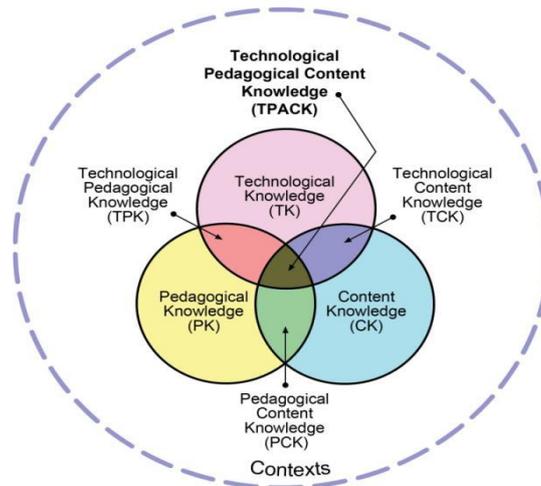
Figure 1. Component of TPACK
(source: http://www.tpack.org/)

Mishra & Koehler (2008) stated that TPACK includes three interrelated knowledge, namely technology, pedagogy and content. TPACK is an understanding of the interaction of the three components. TPACK integrates concept and technique of pedagogy in teaching and learning process in order to develop the materials. World Economic Forum (2017) explained that the role of technology is the important skill that might belong by teachers and students to enable achieving good communication, good creative thinking, and collaborative spirit in building the knowledge and skill in 21st century. This is the figure 2 about closed-loop instructional system that should be possessed by teachers and students.
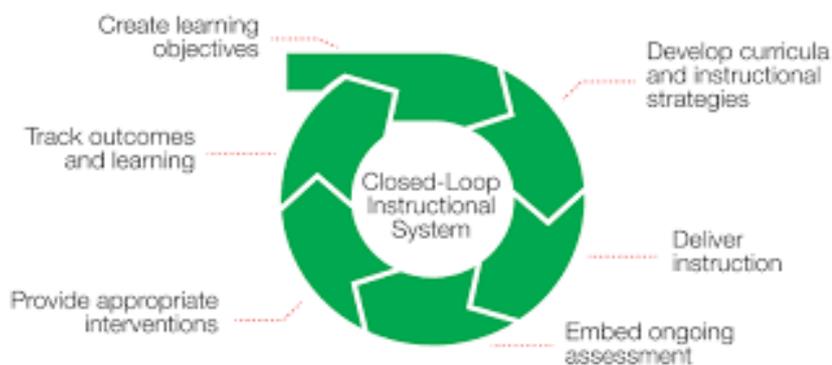

Figure 2
Closed-loop instructional system
Source: World Economic Forum (2015)

The figure 2 describes that teachers need to integrates their materials, teaching technique, assessment and evaluation through technology to achieve the goals of education in 21st century. In the previous research, Chai et al. (2013) stated

that educators need TPACK for effective learning in class. The application development of technological knowledge, pedagogy, and content in teaching is a must to support activities in the learning process (Wu, 2020). As reported by Schmidt (2017), TPACK integrates technology with teaching to make it more effective. Wang (2018) reviewed that the TPAC can explore students' critical thinking in learning. Hammond (2020) discussed what policymakers and educators could do to meet students' social, emotional, and academic needs. In the previous research, Chai et al. (2013) stated that educators need TPACK for effective learning in class.

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METHODS

Research Desain dan Data Collection

The context of the research was in the institution of higher education in Indonesia. The purpose of this research was to explore an in-depth experiences of lectures' instructional practices as viewed through the application of TPACK framework. Given the intention of this study, to explore an experiences, we used a qualitative methodology (Patton, 2002) to explore the experiences, perspectives, and practices of application TPACK on online learning. We applied a case-study inquiry to allow for an individual contextual analysis (Yin, 2014). A case study yielded in-depth descriptions and understandings of several cases (participan) through data collection period (Creswell, 2013; Yin, 2014). The participant was selected based on the criteria who participating in online learning and willing to answers some question to interview as the data collection technique. The instrument used in this study from Fisher et al. (2015) regarding the TPACK elements i.e.: technology, pedagogy and content knowledge. The students' responses with some indicator to the learning plan, learning content, learning strategies, class management, learning assessments, and supporting skills. It can be seen that student responses to the application of TPACK were based on online learning during the pandemic. The participants used technology for teaching and learning in the classroom and get benefit from technology development. The instrument used in this study for lecturer participants from Fisher et al. (2015)

regarding the TPACK including: 1) understanding about technologies in the learning; 2) choose technologies for a learning strategies; 3) used technologies for assessing the results learning; 4) combine technologies in teaching approaches; 5) applied new technologies in the classroom. Same, the instrument used for student's responses i.e.: 1) what did you get from technology development for increase your technology skill; 2) what knowledge that you get with used technology in the pandemic covid-19 era.

Data Analysis

This research used a transformative approach, used a narrative interviewing analysis with a phenomenological approach in which a Covid-19 pandemic is an event that occurs worldwide so that humans construct meaning in an intersubjective and interpretive manner (Corbin & Strauss, 2008). It means that individuals will interpret certain things differently based on their experiences viewing something that happened. Corbin and Strauss (2008) used interpretivism paradigm to declare the participant individually define their empirical experienced in joining and attending the online classroom. This phenomenon is the same as Little John (2011) has studied about the participant's interpretation through empirical settings.

FINDINGS AND DISCUSSION

The findings showed that student's participants responses through google form media to the TPACK application in learning during this pandemic covered three issues. They were knowledge (material), the use of technology, and pedagogy (managing learning), which were described in several indicators. Those indicators comprised of lesson plans, learning content, learning strategies, learning assessment, classroom management, and supporting skills such as the data presented in figure 3 below:
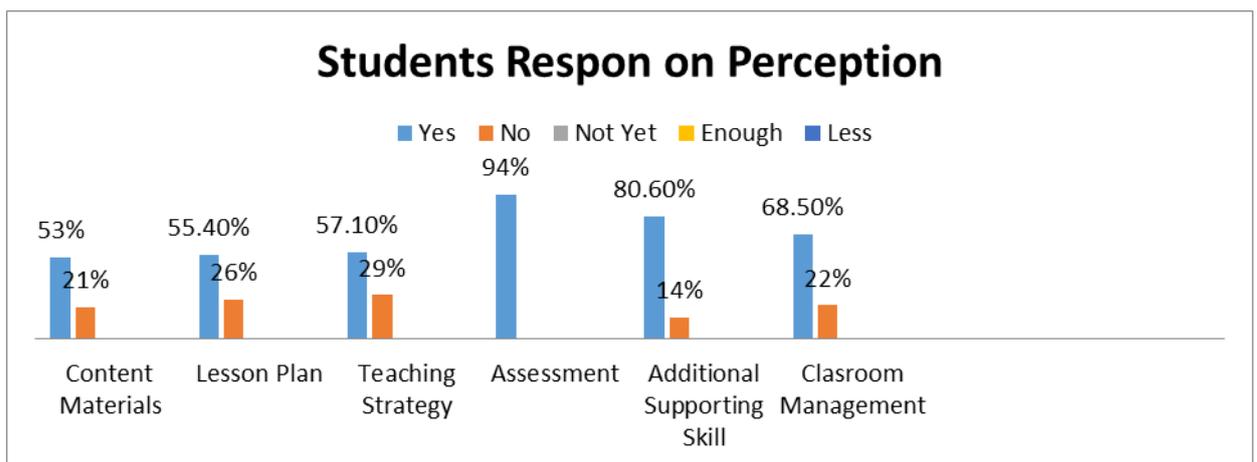

Figure 3: Percentage of student's participant responses

Following are the participants' responses to the TPACK application, which includes:

1. In the learning content, each subject obtained a response of 53%. It means that the content/learning materials were still in line with the curriculum and student needs because learning before and during the pandemic had not changed much. However, it is necessary to integrate material content digitally so that it is more innovative.

2. The learning plan received a response of 55.4%. It means that the course learning plan had been compiled in an online learning-based form. It included learning outcomes, activities, methods, and added online learning experiences, including activities and resources.

3. The learning strategy received a response of 57%. It means that the learning strategy was done by utilizing various available applications such as zoom, google meet, and eknows, an application provided by the institution. It is also necessary to use various learning approaches that can be combined between-group material presentations by summarizing and criticizing the reading, concluding and giving criticism, and performing case studies to provide feedback for each assignment.

4. The learning assessment received a response of 94%. It means that the learning assessment was objectively assessed according to student performance through the assignment given the same as face-to-face learning.

5. Class management obtained a response of 61%. It means that class management had been compiled according to the face-to-face learning schedule. So, the lectures continue without any obstacles in the online learning implementation.

6. Supporting skills received a response of 83%. It means that supporting skills in competency needed attention, especially for lecturers to combine material digitally so that learning can be packaged more creatively and innovatively.

The findings show that 80.6% of teacher educators need ongoing didactic training with an emphasis on the use of digital teaching content knowledge (CK), so such training provides a concrete example of how other teacher educators work with digital teaching. The most common digital services and programs used by teacher educators are digital student platforms, digital communication tools, and electronic meeting tools; these tools are used for teaching, communication and meetings, day-to-day administration, and research. Furthermore, 53% of teacher educators also need technical knowledge (TK) to interact with subject-specific content knowledge (CK) (Mishra & Koehler, 2006). The TPACK application in online learning, includes: 1) The Pedagogy Knowledge (PK) it means that the content and the lesson plan was still in line with the curriculum and the course learning plan had been compiled in an online learning-based form. It included learning outcomes, activities, methods, and added online learning experiences, including activities and resources. However, it is necessary to integrate material content digitally so that it is more innovative. The Content knowledge (CK) it means that the learning assessment was objectively assessed according to student performance through the assignment given the same as face-to-face learning. The class management had been compiled according to the

face-to-face learning schedule. So, the lectures continue without any obstacles in the online learning implementation; 2) The Technical knowledge (TK) it means that the learning strategy was done by utilizing various available applications such as zoom, google meet, and e-knows, an application provided by the institution. It is also necessary to use various learning approaches that can be combined between-group material presentations by summarizing and criticizing the reading, concluding and giving criticism, and performing case studies to provide feedback for each assignment. The supporting skills in competency needed attention, especially for lecturers to combine material digitally so that learning can be packaged more creatively and innovatively. For this reason, support is needed in the practical use of digital tools that are technically concrete and practically show how web-based education can be developed and used in higher education. In addition to having time to get acquainted with the program as a new teaching method and to get more practical workshops and real-world examples of applications to support teaching.

Konig (2020) declared that learning in the early Covid-19 pandemic period had forced educators and students to adjust to the use and utilization of technology to continue learning. In the field, at the beginning of the pandemic, both lecturers and students still used media facilities non-formally institutional product since most of the educators in the early pandemic period still could not use e-knows provided by the institution, as stated by the lecturers:

> "I usually use **Google Classroom (TK)**. I have not utilized e-knows yet at the beginning of the pandemic. It was because some lecturers did not understand its used. The hope that the socialization of **using e-knows (TK)** will be more focused so that learning can be done using the e-learning platform provided by the institution" (Lecturer HY, interview via What's app April 20, 2020). "Another statement by the lecturer (A) informed that the density of **additional assignments and many classes** (**CK**) also gave lecturers limited time to deepen supporting skills on **how to integrate technology-based content (TCK)**. Even though we also attended many workshops during the pandemic period and before the pandemic, **the material delivery was still limited** (**CK**) to our convenience in **designing it and it was still less innovative** (**TPCK**). Hence, this material design can be made together so as not to be psychologically burdensome". It is necessary to have assistance (Lecturer A, interview via WA, June 5, 2020).

The use of technology from student experiences during the pandemic also had a positive impact where students can develop themselves by expanding their knowledge and skills through learning in online spaces, which are widely offered during the pandemic. Consequently, the students became more creative, as revealed by the following participants:

"Personally, I (P) could design and learn video editing "during the pandemic because I wanted to advance my interest in graphics. Another participant said," since this online learning, I (W) joined a philanthropic institution and participated in offline research training, from distribution to assessment." It inspired me to know more about what philanthropy is and what rescue training looks like. Another participant, I (D) was the organizer of the activity and the youth organization training committee, which contained a community service unit and an anti-drug task force that was done offline. (Interview via WAG, June 10, 2020).

Narrative analysis is carried out through interviews in the application of TPACK, it was illustrated that not only students but lecturers also had many opportunities to take part in workshops during this pandemic. It directly had a positive impact on individuals to increase knowledge about the material content to the supporting skills needed to be able to elaborate on innovative teaching. In several types of activities such as problem-solving and collaboration, instructional planning approaches can be used with technology integration (Judith & Mark, 2011); and the role of technology experience is essential for the teaching skill development so that lecturers can align technology with pedagogy even if it is not related to the content (Angeli et al., al. 2016; Schmidt et al., 2017).

From the participants' responses, lecturers and students needed to integrating content and pedagogy with technology in interpreting learning. Thus, they can achieve the learning impact both offline and online. Following the TPACK implementation, which includes: The Pedagogy Knowledge (PK) it means that the content and the lesson plan was still in line with the curriculum and the course learning plan had been compiled in an online learning-based form. It included learning outcomes, activities, methods, and added online learning experiences, including activities and resources. However, it is necessary to integrate material content digitally so that it is more innovative. The Content knowledge (CK) it means that the learning assessment was objectively assessed according to student performance through the assignment given the same as face-to-face learning. The class management had been compiled according to the face-to-face learning schedule. So, the lectures continue without any obstacles in the online learning implementation. The Technical knowledge (TK) it means that the learning strategy was done by utilizing various available applications such as zoom, google meet, and e-knows, an application provided by the institution. It is also necessary to use various learning approaches that can be combined between-group material presentations by summarizing and criticizing the reading, concluding and giving criticism, and performing case studies to provide feedback for each assignment. The supporting skills in competency needed attention, especially for lecturers to combine material digitally so that learning can be packaged more creatively and innovatively.

The main findings on how teachers need to combine technology into the material to be presented as supporting skills for evaluating competence TPACK practice effectively in teaching situations by using some form of digital tools in their work. It is in line with Mishra and Koehler (2006), who explained that technology integration in teaching still lacks especially in rapid online learning. Essential factors in the TPACK framework include technology knowledge as part of improving learning, pedagogical knowledge about educators' understanding of the pedagogical process. It comprises objectives, processes, values, planning, development, and material knowledge (content knowledge) about representing the material. Pedagogical content knowledge is an interaction between content and pedagogy in which the educator interprets the material by discovering various ways/methods to convey the material with the learners' basic knowledge.

TPACK Framework

Essential factors in the TPACK framework include technology knowledge as part of improving learning, pedagogical knowledge about educators' understanding of the pedagogical process. It comprises objectives, processes, values, planning, development, and material knowledge (content knowledge) about representing the material. Pedagogical content knowledge is an interaction between content and pedagogy in which the educator interprets the material by discovering various ways/methods to convey the material with the learners' basic knowledge. Meanwhile, content knowledge technology is an interaction between technology and content development. Gomez (2015) stated that educators must transform content digitally so that learning can take place anytime, anywhere, unlimited space and time, only requires an internet network as a link. The TPACK application in the learning process that is done systematically and structurally by creating large groups (classical teaching) and small groups will overcome differences in students and help create learning speed (rate of the program) according to minimum completeness standards. It is significant for the learning process to help lecturers more optimally by involving them (Angeli et al., 2016). Mishra & Koehler (2009) reviewed that TPACK is a curriculum that integrates pedagogical concepts and techniques to aid learning and develop new methods for delivering learning material/content. They include curriculum development strategies, learning objectives, learning outcomes, learning approaches/interventions, continuous assessment, delivering instructions. When lecturers can integrate technology, it will be an effective solution in achieving learning goals, curriculum development, continuous assessment, and interventions based on student needs in developing 21st-century skills. The application development of technological knowledge, pedagogy, and content in teaching is a must to support activities in the learning process (Wu, 2020). Teacher knowledge and beliefs about pedagogy and technology determined a teacher to teach using technology (see Table 1).

Table 1. Knowledge Domains of TPACK Model

Technological, pedagogical, and content knowledge (Koehler et al., 2013)	
Pedagogical knowledge (PK).	Pedagogical knowledge and content knowledge interact when teachers can use taught content together with subject didactic knowledge in the students' teaching practice.
Content knowledge (CK).	Technical knowledge and content knowledge interact when teachers can use technology in a particular subject content.
Technical knowledge (TK).	Technical knowledge and pedagogical knowledge interact when teachers can integrate technology into an educational purpose.

Technology, Pedagogy, and Content Knowledge (TPACK) are a framework for active and dynamic learning, so that it needs professional development in the field of online teaching and relevant technology (Koehler et al., 2013; Mishra and Koehler, 2008; Oyanagi and Satake, 2016). Hewitt (2008) argued that TPCK is the basis for effective teaching with technology that requires an understanding of representations using technology; also, constructive pedagogical techniques to teach content, knowledge of complex concepts to be quickly learned, and how technology can fix several problems faced by students. Hence, these components become a framework for educators to be professional in their performance, including technological, pedagogical, and content knowledge developed by experts in research recently (Hew et al., 2019; Hernandez and Amescua, 2013). Technology integration is the key to success in the curriculum and content in the learning process (Harris and Hofer, 2017).

In general, TPACK applied to the design of professional development initiatives in higher education faculty, but not much or rare (Herring, Meacham, & Mourlam, 2016). Described by Espinoza, B. D. & Neal, 2018, to build an understanding of TPACK in a professional development program in the Faculty of Education should a more authentic experience, they can incorporate context into TPACK framework. Koh and Chai (2016) said, the importance of recognizing TPACK contextually such as institutional culture, infrastructure, interpersonal and intrapersonal relationships all influence each other so that faculty can identify barriers to effective and professional online teaching. In the following figure, contextual knowledge of the TPACK framework at the faculty in online teaching.
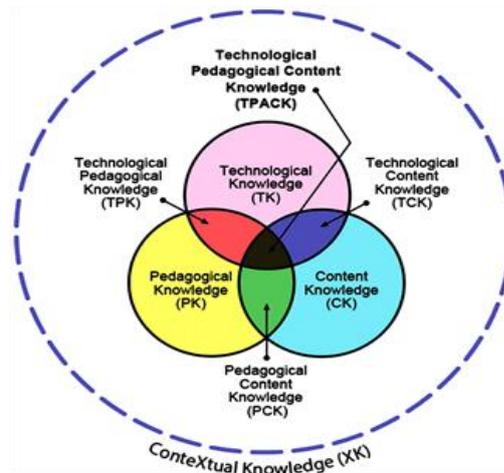
Figure 4
TPACK-ConK Framework (Koh and Chai, 2016)

In Figure 4, that incorporate contextual framework into TPACK will help determine the factors of self-knowledge and context affecting TPACK faculty development for online teaching. The TPACK framework for knowing the application of online learning in increasing student engagement. Meanwhile, Koh, Chai, & Tsai (2014) TPACK takes into account the interaction between types of knowledge (technology, pedagogical and content knowledge) in the instructional design process (Watson & Murin). Herring, Meacham, and Mourlam (2016) state that faculty must learn about the TPACK framework in order to reflect on content knowledge and teaching practices carried out to identify it into scientific disciplines. The faculty's professional development activities such as workshops, mentoring, co-teaching, research and curriculum development should be integration of each TACK domain. Professional development can help faculty to plan, implement and reflect the individual's experience with integrating technology in authentic contexts into contextual dimensions TACK models. TPACK adaptation in the context of knowledge in the implementation of faculty professional development through the integration of TPACK existing framework, namely the preparation and design that includes the time required to develop online courses. Teaching and involvement include the time to teach online, while the availability of and access to technology are resources available for use by faculty. Besides the application of TPACK, teachers also maximize and complete the curriculum during a semester by composing students in the activity of online classroom. Learning goal mastery can be achieved by tasking students with some learning activities like; learning orientation, presentation, exercising, guiding, and independent study. The students' learning might be complete if it has conveyed some principals, such as; giving assessment, conducting evaluation, hosting remedial teaching and checking the students' completeness of materials. On the contrary, the online classroom also faces some problems in its action. Many students join and attend the online classroom to have a lesson on its materials, but then, the do hidden

video and do not respond any questions and answers which are delivered by teachers. They assume that online interaction makes them feel bored and lazy to get involved in the process of teaching and learning. Instead, they love only listening with doing anything else without being interactive with the teachers' presentation on screen. This is a part of the weaknesses of using technology that cannot have a manner like human beings (sense of sadness, regretful, happy, angry, etc.) while doing interaction between machine technology and people; teachers and students. Additionally, teachers and students should be provided with the internet quota as the motor of connection in joining the internet online classroom. They need some money to consume buying the internet quota in every they have online classroom. This condition makes teachers and student lack of money otherwise in this difficult condition during covid19 pandemic. It brings the big economic impact that hits teachers and students while conducting online teaching and learning. Besides that, the positive things about this online and virtual classroom during the covid19 pandemic is that students produce feeling of care to friends and other people by cooperating and caring each other to handle many problems whenever they have the online classroom as well helping their society as they could do as the social humans.

TPACK Application

The TPACK application can help solve complex teaching problems. In several types of activities such as problem-solving and collaboration, instructional planning approaches can be used with technology integration (Judith and Mark, 2011); and the role of technology experience is essential for the teaching skill development so that lecturers can align technology with pedagogy even if it is not related to the content (Angeli et al.2016; Schmidt et al., 2017). Haris and Hofer (2017) identified that TPACK had become part of the learning needs that are the demands of the times. It includes 1) context and culture; 2) educator and student interaction; 3) applied knowledge; 4) confidence in how TPACK can be conducted; 5) technology; 6) more critical and meaningful use of TPACK; 7) TPACK as method to help individuals and groups in learning; 8) TPACK used in collaboration; and 9) TPACK as distributor in knowledge. What was still less explored is that lecturers need to improve their performance through learning strategies. It included orientation, presentation, structured training, guided training, and independent training. Konig (2020) declared that learning in the early Covid-19 pandemic period had forced educators and students to adjust to the use and utilization of technology to continue learning. The TPACK implementation must be done by studying steadily to increase student engagement in the learning process. Complete learning has main principles, including evaluation using feedback, the need for remedial, and deepening learning completeness (Gentile & Lalley, 2003). Undeniably, learning in the 4.0 era emphasizes mastery learning so that students' abilities can be improved to face competition in entering the era of society 5.0. On the other hand, hosting the online learning for students makes a challenge for schools and

institution to achieve the goal of education in industry era 4.0 and society 5.0. The usage of technology beyond the internet for education is not something special for the powerful countries (Basilia, 2020). On the contrary, students are shaped to be able to face the education in era 4.0 and society 5.0 in their future by mastering the usage of high technology, pedagogy, and content knowledge in their teaching and learning online classroom. TPACK works systematically and structurally in the teaching and learning process, moreover it can be effective in teaching big group or small group. It also facilitates the students to measure and manage the rhythm of their study based on the competence and achievement that will be received.

TPACK has integrated technology in teaching effectively. In line with this, Mishra dan Koehler (2006) argued that actually teaching using technology is still less implemented in online classroom. Some important factors in TPACK consist of technology knowledge (about the use of technology in the online classroom) and pedagogical knowledge (about the teaching circle; designing lesson plan, method and strategy, assessment, evaluation), also content knowledge (about materials presentation). Lecturers and students must be innovative in using technology in learning during a pandemic period, Constructivist principles can be applied in technology-based learning from the perspective of higher education (Asamoah, 2017). Educational institutions must be able to improve the need for online learning after the COVID-19 pandemic. Therefore, curriculum design is very important to answer problems and provide solutions for achieving learning objectives (Cahapay, 2020). Otherwise, pedagogical knowledge is the way teacher deliver the transferring knowledge through using some teaching techniques and methods to convey their materials. Instead, technological content knowledge is the integration of transferring knowledge through applying technology to support their teaching strategy and methods. This part of circle is very important to maintain the teaching process to maximize the goal of education in general (Angeli, Valanides, & Christodoulou, (2016). Lectures must know about technological / pedagogical knowledge that combines subject matter content with hyperlink technology to conduct discussions or reply to posts on discussion forums and when to respond to add explanations to the depth material.

CONCLUSION

The application of Technology, Pedagogy, Content Knowledge (TPACK) had a significant impact on teaching efficiently and effectively because mastering technologies helped lecturers deliver and distribute material more creatively and innovatively while did not leave the pedagogical side of online learning. Furthermore, the implications in online learning must enable lectures to integrate material with technology in pedagogy so that learners will be motivated to learn. The use of TPACK tends to applying ontology paradigm (the use of technology and transferring knowledge is equal) and integrating aspect epistemology (students might practice in

once time technology and materials). TPACK might explore students to rise their critical thinking. TPACK might solve a very complex problem in teaching. Chai, Koh, & Tsai (2013) mentioned that teachers need to apply TPACK to have an affective teaching. TPACK might collaborate the teaching strategy and teaching materials on era 4.0 that integrate the use of technology and environment should be imbalance in hosting education. They support each other to create the effective and innovative teaching. Recommendation are made for lectures need to understand the potential of digital tools in identifying pedagogical value in their own teaching and learning contexts to increase motivation and integrate digital technologies in addressing the learning needs of students in higher education.

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