Journal of Pedagogical and Teacher Professional Development

journal homepage: https://jptpd.uinkhas.ac.id/
https://doi.org/10.35719/jptpd.v2i1.961
2025, VOL. 2, NO. 1, 17-37

Using Video Technology with Flipped Teaching to Explore University Students' Perception of Their SRL and Instructors' TPACK

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Abstract

This study determines how the use of videos and a blended flipped class model at a university affects university students' self-regulated learning (SRL) and the instructor's technological pedagogical and content knowledge (TPACK). The proposed flipped model uses videos in-class, instead of before class, as is the case for the traditional model. This study uses mixed-method research with a case study for one university course. The results indicate that there is a significant difference in SRL and TPACK and that the videos for flipped courses are diverse, rich, and attract students' attention and interest. Watching technology videos is more efficient in class than watching them out of class. Students work together as a learning community to complete tasks, and the instructor uses technology videos to explain the topics, joins student discussion, and uses multiple strategies and abundant videos to demonstrate the relevance of different thematic units in this course. Using videos in flipped classrooms is beneficial to the university instructor's TPACK.

Keywords: Flipped Classrooms, Self-Regulated Learning, Technological Pedagogical and Content Knowledge, TPACK, Video Technology

INTRODUCTION

Flipped classrooms use constructivism in a learner-centered learning environment, so university teachers maximize the classroom time to allow students to solve problems, to provide differentiated instruction and to provide students with an environment that allows abundant social interaction. The flipped classroom has been used for in college education for some years. Flipped classrooms improve student learning (Akçayır & Akçayır, 2018; Awidia & Paynter, 2019; Hao, 2016; Sun et al., 2018; Thai et al., 2017; Wanner & Edward, 2015) and professional development for teachers (Jang, 2021; Koh & Chai, 2016), but financial constraints mean that resources must be used effectively to increase the benefit from new digital technologies.

A flipped classroom is also referred to as an inverted classroom, reversed instruction or blended learning (Baepler et al., 2014; Barnard et al.,

History:
Received : February 25, 2025
Revised : May 11, 2025
Accepted : May 12, 2025
Published : May 13, 2025

Publisher: UIN Kiai Haji Achmad Siddiq Jember
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2009; Kim et al., 2014). Students in a blended learning environment experience face-to-face and online learning and personal interaction with the teachers and other students and enjoy the flexibility and variety of online content. The flipped learning model includes pre-class and in-class activities (Lai & Hwang, 2016). Students consider that re-watching videos and revisiting content is particularly helpful during pre-class time (Lo & Hew, 2017). In-class activities allow increased individual assistance by the teacher in a group space (Lo & Hew, 2017) and learning with and from peers (Lo et al., 2017; Hao, 2016).

Instructional videos are increasingly used in higher education. Growing evidence shows the benefits of online video learning (Vieira et al., 2014; Yousef et al., 2014), using instructional videos for feedback (Hung, 2016) or tools to enhance the learning process (Vieira et al., 2014). Therefore, online courses use videos as the primary source of information. Hybrid courses use online instructional videos as supplemental material and face-to-face lectures (Graham, 2006). Video is recognized by educational researchers and educational institutions to be an effective multimedia technique. Video-based learning is a unique knowledge and skill acquisition strategy that involves learning by watching videos (Sabli´c et al., 2021). Instructional videos o improve learning outcomes by increasing interaction between learning process stakeholders, increasing learner satisfaction, enhancing reflection and feedback and promoting professional development for teachers (Kang & Es, 2019; Sabli´c et al., 2021; Weng et al., 2023).

Importance of this Study

Blended flipped learning environments add flexibility to traditional lecture-based learning environments and allow instructors to provide structure, organization, scaffolding and time management to enhance students' learning experiences (Aldhafeeri, 2015; Artino & Jones, 2012). University students must be able to regulate their learning and watch pre-course videos. However, students' self-regulation skills are often underdeveloped (Bjork et al., 2013; Winne & Jamieson-Noel, 2003) so the flipped classroom teaching model for this study allows students to watch teaching videos with the instructor during class, instead of watching videos by themselves before class. This study determines whether using technology videos for flipped teaching affects the development of university students' self-regulated learning (SRL) ability and the development of university instructors' TPACK.

Research Purpose

Previous studies have shown that traditional flipped learning significantly enhances student learning performance (Baepler et al., 2014; Chen et al., 2016; Hao, 2016; Sahin et al., 2015). Blended online flipped classes have a significant and positive effect on student performance (Lo et al., 2017; Lo & Hew, 2019). Lo & Hew (2019) noted, that video-lectures dominate asynchronous instructional activity as preparation for class but major synchronous activities include quizzes at the beginning of the session, reviews of the pre-class materials, individual and small-group activities, such as peer instruction, and/or lectures to clarify or introduce new material. To better understand the new flipped learning approach, this study determines how using technology videos in a blended flipped class model at a university affects university students' SRL and the teacher's TPACK.

REVIEW LITERATURE

Video Technology Study

Seo et al. (2021) determined the importance of student engagement in online and hybrid courses that use online video learning. However, little is known about students' goals and intentions when viewing videos. There is also limited empirical evidence of the impact of learning environments on engagement so there is limited understanding of how students learn from videos. Previous studies identified a set of engagement goals for video-based learning and studied the associated student activities in relation to the learning environment (course week, exams, and re-watches).

One study examined 116 students' film viewing activities that corresponded to their participation goals and intentions. Various engagement goals were identified, such as reflect, mark, remember, clarify, browse, search, orient and take a break. Another study used clickstream data for 387 students to determine the impact of the learning environment on students' interaction with the film. The multi-level model shows different modes of courses: online and hybrid. Students in online courses demonstrate more strategic and adaptive use of videos. Students in online courses engage in less reflection and searing.

Beege et al. (2022) determined how classes should be designed and whether teaching videos affect teaching effectiveness. The teacher's appearance and communication are important characteristics. The study of 107 college students varied the professionalism of video teachers using a two-factor between-subjects design that considered teacher appearance and communication (professional vs. non professional). A comparative analysis showed that a professional congruence between teachers' appearance and communication significantly promotes social processes and intrinsic motivation and reduces the effect of irrelevant factors if teachers have a professional appearance and communicate professionally. Mediation analyses were conducted to determine the impact of professional congruence on learning. The results of this study inform instructional design and the design of videos for learning purposes.

Kuhlmann et al. (2024) determined that the effectiveness of well-designed instructional videos for STEM learning depends largely on how students actively engage cognitively with them. Students' ability to interact with film depends on personal characteristics, such as prior knowledge. 128 undergraduate biology students watched a series of instructional videos and took a biology unit exam one week later. The results showed that more active engagement through fast viewing and rewinding positively predicts unit exam performance, but only for students with little prior knowledge. These results show that the way in which students cognitively engage with videos predicts what is learnt about these relationships and depends on prior knowledge. Researchers mine this data to measure students' cognitive engagement with instructional videos. This study highlights the importance of active cognitive engagement with video interface tools and the need for students to accurately calibrate learning behaviors from videos in relation to prior knowledge.

Self-regulated Learning in Flipped Classrooms

Flipped learning improves independent learning and self-regulated thinking: not traditional learning modes. The online learning environment is characterized by autonomy so self-regulation is critical to successful online learning (Barnard et al., 2009). Students' interest in learning and their enthusiasm for learning is enhanced by the use of flipped learning situations (Hwang et al., 2015). Lai & Hwang (2016) determined the effectiveness of a self-regulated flipped classroom approach using a quasi-experimental design for an elementary school Mathematics course. The experimental results show that the post-test scores for the experimental group are significantly higher than those for the control group. Students with higher self-regulation show significantly different learning achievements when learning using different approaches but there is no significant difference between students who exhibit less self-regulation. The results also showed that using a self-regulated strategy for flipped learning improves students' self-efficacy and strategies for planning and using study time.

Flipped classrooms give students more autonomy in the learning process, placing a higher demand on students' SRL skills (He et al., 2016; Lee & Tsai, 2011). The extent to which students are given autonomy differs according to the method for the flipped class. Students determine how much study of various learning material is required (Bouwmeester et al., 2019; Shih & Huang, 2019) and can adjust the learning pace and sequencing by pausing and rewinding instructional videos for the learning content (Abeysekera & Dawson, 2015) and decide where and when to learn. Students regulate their own learning according to their increased autonomy to achieve higher learning outcomes during flipped classes (Lai & Hwang, 2016; Lee & Choi, 2019). This study determines how the use of video technology in flipped classrooms affects students' self-regulated learning.

TPACK in Flipped Classrooms

Kohler & Mishra (2005) proposed the TPACK framework, which has seven elements or categories: 1) technological knowledge (TK), 2) content knowledge (CK), 3) pedagogical knowledge (PK), 4) pedagogical content knowledge (PCK), 5) technological content knowledge (TCK), 6) technological pedagogical knowledge (TPK), and 7) technological pedagogical content knowledge (TPACK). A review of TPACK-related questionnaires and surveys shows that few quality instruments are suited to measuring university teachers' TPACK. Most existing TPACK questionnaires and surveys allow self-description by teachers and few address students' perceptions of their teachers' knowledge (Shih & Chuang, 2013). To determine the substance of teachers' knowledge, Jang & Chen (2013) constructed a transformative TPACK survey that differs from the majority of the TPACK instruments, which use the seven components of TPACK. The study used Schulman's

PCK theory, including Subject Matter Knowledge (SMK), Instructional Representation and Strategies (IRS), and Knowledge of Students' Understandings (KSU) and Technology Integration and Application (TIA). Conceptually, the TIA dimension includes the TK, TCK, TPK and TPACK elements of the TPACK diagram. Jang & Chen (2013)'s method has been used to measure college students' perceptions of their university instructors' TPACK (Chang et al., 2015; Jang & Chang, 2016). This differs greatly from most of the existing surveys, which use P-12 teachers' self-described evaluations.

Hao & Lee (2016) surveyed more than 470 pre-service teachers to determine how using flipped learning instruction affects teachers' professional development. This analyzed the roles of individual differences and personal characteristics, such as self-efficacy for teaching and teacher knowledge. The results show that pre-service teachers exhibit self-efficacy and non-technological teacher knowledge, which are associated with most stages of concern. Females exhibit more awareness and management concerns; non-science pre-service teachers possess more information, personal and collaboration concerns. Senior teachers exhibit the greatest awareness of flipped classrooms and the effects of other personal characteristics on the stages of concern were identified. These results have implications for teacher educators and teacher education programs in terms of updating a curriculum and instruction to equip pre-service teachers' TPACK with essential knowledge and skills to teach effectively in 21st century classrooms.

Chang et al., (2015) measured the TPACK for two physics instructors using flipped classes in terms of the TPACK framework. The study spanned an 18-week semester within Taiwan and China. Pre-test and post-test TPACK surveys, instructor interviews, in-class observations and students' feedback and opinions were collected. The results show that the instructors' TPACK significantly increased from the middle to the end of the semester. The Taiwanese instructor used life examples and multimedia and the instructor in China used students' knowledge and evaluation. The results showed different teaching characteristics for both environments.

Jang (2018) determined how flipped teaching and learning classrooms affect university students' perceptions of teachers' TPACK. This study used a mixed method design that used quantitative and qualitative techniques to show that flipped classrooms benefit university teachers' TPACK. A flipped class design, including video technology and in-class activities affects university instructors' TPACK development.

METHOD

This study uses mixed-method research and a case study with quantitative and qualitative analyses (Creswell & Clark, 2011). The study spans a 16-week semester. Data from pre-test and post-test SRL and TPACK surveys, in-class observation, interviews and online students' feedback and opinions is used.

Sample

The principal researcher (instructor for this course) has 25 years of teaching experience in the university and uses a modified flipped classroom model and developed the video technology and flipped classroom model for this study. An experimental class of about 60 students were subjected to a mixed flipped classroom model. The sample group is composed of freshmen and sophomores, with a small number of senior students. Students in this university must have a specific ability to take this course. The "Technology Application and Life" course unit includes traditional life science phenomena, technology and materials, technology and environment and healthy food modules and artificial intelligence, robotic arms, unmanned stores, autonomous cars and Internet of Things applications.

A questionnaire was used to determine the students' perceptions of their SRL and the teacher's TPACK in the middle of the semester. The questionnaire was administered to students again at the end of the semester to determine their perceptions of their SRL and the teacher's TPACK.

Mixed Flipped Classroom Model and Implementation

A mixed flipped classroom model is developed by this study. This model uses digital technology resources for classroom teaching for pre-class, in-class and after-class activities and an extended assignment is combined with social resources. This model involves university students watching teaching videos with the instructor during class, instead of watching videos by themselves before class. The AI unit is illustrated as follows.

Unit example: Artificial intelligence

Pre-class activities

1. Pre-class videos selection or production:

The instructor collects course videos that are related to technology application and life, each of which is about 15-20 minutes long. The videos are from YouTube or Discovery and other media, such as artificial intelligence vs. human intelligence, robotic arms, autonomous cars and other technology videos.

2. Tronclass platform:

Teaching resources, such as course PPTs, outlines and videos were placed on the online Tronclass platform. The e-platform was used to discuss, call the roll, upload and evaluate assignments.

3. Study groups:

The first two steps require physical classes to explain the objectives, content and methods for this course. The class is divided into several study groups of 4-5 people. This number of students for course activities promotes teamwork and discussion.

In-class activities

1. Watching videos and course content

Students watch videos or course content with the instructor in the classroom to memorize and understand knowledge. Students understand basic unit knowledge through learning. Watching the video, AlphaGo defeated the Go King Lee Sedol, allows students to think about the use of technology in life, whether it increases convenience or is a threat to the future. At the beginning of class, the teacher encourages students to ask relevant personal questions about problematic elements of the course or about the class materials (class content, PPT outlines and videos), and the teacher gives a preliminary explanation and answers these questions.

2. Raise problems

Individuals (or groups) raise questions about the use of artificial intelligence in life. Each group elects a representative, or a representative is designated by the teacher, to report the results of the group discussion to the whole class.

3. Instructor's comments and summary

The teacher also provides additional explanation for each group's report, summarizes the key points of this unit or ideas that are related to life technology and uses discussion. The assignment is then uploaded to the online TronClass teaching platform and extended discussion topics are proposed.

After-class activities

1. The results of the group discussion are uploaded to the Internet

Using the online Tronclass platform, each group uploads the unit results of the group discussion for other groups, and each group member can modify the results online.

2. Extend relevant discussion topics

The results of each group's discussion vary and related questions or topics are extended for discussion. How artificial intelligence affects life is developed as a new topic and a thematic task for the group.

3. Answer extended assignments

After discussion, each group encounters questions or topics about the discussion and answers these as a case assignment to allow students want to determine the advantages and disadvantages of artificial intelligence to life. By watching a video about robot vacuums, students determine the convenience of artificial intelligence or the possible reduction of job opportunities.

Data Collection

This study uses Barnard et al.'s (2009) Online Self-regulated Learning Questionnaire (OSLQ). The instrument includes six dimensions that are related to goal setting, environment structuring, task strategies, time management, help seeking and self-evaluation. This study also uses a revised version of the 33-item instrument that was developed by Jang & Chen (2013) to measure university students' perceptions of instructors' TPACK. Four main categories of teacher knowledge, including Subject Matter

Knowledge (SMK), Representations and Strategies (IRS), Knowledge of Students' Understanding (KSU) and Technology Integration and Application (TIA), are used to study the dimensions of TPACK. Both questionnaires use a 5-point Likert-type scale response with the following anchors: 1=Never, 2=Seldom, 3=Sometimes, 4=Often, and 5=Always to measure the variables for each SRL and TPACK construct. A flipped course can match an online-aid course so the reliability and internal consistency analysis of the two scales yielded satisfactory results. These questionnaires were distributed to the students in the middle and at the end of the semester.

A semi-structured interview was undertaken. Students from the collaborating groups were interviewed to determine their opinions of the teaching and the learning model. A total of six students were interviewed. Most of these students were leaders of the small groups and were familiar with the other group members and their thoughts. This interview determined whether the instructor's TPACK had changed or the students' SRL had developed. The interviews were used for statistical analysis and to determine the ratings that were assigned to the instructor. Data was collected from multiple sources and was provided to the instructor for further discussion and reflection. The data pertains to the pre-test and the post-test, the online opinions, interviews and in-class observation.

Data Analysis

The data was analyzed using SPSS and by discussion and elaboration of the related qualitative data. For quantitative data, SPSS statistical software was used to enact a basic descriptive statistical analysis of the 5-point SRL and TPACK questionnaire and a paired sample t-test was used to compare the students' pre-test and post-test scores. Qualitative data included documentary interpretation and qualitative analysis (Bogdan & Biklen, 1998).

To determine how the instructor's knowledge of science teaching influences enactment, the results of the coding scheme that measure the instructor's knowledge are compared with those that are related to their practices, in order to identify commonalities. The statistical results for the dimensions of the students' SRL and the instructor's TPACK are combined with the results of observation and interviews to create a first and second cycle coding. Independent examination of the data by each of the researchers and comparisons of the results established the inter-rater credibility for the results.

In case of disagreements, the coders discussed their different opinions and agreed on one idea or a compromise of the ideas from all researchers. To ensure constant comparison and triangulation methods, data from interviews with students, observation of teaching, students' opinions and other complementary documents, such as online assignments and discussion, are used. This process is used to determine changes in university students' SRL and the instructor's TPACK.

RESULTS AND DISCUSSION

Results

University Students' SRL Analysis

In terms of the SRL results in Table 1, there is a significant difference for this instructor's class. For each dimension, there are significant differences in three dimensions, including environment structuring, task strategies and help seeking. The mean value for environment structuring for the post-test is the greatest (M=3.95) and the mean value of goal setting is the least (M=3.32). The post-test scores for each dimension are all greater. This study determines significant differences in the results for the three dimensions.

Table 1. University students' perception of SRL.

Dimension	Pre-test		Post-test		T
	M	SD	M	SD	
Goal Setting	3.23	0.62	3.32	0.67	-1.45
Environment Structuring	3.20	0.54	3.95	0.64	-2.95*
Task Strategies	2.63	0.68	3.53	0.76	-2.73*
Time Management	3.02	0.74	3.54	0.71	-1.32
Help Seeking	2.45	0.72	3.62	0.78	-3.03*
Self-Evaluation	3.12	0.81	3.38	0.75	-1.29
SRL (Total)	**2.85**	**0.72**	**3.52**	**0.74**	**-2.56***

*P<.05

Technology videos are diverse and rich and attract students' attention and interest

Table 1 shows the results for environment structuring. There is a significant difference in the class. For the six dimensions of SRL, the mean value for environment structuring is the greatest because the instructor provides abundant and diverse technology videos for explanatory paragraphs so students understand the course content better and avoid distraction when learning. Analysis shows that innovative teaching videos create interest and enable students to discover the best studying style and classroom environment that allows students to study more efficiently and digest knowledge more easily.

"I think the technology videos played in class are abundant, such as robots, Da Vinci's arms, unmanned shops and other thematic units". (S1 online response)

"The instructor used a video of two robots talking to each other to attract students' attention and used a questioning strategy to explore the AI theme in depth". (S2 Interview)

"The instructor inserted AI YouTube videos into PowerPoint presentations to create interest and a comfortable learning environment for students. Consequently, the course was not too boring and students learned more efficiently". (Researcher observation)

Watching technology videos is more efficient in class than out of class

The results in Table 1 for task strategies show that there is a significant difference in the results for the class because most students have slow internet speeds and low bandwidth at home so the effects of watching videos in class are better than watching videos out of class. Learning in a group is also more efficient because students in groups learn together and learn faster.

"I have slow internet speeds and low bandwidth at home. It is beneficial for me to learn thematic contents by watching videos in class, rather than watching videos out of class". (S3 online response)

"In the past, I couldn't concentrate on watching videos in flipped courses. However, in this course, I think learning is more efficient because students in groups learn together and learn faster". (S4 Interview)

Students work together as a learning community to complete tasks

There is a significant difference in the results for the dimension of help seeking, as shown in Table 1. Students watch technology videos together to understand deep learning in the AI unit so they can discuss the meaning of deep learning. Classmates also cooperate to solve problems with AI units and enhance their understanding of topics, the ability to process information and the ability to discuss. Learning in groups is also more efficient because individuals cooperate according to their expertise and students tend to concentrate more on the course.

"In order to give an oral report in the classroom, our group distributed work according to our expertise. Some people took notes, others collected data, and I delivered the presentations". (S5 Interview)

"My group uploaded the results of group learning to the website for others. I also gained experience in learning how to reflect on problems by considering other groups' results". (S6 online response)

University Instructor's TPACK Analysis

The results in Table 2 for TPACK show that there are significant differences for this class, particularly in terms of three dimensions: Subject Matter Knowledge (SMK), Instructional Representation & Strategies (IRS) and Technology Integration and Application (TIA). The mean value for TIA for the post-test is the greatest (M=4.45) and the value for Knowledge of Students' Understanding (KSU) is the least (M=4.12). The post-test scores for each dimension are all greater.

Table 2. University students' perception of the instructor's TPACK.

Dimension	**Pre-test**		**Post-test**		**T**
	M	**SD**	**M**	**SD**	
SMK	3.82	0.62	4.40	0.64	-3.35*
IRS	3.71	0.61	4.38	0.68	-3.39*
KSU	3.83	0.71	4.12	0.75	-1.26
TIA	3.91	0.65	4.45	0.70	-2.86*
TPACK	**3.81**	**0.65**	**4.32**	**0.70**	**-2.98***

*P<.05

The instructor uses technology videos to explain topics and joins in student discussions

The results in Table 2 show that in terms of Subject Matter Knowledge (SMK), there is a significant difference. Students' interviews and online responses show that the reason for the significant difference is that the instructor uses different and rich videos to allow students to understand thematic content. The instructor found that students discussed the advantages and disadvantages of adopting unmanned shops. The instructor also explained the differences between AI and human intelligence using relevant videos to enable students to understand the topic.

"The instructor used different and rich videos to enable us to understand the thematic content. After watching the video on unmanned shops, students were divided into groups to discuss the advantages and disadvantages of adopting unmanned shops to improve service in convenience stores". (S7 Interview)

"There are many different thematic units in this course, which has newer videos, and the teaching is very content-rich". (S8 online response)

The instructor uses multiple strategies and abundant videos, and demonstrates the philosophy of different thematic units

The results in Table 2 show that in terms of Instructional Representation & Strategies (IRS), there is a significant difference. Students' online responses show that the reason for the significant differences is that the instructor uses different teaching strategies and videos that are related to daily life to teach subjects in the class. The results of in-class observation show that the instructor also played demonstration videos to present the structure of physical knowledge to students. He also explained the differences between AI and human intelligence using a questioning strategy.

"The instructor used 2 to 4 videos in class for every topic. Videos created a good atmosphere so we were interested in learning". (S9 online response)

"I observed that the instructor is good at using a questioning strategy to encourage students think about themes. For example, is it possible for most people to use Da Vinci's arms for surgery? Please explain the reasons for your answer". (Researcher Observation)

Technology videos and a flipped teaching strategy model enhance the instructor's TPACK

Table 2 shows that there is a significant difference in the results for the TIA dimension, and the mean value for TIA is the greatest (M=4.45) of the values for the four dimensions. The results for in-class observation and interviews show that the instructor integrated the structure of content knowledge, multimedia, technology and platform presentation for students in this course. Students in class were required to learn various types of knowledge about AI so the instructor chose diverse technology videos and teaching methods for specific course units.

"Most theme videos I use are from YouTube and some of them are clips that increase or shorten unnecessary parts. I used PowerPoint for presentations and videos to present course content and put it online to enable students to read or study course content after class". (Interview)

"I observed that the instructor made good use of technological videos and used different teaching strategies, such as a questioning strategy, group discussion, project reports or inquiry teaching". (Researcher observation)

Discussion

This study determines how video technology with a flipped class model at a university affects university students' self-regulated learning. In terms of the SRL results in Table 1, there is a significant difference for this class. The results for this study show that students' self-regulation skills are often underdeveloped (Bjork et al., 2013; Winne & Jamieson-Noel, 2003), so for the flipped classroom teaching model for this study, students watch teaching videos with the instructor during class, instead of watching videos by themselves before class. These diverse and rich videos attract students' attention and interest, stimulate feedback (Hung, 2016) and enhance the learning process (Vieira et al., 2014). This practice helps those students who were not prepared well during previous learning processes (Sahin et al., 2015). Kuhlmann et al. (2024) showed that this type of well-designed technology videos allows students to manage their prior knowledge.

The results of this study show that the university instructor achieved significant differences in regard to environmental structuring by providing abundant and diverse videos, which created a constructive environment in a flipped classroom and enabled students to study more efficiently and digest knowledge easily. Environmental structuring in flipped classrooms often requires students to properly process and then critically assimilate information from different sources for knowledge construction (Chan, 2010; Kang et al., 2010) so university students are enabled to progressively develop a deep understanding of knowledge by convenient access to appropriate and sufficient resources and extensive sharing of useful information (Kong, 2014).

The flipped classroom affects the university students' task strategies by increasing students' responsibility for their own learning. There is a significant difference in task strategies because most students encounter slow internet speeds and low bandwidth at home. The effects of watching videos in class are probably better than watching videos out of class. University students become more self-regulated in their learning than they would in a traditional classroom environment (Lai & Hwang, 2016; Sletten, 2015).

A flipped classroom places more reliance on students' self-directed learning so the instructor must encourage to students be more responsible for their learning. If students exhibit better self-regulation in these courses, they more easily understand the learning materials without being affected by other unrelated content. University students' role in the learning process changes because they are active participants in the educational process.

The use of video technology with flipped classrooms encourages collaboration between students by allowing group work. If students are engaged in the mutual construction of shared knowledge and understanding with other students and cooperate with other students, they have a sense of a learning community (Luo et al., 2017). Students also receive timely assistance from their classmates in a flipped classroom. More time is available in the face-to-face sessions so a flipped learning environment provides students with a greater opportunity to seek help from their peers and the teacher. Scardamalia & Bereiter (2006) developed a knowledge building pedagogy and learning activities have been further enhanced to facilitate the process of knowledge creation. Knowledge building pedagogy uses group reflection to co-construct and innovate knowledge and in the process of seeking knowledge, students must think actively, transform existing knowledge into ideas and constantly revise and improve (Scardamalia & Bereiter, 2006).

In contrast to previous studies that determine students' effectiveness, this study determines how a flipped teaching and learning model affects students' SRL and the university instructor's TPACK. The instructor achieves a significant difference in terms of the overall TPACK mean value between the pre-test and the post-test and there are significant differences in the SMK, IRS and TIA dimensions. The mean TPACK values for each dimension all increase for the instructor's class, so a flipped classroom produces improvement and affects this university instructor's TPACK. In terms of SMK, the instructor provides numerous and varied teaching videos to explain the topics and joins in student discussions. The main video technology involves the integration of information technology into unit examples, to engage students' interest, enhance reflection and feedback and promote the instructor's professional development (Kang & Es, 2019; Sabli et al., 2021; Weng et al., 2023). Rich video content in a flipped class is also a major factor in enhancing university the instructor's TPACK.

In terms of IRS, the instructor uses multiple strategies and abundant videos, and demonstrates the philosophy of different thematic units. The instructional design patterns enable students to understand the course materials from different perspectives, which enhances their comprehension of the subject content (Foot & Howe, 1998). Beege et al., (2022) determined how a class teacher's communication is designed and how teaching videos affect teaching effectiveness. The instructor played demonstration videos to present the structure of physical knowledge to students and explained the differences between AI and human intelligence using a questioning strategy.

In terms of TIA, online records and interviews show that the instructor reflects on and improves their own teaching and reconsiders technology use in the next lessons. Effective teaching videos are the most important element of the teaching resources for flipped classrooms. The instructor created a teaching video for a specific thematic unit, that lasted about 10 to 15 minutes. Gorissen et al., (2012) showed that the length of video-recorded lecture-sections must not exceed 20 minutes to prevent negatively affecting the student's attitude. Numerous studies conclude that the provision of digitally recorded videos is critical for students to interact with course material in a flexible way (Kiteley & Ormrod, 2009). This also shows that video making skills and applying technology in flipped classes enhances the university instructor's TPACK.

This study determines the effects of the use of video technology in a flipped classroom on university students' SRL and the instructor's TPACK by analyzing students' questionnaire results, classroom observations, interviews and online responses from students. A limitation of this study is there is no detailed explanation of how students learn from videos (Seo, et al., 2021). This study focuses on only a Life Technology and Application course, and an AI unit in particular, so further research is necessary to determine the efficacy of this flipped classroom model for other subject areas.

A revised model to address self-regulated learning and time management problems is worthy of further study. In terms of curriculum design for flipped teaching, university teachers' design competence is associated with teachers' TPACK (Koh & Chai, 2016). The way in which the design of video technology in a flipped classroom affect instructors' professional development in this specific context and how the model that integrates flipped instruction impacts university students' critical thinking abilities are subjects for future study.

CONCLUSIONS AND SUGGESTIONS

This study concludes that using video technology within a flipped classroom significantly enhances university students' self-regulated learning (SRL). Instead of watching videos outside of class, students engage with teaching videos during class time, which promotes attention, feedback, and better knowledge retention. This model supports students who may struggle with independent preparation by creating a structured environment filled with abundant and diverse resources. As a result, students demonstrate improvement in environmental structuring and task strategies, becoming more responsible, collaborative, and active in their learning process compared to traditional classroom settings.

Additionally, the flipped classroom model positively influences the university instructor's Technological Pedagogical Content Knowledge (TPACK). The instructor shows growth in key TPACK domains such as Subject Matter Knowledge (SMK), Instructional Representation Strategies (IRS), and Technology Integration and Application (TIA). This improvement is attributed to the strategic use of varied teaching videos, questioning strategies, and continuous reflection on teaching practices. While the results are promising, the study notes its limitation in scope, focusing solely on one course and topic, and recommends further research to generalize the findings and address time management issues in SRL through improved curriculum design and flipped instruction models.

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