

Using ChatGPT to Develop University Instructors' TPACK and Students' Self-Regulated Learning

Syh-Jong Jang

Center for General Education, Asia University, Taichung

Email: jang6812@asia.edu.tw

How to cite this paper: Jang, S.-J. (2025). Using ChatGPT to Develop University Instructors' TPACK and Students' Self-Regulated Learning. *Open Journal of Social Sciences*, 13, 635-651.
<https://doi.org/10.4236/jss.2025.135036>

Received: April 21, 2025

Accepted: May 27, 2025

Published: May 30, 2025

Abstract

ChatGPT has gained popularity on social media and proves to be a valuable resource in higher education, assisting students in understanding and evaluating topics by offering topic-specific information, suggesting undiscovered aspects, and introducing new research topics. However, there are currently limited studies on ChatGPT generating text and creating scientific teaching resources in the context of science education. Moreover, there is no research on how university students or teachers apply it to influence teachers' teaching or students' learning ability. The study aimed to explore how a university instructor used the ChatGPT flipped model to impact university students' perceptions of the instructor's TPACK and students' self-regulated learning (SRL) ability in a general education course. The results show that while the total mean values of TPACK pre- and post-tests did not reach significant differences, the self-regulated learning (SRL) outcomes of university students obtain significant differences. The research indicates that ChatGPT can assist the university instructor in sourcing text materials, facilitating class discussions, and providing individualized guidance. Additionally, ChatGPT helps the instructor find various topics and offers rich and diverse cross-domain content suggestions. ChatGPT facilitates quick access to required information and reducing search time. It also assists students in finding various topics, offering suggestions, explanations, and aiding in task organization. While it offers different types of subject information and aids in task completion, students should self-evaluate the text information provided by ChatGPT to ensure correctness and suitability. Despite functioning as an artificial intelligence environment, it lacks the ability to empathize with users. The research implications of this study are presented along with relevant suggestions.

Keywords

ChatGPT, University Flipped Classrooms, TPACK, Self-Regulated Learning, Mixed Analysis

1. Introduction

ChatGPT has gained popularity on social media and is considered a valuable resource in higher education. Developed by OpenAI in 2023, ChatGPT is an artificial intelligence tool that generates text based on user prompts. It aims to understand natural language and provide intelligent and relevant responses to user queries. This technology has the potential to revolutionize various activities in educational settings, including information retrieval, answering specific questions, engaging in open conversations and discussions, writing and editing reports and papers, providing data samples for databases and analysis, solving mathematical calculations and statistical analyses, and translating text into other languages. It aids in summarizing information, providing overviews, saving time, and enhancing work quality. Additionally, ChatGPT can assist students by offering information and resources on specific topics, suggesting undiscovered aspects, and introducing new research themes, thereby improving their understanding and evaluation of subjects (Halaweh, 2023; Kasneci et al., 2023).

ChatGPT is an emerging tool, which many educators and students may be unaware of its existence or have only heard of it without trying or exploring its potential. Halaweh (2023) explores the potential applications of ChatGPT in an educational context, presenting arguments supporting its integration into education. The study suggests providing strategies and techniques for educators to responsibly and successfully implement ChatGPT in teaching or research. To ensure correct usage of the tool, training should be provided, educating users on its functionalities, accuracy assessment, information evaluation, and query tracking. Additionally, users should be aware of the distinction between text generation and idea generation.

The flipped classroom represents a major innovation and challenge in current university teaching. The design of online flipped teaching combines asynchronous and synchronous activities, serving different purposes and complementing each other. Synchronous online learning increases learners' motivation, while asynchronous online learning enhances learners' ability to process information (Hrastinski, 2008). Chen, Wang, Kinshuk, and Chen (2014) proposed a "holistic flipped classroom," emphasizing the importance of including and monitoring different synchronous and asynchronous learning activities. Although online flipped classrooms are becoming increasingly popular in higher education, few studies have focused on evaluating this teaching method (Chen et al., 2014; Lo, Hew, & Chen, 2017; Lo & Hew, 2019)

Research Purpose

University instructors should contemplate new teaching methods and strategies. Currently, there has been little research on ChatGPT-generated text related to science education topics, and few studies on how university teachers apply it for creating science teaching resources (Cooper, 2023). Even less research has focused on how university teachers use ChatGPT to improve their professional growth. Cooper (2023) suggests potential applications in creating science teaching resources. This study delves into the innovative use of ChatGPT in a flipped classroom model for the “Technology Application and Life” course at a central university, utilizing quantitative and qualitative research methods, including classroom observations, recordings, and interviews to explore students’ perceptions of the instructor’s TPACK and their SRL impact reasons.

2. Review Literature

2.1. ChatGPT Characteristics

ChatGPT can be a valuable resource in higher education, aiding in improving writing skills by generating text, summarizing information, and providing overviews, saving time and enhancing work quality (Halaweh, 2023). Additionally, it can detect grammar and style errors, making written content more easily understandable (Atlas, 2023). ChatGPT can also assist students by providing information and resources on specific topics, suggesting undiscovered aspects, and introducing new research topics, thereby enhancing their understanding and evaluation of the subject (Kasneci et al., 2023). Kung and colleagues (2023) found its assistance in medical education and clinical decision-making, particularly in generating accurate answers during medical licensing exams.

ChatGPT can be used for scientific writing, review, and editing, as well as writing articles, solving problems, and creating new content (Cooper, 2023). ChatGPT can be very useful as it can help save time and effort, quickly generating text that would take a human a long time to create. It does not need to express concerns in terms of efficiency in generating text, nor in the ability to discover, summarize, write, and edit text. For example, let us illustrate Google, which is used to find hyperlinks to electronic documents and information in a single click, more effectively and efficiently than traditional methods (such as searching libraries, reading printed books, magazines and newspapers). Furthermore, MS Excel has been used to assist in calculating, sorting, and filtering data in numerous educational disciplines without any problems as it reduces the time and effort required to perform these tasks manually (Halaweh, 2023). Likewise, ChatGPT can be a useful assistant tool with capabilities beyond Google and MS Excel. Using tools like ChatGPT to aggregate and summarize information is beneficial because it saves the time, effort, and mental energy that would otherwise be spent searching hundreds of web pages and databases, downloading files, and filtering them.

As with any new technology, especially when knowledge or skills are assessed through a technical interface, there are concerns about its application and use.

However, another study has raised doubts about ChatGPT's reliability as a source of information. For example, questions have been raised about the effectiveness of the learning experience when conducting online learning during the COVID-19 pandemic (García-Peñalvo, 2023). There is an issue with using ChatGPT where students may plagiarize and paste text without critically analyzing the content selected from the source, without citing the original source, and without realizing the potential for plagiarism. This problem makes the text generated by ChatGPT unsuitable for academic writing (García-Peñalvo, 2023). Questions have been raised about plagiarism detection in writing generated by ChatGPT and how to distinguish factual from fictional text (Chatterjee & Dethlefs, 2023; Khalil & Er, 2023). Teachers are increasingly concerned that students may use ChatGPT to complete their writing assignments

Since the launch of ChatGPT, educators have raised various concerns about its integration in educational settings. Halaweh (2023) provides an in-depth exploration of these issues and explores the potential uses of ChatGPT in educational contexts. Specifically, present arguments in support of integrating ChatGPT into education, as well as provide educators with a set of strategies and techniques to ensure responsible and successful implementation of ChatGPT in teaching or research. Halaweh (2023) suggests that policies using ChatGPT in any educational topic need to review and evaluate the information generated by ChatGPT as it may produce irrelevant or inaccurate information. You need to check the source of the information and cite it correctly. If there is any suspicion of plagiarism or predominantly AI-generated text, the lecturer will scrutinize the text and make a judgment based on the detection software to take the most appropriate action, taking into account the context of the course and the specific assignment.

2.2. Related Research on ChatGPT

The emergence of artificial intelligence (AI) generative technologies offers transformative potential in education. Cooper (2023) explored three main areas: 1) How does ChatGPT answer questions related to science education? 2) How can educators use ChatGPT to promote science teaching? and 3) How is ChatGPT used in this research? Study this technology using self-study methods. Impressively, ChatGPT's output frequently aligned with the key themes of the study. However, ChatGPT currently runs the risk of positioning itself as the ultimate epistemic authority, assuming a single truth without sufficient evidence or appropriate qualifications. Key ethical issues related to AI include its potential environmental impact, content moderation issues, and the risk of copyright infringement. It is necessary for educators to model responsible use of ChatGPT, prioritize critical thinking, and make expectations clear. ChatGPT may be a useful tool for educators designing science units, rubrics, and tests. Educators should critically evaluate any AI-generated resources and tailor them to their specific teaching context. ChatGPT is used as a research tool to assist editing and experimentation to make research narratives clearer. The purpose of this article is to contribute to the

broader conversation about the use of generative AI in science education.

Khalil and Er (2023) conducted an experiment to determine whether plagiarism detection tools were able to detect papers written using ChatGPT and found that 40 of the 50 papers tested had a similarity score of 20% or less, proving a high degree of originality. Similarly, Susnjak (2022) used ChatGPT in an experiment to evaluate its ability to perform critical thinking rather than simple information retrieval, and the results were highly accurate, precise, and logically consistent. In contrast, Dowling and Lucey (2023) pointed out that although ChatGPT has advantages in idea generation and material identification, it is weaker in literature review and creating appropriate testing frameworks in the context of financial research.

2.3. Self-Regulated Learning

Paris and Paris (2001) believe that “Self-regulated learning (SRL) is mainly an individual’s emphasis on autonomy, monitoring and control of one’s own actions, to expand each person’s expertise and self-growth, and to achieve task goals. (p 89). Self-regulated learning is a mode of action taken by learners to self-shape their thoughts and emotions in order to achieve academic goals. Self-regulators have motivational beliefs, the use of cognitive strategies, metacognition and other abilities, which drives individuals to maintain motivation and willpower to complete tasks; some scholars emphasize that self-regulated learning is when learners use rich learning strategies and meta-knowledge, and apply them to learning situations to control progress and ensure that through intrinsic feedback to achieve learning goals (Pintrich, 2000; Zimmerman, 2000).

Zimmerman (2008) concluded that various definitions of self-regulated learning have the following common characteristics: 1) Learners know how making adjustments will help their learning effects or processes. 2) Learners will self-evaluate the effectiveness of self-adjustment, which will then affect the next self-regulation process, forming a self-oriented feedback loop. 3) The process and method of self-regulation by learners. Learners can understand the feedback of learning results and know how to use effective strategies for learning. They can also know the reasons why a specific self-regulation learning process, strategy or reaction is used. 4) The situation where learners do not make adjustments is also a concern of self-regulated learning. 5) Learners usually make self-regulation when they are sufficiently motivated.

2.4. Research on TPACK of University Science Teachers

Regarding related research on university teachers’ TPACK, Chang, Jang, & Chen (2015) aimed to explore the professional development of two physics teachers in universities in Taiwan region and Chinese Mainland through the framework of the TPACK questionnaire. This study was conducted over 18 weeks of one semester in both Taiwan region and Chinese Mainland, collecting and analyzing various data, including pre-test and post-test TPACK surveys, classroom observations, student feedback, and student opinions. The results showed significant increases

in These teachers' scores on teaching representation and strategies, and technology integration application. Chinese teachers' students also showed significant increases in knowledge comprehension scores from the middle to the end of the semester. Taiwan region emphasized real-life examples and the use of multimedia, while China focused on student knowledge and evaluation. The study highlighted different teaching characteristics in the two environments, providing insight into the professional development of TPACK among university physics teachers in Taiwan region and Chinese Mainland.

Regarding the research on teachers' TPACK from the perspectives of college students, Jang and his colleagues developed the TPACK tool and related research (Chang, Jang, & Chen, 2015; Jang & Chen, 2013; Mishra, & Koehler, 2006). Jang and Chen (2013) measured TPACK for 317 university science students from their perspectives. The draft TPACK tool originally had five aspects and 35 items. After exploratory factor analysis, the results showed only four factors: Subject Matter Knowledge (SMK), Instructional Representation and Strategies (IRS), Knowledge of Students' Understanding (KSU), and Technology Integration and Application (TIA). These factors are distributed among the 33 items of the TPACK tool. The items from the original teaching objectives and context (IOC) factors were integrated into other aspects. SMK refers to the extent to which teachers understand the subject matter and subject beliefs from students' perspectives. IRS refers to the content students are aware of that teachers use in teaching presentations, including analogies, metaphors, examples, explanations, and other teaching strategies. KSU points to how university students observe teachers assessing student understanding before, during, and at the end of course units. TIA refers to the range of student perspectives that teachers select and integrate into teaching content and pedagogy, including TK, TCK, TPK, and TPCK. These factors are closely related to teaching effectiveness. The data shows $\alpha = 0.943$ for SMK, $\alpha = 0.949$ for IRS, $\alpha = 0.902$ for KSU, and $\alpha = 0.942$ for TIA. Therefore, all aspects have passed the internal consistency test. This TPACK questionnaire has content and construct validity, established through empirical studies and existing questionnaires. The research questionnaire items have been revised many times based on: 1) students reviewing the readability and clarity of the topic description, 2) experts reviewing the scope and accuracy of the questionnaire concepts, 3) item analysis to select items, and 4) factor analysis to re-examine various dimensions of TPACK in university teaching situations (Jang & Chen, 2013).

3. Research Methods

This study adopts a mixed analysis method of quality and quantity (Creswell & Clark, 2011), and adopts a quantitative and pre-test and post-test design. The pre-test is to let us understand the SRL profile of university students and the instructor's TPACK, and the post-test is to understand the development of SRL and TPACK. In addition, we used some qualitative data (such as classroom observations, interviews, reflective notes, and flipped teaching videos) to supplement the findings from the

quantitative data from the perspectives provided by the instructor and students. This kind of research method can better understand more complex and multi-faceted teaching and learning.

3.1. Research Objects and Courses

The research sample is from a comprehensive school in the central region of a university with currently 12,000 students. The “Technology Application and Life” course is offered by the General Education Center. Students must not only take professional courses, but also for general education courses. The subjects of this study are students in a class. There are about 60 students in this class. They are mainly freshmen and sophomores. Students entered the university due to university selection, examination and other admission methods. All students have a college degree or above, and most students have a certain ability to take this course. The teaching instructor is a researcher and has collected many life science and technology theme units based on this course unit and research purpose, including life physics and chemical phenomena, technology and materials, healthy food, technology and environment, artificial intelligence (AI), robots, Internet of Things applications, E-commerce, big data application, Google Map life map, technology and life, etc.

3.2. Teaching Model and Implementation Steps

Study the situation where the instructor first uses ChatGPT to prepare teaching. What is the quality of the text generated by ChatGPT to answer science education topics? For example, the topic like (Life Science VS Artificial Intelligence) serves as preparations for the preparatory course unit teaching. Based on previous research on the connotation of flipped classroom and after modifying the model (Jang, 2017), the researcher considered that students may lack technological equipment and prior knowledge, so that the instructor can use the flipped teaching model. As shown in **Figure 1**. Step 6 is the focus of this teaching model on

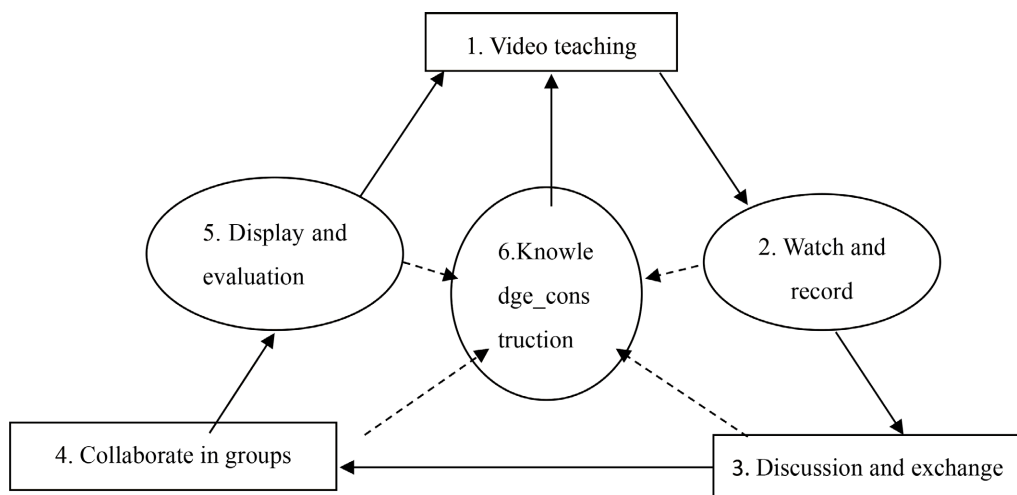


Figure 1. University flipped learning model.

constructing knowledge, while teaching steps 1 to 5 mainly include teaching and learning activities before and during the flipped classroom.

3.2.1. Step 1: Video Teaching

The instructor uses ChatGPT to answer science education topics based on the course unit and research purpose, and collects many videos of life science and technology units. Each unit is edited to a length of about 15 - 20 minutes for students to watch before class. These life technology themed units include physical and chemical phenomena of life, technology and materials, healthy food, technology and environment, robots, Internet of Things applications, e-commerce, big data applications, Google Map life maps, technology and life, etc.

3.2.2. Step 2: Watch and Record

Students carefully watch the life technology video teaching. They need to concentrate on thinking about the content being explained. At the same time, record the key points of the content and the difficulties in learning the content.

3.2.3. Step 3: Discussion and Exchange

During the class, the instructor conducts special discussions based on the selected video teaching and questions. Students can be grouped for discussion. Those who choose the same question form a group, and the group size is controlled within 5 people. Everyone can participate in the activities; allow and encourage students to participate meaningfully in a low-risk, non-threatening way; can provide participants with opportunities to communicate with peers and check the correctness of their ideas at any time; provide a variety of solutions Question strategies, brainstorming.

3.2.4. Step 4: Collaborate in Groups

The instructor should use ChatGPT to provide selective guidance at the beginning and gradually shift to independent inquiry learning for students (for example, use ChatGPT to choose any science unit topic and ask ChatGPT to answer the required information and write a summary and inspiration from experience). Respect students' independence throughout the entire classroom design, allowing students to build their own knowledge system in independent learning. Carry out collaborative division of labor design within the team based on the difficulty and type of the problem. When the problem is broad and can be divided into several sub-problems, group members can engage in inquiry-based learning.

3.2.5. Step 5: Display and Evaluation

After students go through independent exploration and collaborative learning, they complete a collection of individual or group results using ChatGPT. Students need to report in class, exchange learning experiences, and share the success and joy of work production. In this teaching model, evaluation should be completed by experts (researchers), peers and learners themselves.

3.2.6. Step 6: Knowledge Construction

Knowledge construction is the goal of this course. It is completed during and after class with the assistance of information technology. Knowledge internalization is completed in class with the help of the instructor and classmates, thus forming the integration of ChatGPT and flipping.

The instructor of this course established an online communication platform, and could use information technology to provide online communication support for students' learning before and during class. Students could interact with their classmates at home through message boards, chat rooms and other online communication tools to learn about each other's gains and questions, and classmates could answer questions interactively. Regarding the results of students' learning, on the one hand, the instructor used various forms to allow students to report homework in class, exchanged learning experiences, and shared the success and joy of work production, such as holding exhibitions, debates, small competitions, etc.; On the other hand, the instructor should evaluate students' learning results from multiple perspectives, such as group assignments or individual independent homework assignments, to truly achieve formative and summative evaluation.

3.3. Research Tools and Data Collection

The sources of data collection are as follows: 1) Survey of university students' views on their own SRL; 2) Survey of university students' views on their instructor's TPACK; 3) Interviews with sampled students; 4) Reflection notes. the instructor writes notes to observe and reflect on the practice and process of their entire teaching activities; 5) Online materials and student worksheets as research materials.

3.4. Research Tool

This study used a questionnaire survey method. Self-regulated learning (SRL) adopts the self-regulated learning scale developed by Barnard, Lan, To, Paton, and Lai (2009), including six major items: goal setting, environmental structure, and task strategies, time management, seeking assistance, and self-evaluation. Jang and Chen (2013) developed the "University Students' TPACK Questionnaire for Teachers" to gather students' opinions on the instructor's teaching and to enable the instructor to reflect on and improve teaching methods. This questionnaire requires students to fill in basic information such as gender, department, and grade. This scale uses a five-point Likert scale, with each question having five answer options. The scoring method in the questionnaire increases in order from "never" to "always", with scores ranging from 1 to 5 points. The higher the score on this item, the more obvious the student's performance on this item is; conversely, the lower the score, the less obvious the student's performance on this item is. The questionnaire implementation was arranged at the beginning and end of the semester.

3.4.1. Interviews

In order to gain insights into SRL among students at participating universities, what is the quality of the text generated by students answering science education

topics on ChatGPT? Several performance-oriented scenarios impact their SRL. Four students from each class were sampled for interviews, with priority given to students who were more willing to express themselves. To gain an in-depth understanding of the participating university instructor's TPACK, classroom observations were followed by the first interview during the midterm exam week, involving about 3 - 4 students. The second interview was conducted during the final exam week. The content of the interview was mainly to gain an in-depth understanding of the reasons for changes in students' SRL and the instructor's TPACK.

3.4.2. Reflective Notes (Including Classroom Observations)

During the research, the instructor observed the practice and process of their entire teaching activities by writing notes. The main function of note writing in this study is a tool for the teacher's reflection, analysis, and self-evaluation. The instructor in this study gave detailed descriptions and analyzes every time how he used ChatGPT in teaching, students used ChatGPT or students raised questions. If there are any reactions or actions taken, judge and reflect on them. Finally, think about new ways or think about countermeasures from different perspectives.

3.4.3. Student Learning Reports and Online Materials

After each unit, students were asked to submit online learning reports to learn about students' views on course concepts, course progress, and other related information. In addition, relevant evaluation data such as ChatGPT homework submissions and video viewing experiences of middle school students during the study were also collected. Through the homework and video viewing experiences, students' learning situations and problems were understood. Through the collection and analysis of various data related to student learning activity records, the instructor could discover students' learning difficulties and discuss the issues as a reference for teaching improvement and strengthening.

3.5. Analysis Information

The quantitative data were analyzed using SPSS statistical software for basic descriptive statistics on the initially collected questionnaires, allowing participating teachers to understand the analysis results, including the average and standard deviation of each item, the average of each aspect, and student feedback and suggestions. These results provide the instructor with a way to trigger reflection and improve teaching methods. Then, the questionnaire was administered to the students again at the end of the semester, and basic descriptive statistical analysis was added. Paired samples T-test was used to analyze and compare students' SRL development and the instructor's TPACK change.

Qualitative data analysis combines literature interpretation and qualitative analysis methods (Bogdan & Biklen, 1998). The sources of qualitative data are mainly the instructor's classroom observations and student interviews. First, collect all original data; second, organize, classify and edit the original data into easily distinguishable and accessible data files. Coding of qualitative data can serve as

the primary basis or frequency of research findings. Each researcher independently reviewed the data and compared the results to establish the credibility of the research findings with interactive assessment. Even if there were differences of opinion, the coders discussed their differences and agreed on one person's ideas or reached a consensus among all researchers. In order to use continuous comparison and triangulation, we compared interview data and made observations about their teaching, student comments, and other supplementary documents, such as their online assignments and worksheets (Merriam, 2009). Finally, an important catalog is summarized based on the types of research questions and findings, and then an in-depth analysis is conducted to explore the reasons for the growth of students' SRL and the instructor's TPACK.

4. Results

4.1. Self-Regulated Learning (SRL) Development

In **Table 1**, concerning the self-regulated learning (SRL) outcomes of university students influenced by ChatGPT, overall, significant differences were obtained in this class. Across each dimension, the study identified three dimensions with significant differences, including task strategies, time management, and seeking help. In this class, post-test scores for each dimension have improved, indicating that ChatGPT has a certain impact on each dimension of SRL. The paper provided explanations for the reasons behind changes in each aspect of student SRL, summarizing important findings for each dimension, and further analyzing the growth factors of university students' SRL.

Table 1. University students' SRL.

Dimension	Pre-test		Post-test		T
	M	SD	M	SD	
Goal setting	3.23	0.66	3.42	0.66	-1.43
Environment structuring	3.11	0.53	3.43	0.63	-1.32
Task strategies	2.87	0.78	3.95	0.85	-2.93*
Time management	3.27	0.76	4.10	0.71	-2.72*
Help seeking	3.17	0.73	3.91	0.79	-2.56*
Self evaluation	2.65	0.82	3.09	0.76	-1.29
SRL(Total)	2.96	0.71	3.42	0.73	-2.42*

*P < 0.05.

4.1.1. ChatGPT Providing Different Types of Subject Information to Help Complete Tasks

ChatGPT can provide information of different types or topics. It is a large database that can help university students complete tasks and provide effective strategies. For example, one time a student reported that the assignment question was too difficult to understand, so he copied and pasted it onto this website, but did

not expect ChatGPT to give so good answer. Writing a script is difficult, as you need to read a lot of films, but it helped us quickly conceive of the basic framework of the script. Students' qualitative views are as follows:

The first time I used it was when I was doing homework for a certain class. The questions given by the teacher were too difficult to understand, so I simply copied and pasted them onto this website. Unexpectedly, the answers it gave were almost perfect and could be put directly into the homework. However, you should still pay attention when using it to see if the answer it gives is what you expected.

4.1.2. ChatGPT Can Quickly Find the Required Information and Reduce a Lot of Search Time

ChatGPT is a tool based on artificial intelligence that can help students generate text in a short time. As long as they enter reasonable instructions, they can quickly find the information you need. However, because the database is too large, the search results may not be completely correct. Because it can help save time and effort, quickly generating text that would take humans a long time to create. Students' qualitative views are as follows:

I often use it to find information, and I can save a lot of time searching for information on the Internet. It generates information very quickly and provides very detailed information. However, sometimes when the instructions given to it are not very clear, it may give come up with some very strange answers.

4.1.3. ChatGPT Can Help Students Find Various Topics, Provide Suggestions, Explanations and Organize Information

ChatGPT can create new things with various themes, such as travel advice, copywriting, stories or novels, or act like anything else it can do. It is also a powerful language processing tool that can answer questions, provide suggestions, explain content, and organize data. Students' qualitative views are as follows:

In addition to quickly getting answers to the questions you want to know, ChatGPT can also help you organize the information. You don't need to browse every web page. It is also suitable for various application scenarios. Whether it's helping with technical issues, providing travel advice, or assisting with copywriting, it can handle it.

4.2. The Instructor's TPACK Development

The TPACK results in **Table 2** show that while the total mean values of TPACK pre- and post-tests did not reach significant differences, the post-test scores of each dimension improved. Only the "Instructional Representation and Strategies" dimension showed significant differences, with the post-test TIA having the highest mean value ($M = 4.22$) and the student knowledge and understanding (KSU) the lowest mean value ($M = 3.92$). The following explains the main findings in

these dimensions of the instructor's TPACK and the impact of ChatGPT.

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

Dimension	Pre-test		Post-test		T
	M	SD	M	SD	
SMK	4.04	0.66	4.10	0.65	1.36
IRS	3.65	0.61	4.16	0.68	3.36*
KSU	3.85	0.72	3.92	0.77	1.21
TIA	4.09	0.63	4.22	0.70	1.72
TPACK	3.90	0.66	4.12	0.70	1.88

*P < 0.05.

4.2.1. ChatGPT Can Enhance Instructor's Ability to Discover Topics and Provide Diverse Teaching Material Content

As shown in **Table 2**, one reason for the improvement in the subject matter knowledge (SMK) dimension is that the instructor tends to provide rich and diverse explanatory videos that enhance students' understanding of the course content. ChatGPT helps create content on various topics and can be used to write teaching materials or produce teaching video scripts, providing clear and easy-to-understand information. Acting like an all-knowing encyclopedia, ChatGPT provides the necessary text answers and allows the extension of questions on the original topic, inspiring more creativity and ideas. It offers insights that may not have been previously considered, providing valuable references and high-quality text to quickly convey its ideas.

ChatGPT is like an all-knowing encyclopedia. It can answer any question. As long as the information exists in the database, whether it's about robots, the Da Vinci arm, unmanned stores, or other thematic units.

4.2.2. ChatGPT Can Be for Information Retrieval and Individualized Guidance

As shown in **Table 2**, the instructor's "Instructional Representations and Strategies (IRS)" dimension reached significant differences. ChatGPT, an AI based tool, can assist instructors and students generate text in a short time. As long as they enter reasonable instructions, they can rapidly find the required information. However, since the database is too large, the search results may be more general but still have reference value, such as the advantages and disadvantages of video teaching methods. ChatGPT can provide students with individualized guidance and Q&A, answering their questions and offering supplementary information or explanations. In class, ChatGPT can assist in discussions, address student queries, provide references from diverse perspectives, and stimulate deeper thinking.

The advantages of the video teaching method include stimulating students' interest in learning. Multimedia teaching can break the monotony of

traditional methods, inspire students' imagination, enhance understanding, expand information capacity, satisfy curiosity, and compensate for teachers' shortcomings, thus improving classroom teaching structure. However, over-reliance on videos may dilute the teaching focus, leading to poorer student learning outcomes. Additionally, video teaching preparation is time-consuming and requires significant effort.

4.2.3. ChatGPT Can Integrate Text Materials with Cross-Domain Content, but Requires Evaluation for Accuracy and Applicability

Technology Integration and Application (TIA) has the highest average among the four dimensions. Through online records and interviews, the instructor in this course integrated content knowledge, multimedia, technology, platforms, and other structures, presenting them to students. ChatGPT's extensive database contains knowledge across various fields, providing an additional learning channel for cross-domain learning. Students can access extra resources, such as recommended readings, relevant research papers, or online courses, to expand their knowledge. While ChatGPT offers useful information, users must judge the credibility of the answers themselves and conduct further self-assessment.

The instructor uses artificial intelligence YouTube videos in PowerPoint presentations to stimulate students' interest and create a comfortable learning environment. Videos on topics like robots, unmanned stores, or autonomous driving make the course more engaging and help students learn more efficiently.

5. Discussion and Implications

ChatGPT helps the instructor find various topics and provides rich and diverse teaching material content suggestions. ChatGPT can provide information on different types of topics. As a large database, it can help complete tasks and provide effective strategies. ChatGPT functions like an all-knowing encyclopedia, providing text answers quickly and offering creative inspiration. ChatGPT can create new text content, themed units like robots, da Vinci arms, unmanned stores, or simulate various other scenarios. Impressively, ChatGPT's output frequently aligned with the key themes of the study. However, ChatGPT currently runs the risk of positioning itself as the ultimate epistemic authority, assuming a single truth without sufficient evidence or appropriate qualifications (Cooper, 2023).

ChatGPT helps the instructor integrate cross-field content text materials into teaching. The instructor can insert artificial intelligence YouTube videos into PowerPoint to stimulate students' interest and create a comfortable learning environment for students. ChatGPT could provide information of different types or topics. It is a large database that can help university students complete tasks and provide effective strategies. University faculty are increasingly concerned that students may use ChatGPT to complete their writing assignments because ChatGPT's answers are all based on big data opinions and concepts, which may

not necessarily be correct. Users must judge the credibility of the answers themselves, requiring further self-assessment.

On the other hand, ChatGPT can help university students find various topics, provide suggestions, explanations and organize information in this study. Therefore, these include potential bias and discrimination, due to its reliance on natural language processing; privacy concerns, since search and query materials may be saved and used for unauthorized purposes; lack of creativity and critical thinking, as well as inaccuracy and plagiarism (Atlas, 2023; Mhlanga, 2023). Due to the above concerns, some universities have chosen to block ChatGPT because students may use it to automatically generate assignments or other coursework (Ropek, 2023). However, attempts to prevent or prohibit its use will not effectively deter students. Instead, ChatGPT is expected to become an essential part of the writing process, similar to how calculators and computers revolutionized mathematics and science (McMurtrie, 2022).

Chat GPT's answers are all based on big data opinions and concepts, which may not necessarily be correct. University students must judge the credibility of the answers by themselves. Further self-assessment is required. However, it has been reported to generate false citations and reproduce biases that exist in the literature (Gleason, 2022). According to the cited ChatGPT output, AI systems may perpetuate biases present in the data they were trained on. OpenAI (2023) acknowledges in its educator recommendations that ChatGPT may produce content that perpetuates harmful biases and stereotypes in subtle ways, with the model often biased toward content that reflects Western perspectives and people. This study believes that long-term dependence may bring negative effects. For example, their motivation to take the initiative to learn is reduced, their writing ability becomes worse, and their ability to think about problems declines.

Finally, the study found that ChatGPT is like an artificial intelligence environment. Although it cannot empathize with us, it can relieve emotions in a single direction. After university students often use ChatGPT, its answers can also be seen as a bit humane. In addition to the initial "I'm sorry", and the subsequent "Thank you" and "Oh, I understand", it feels like ChatGPT can understand and think of it. Find it interesting. Some university students may feel that life has been a bit stressful recently, and they just took advantage of the midterm report of this class to use ChatGPT to relieve their current mood. If you can't find anyone to complain to in real life, maybe ChatGPT will be a good person to listen to.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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