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Praxeological learning approach in the development of pre-service EFL teachers' TPACK and online information-seeking strategies

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Abstract

This study is purposed to implement and test a praxeological learning approach to enhance pre-service EFL teachers' technological pedagogical content knowledge and online information-seeking skills. This study was conducted based on a convergent parallel mixed design involving thirty-seven sophomore pre-service EFL teachers. Multiple data collection tools were administered at the beginning and end of the course, and data were analyzed aligning with quantitative and qualitative methods complementarily. Active and decisive participation of the pre-service teachers shaped the course design following the sections of independent study, context orientation, and context-based study within the Technological Pedagogical Content Knowledge Framework. Findings showed that pre-service teachers' technological pedagogical content knowledge and online information-seeking strategies of evaluation, selecting main ideas, and trial & error were significantly improved. Praxeological learning, following the Technological Pedagogical Content Knowledge Framework step-by-step and highlighting context-sensitivity, scaffolded pre-service teachers' knowledge construction cumulatively and provided them with authentic learning experiences. The praxeological learning approach can support long-term motivation for technology integration knowledge and skills acquisition for pre-service teachers' future careers.

Keywords: Technological pedagogical content knowledge, Online information-seeking strategies, Praxeological learning, Technology integration, Instructional technologies, Pre-service teachers

Introduction

Digital technology usage in the field of English as a Foreign Language (EFL) education has highlighted its importance (Al-Wasy, 2020; Hao et al., 2021; Seyyedrezaei et al., 2022). However, catching up with the advanced technologies and integrating them into EFL education are continually hard duties for both pre-service and in-service teachers. Digital skills for teaching purposes in literature are called under the Technological Pedagogical Content Knowledge (TPACK) theoretical framework (Mishra et al., 2006). It is also important to have facilitating competencies like Online Information-Seeking

Strategies (OISS) to know how to reach reliable and available information sources to be able to improve TPACK. Hence, pre-service teachers not only acquire this knowledge and skills but also should have perseverance and motivation that will enable them to continue acquiring and improving their digital competencies as part of their professional lifelong learning.

Pre-service teachers show different profiles regarding when technology knowledge and attitudes variables were considered (Tondeur et al., 2017). Further, several factors have an impact on TPACK professional development (Kulaksız & Karaca, 2023). So, TPACK is not a stand-alone knowledge area and is affected by contexts and individual differences. Considering these internal and external influences, achieving these complex skill sets during a teacher education program with the ability for further learning desire remains a long-term challenge- even for experienced teachers. Although there are different interventions regarding pre-service teachers' TPACK development in the literature, how technologies create training gaps due to traditional approaches and how to overcome new training demands are still ongoing hot discussion topics (Kaminskienė et al., 2022). Praxeological learning fundamentally centers on the learning progress as a social transformation in the aimed subject (Pascal & Bertram, 2012). It not only focuses on subject or know-how knowledge but also enables learners to gain sustainable motivation, positive attitudes, and awareness of the constant need for development. Therefore, praxeological learning is a promising approach in pre-service teacher education to develop technology integration knowledge and skills. This research was built upon a previous qualitative study (Kulaksız & Toran, 2022) aiming to develop pre-service teachers' TPACK. The current research extends the previous study in terms of clarifying the praxeological approach and TPACK construction process during the instructional design of the course, adding OISS as a new variable facilitating TPACK construction, and employing a mixed method benefitting from both qualitative and quantitative research designs to enhance evidence sources. From this point of view, this study concentrates on pre-service teachers' TPACK and OISS enhancement through the lens of praxeological learning.

TPACK and OISS in teacher education

TPACK framework interprets teachers' technology integration into teaching and learning processes from the view of a broad range of competencies. These competencies contain domains of technology knowledge (TK), content knowledge, and pedagogy knowledge as sole subjects, also their intersecting areas as technological pedagogical knowledge, pedagogical content knowledge (PCK), technological content knowledge, lastly and more importantly TPACK (Mishra et al., 2006). Moreover, Mishra (2019) upgraded the framework by defining context as contextual knowledge to get the greater attention of scholars. Studies regarding context claim that not only TPACK is a self-directed skill but also depends on where it is situated (Brianza et al., 2022; Kulaksız & Karaca, 2022, 2023; Rosenberg & Koehler, 2015).

The TPACK development in teacher education programs is investigated by researchers, where the different knowledge-building processes are in different settings. Baran and Uygun (2016) proposed some design principles known as TPACK-DBL (design by learning) to facilitate the understanding of TPACK of in/pre-service teachers. These principles

include design ideas by brainstorming, technology-integrated artifacts design, design examples investigation, design experience reflection, teaching in real settings, and design team collaboration. As a result of their case study, it was found that students' design activities help them to comprehend practical reflections of the TPACK knowledge by following the phases of the theory–practice connection in TPACK, readiness for practice, technology skills, and sustainable learning of TPACK. Olofson et al. (2016) examined teachers' process of TPACK knowledge construction which called TPACKing practices. It shows that TPACKing is an iterative knowledge-building procedure affected by interpersonal, intrapersonal, and technological contextual factors, which means unique enacting by the persons. Further, individuals' independent technology pursuit, contextual interaction in their settings, and the features of the available digital tools drive teachers' knowledge construction. Papanikolaou et al. (2022) approached pre-service teachers' TPACK development by using PeerLAND (Peer Evaluation of LeArNingDesigns), which is an online platform. They benefit from the features of the design and evaluation process in a multi-layer design environment and results with peer evaluations. With the guidance of the platform, students can take instructional decisions for their learning activities. This method improved student teachers' TPACK and they believe the review process will contribute to their learning design in the future, although there were some drawbacks such as the validity and quality of feedback from peers (e.g., inadequate/subjective comments).

On the other hand, Tuluk and Kepceoğlu (2019) found that there is a relationship between OISS and web-PCK. Ko (2018) study results show that teachers seek information more likely for TPACK's technology-related domains and to reach reliable and high-quality resources. Poitras et al. (2017) used nBrowser to provide scaffolding to ease pre-service teachers' technology-enhanced planning. As a result, metacognitive and cognitive activities mediate TPACK development during searching and getting information. Because students use some cognitive ways while searching for information on the internet.

According to the proposed framework of Tsai and Tsai (2003), individuals use behavioral, procedural, and metacognitive domains to seek information online. These domains are composed of seven strategies: control, disorientation, trial & error, problem-solving, purposeful thinking, selecting main ideas, and evaluation. Information-searching skills and behaviors include a wide range of methods, which guide people to explore and access information (Dahlqvist, 2021). So, it is important to better understand teachers' information-seeking strategies as their professional development is continuous (Khan et al., 2014). As a result, OISS was included in the study as a supportive skill of pre-service teachers' TPACK development. Inspired by previous papers, this study aimed at seeking a new pathway for knowledge construction of pre-service teachers' TPACK and OISS through praxeological approach. This way can help to identify pre-service teachers' self-directed learning needs in the domain and how they can pursue technology integration knowledge and skills in the long-run.

Why is praxeology as a learning approach important for TPACK?

According to praxeological learning approach, learners build knowledge and instructors should motivate students to pursue social transformation by generating and solving issues using their comprehension (Pascal & Bertram, 2012). The curriculum is driven by praxeology, which reveals underlying assumptions and aids in generating new

epistemologies (Winterbottom et al., 2022). Praxeological learning as an instructional strategy is a valuable method for reaching learning outcomes and strengthening the skills of pre-service teachers through authentic cases in teacher education (Winterbottom & Mazzocco, 2016). Furthermore, praxeology attracts attention due to its feature of an innovative type of thinking by bridging the theory and practice of teacher training (Semenikhina et al., 2018).

Bueno et al. (2023) concluded that TPACK vision shows a transformative and homogeneous point of view and evolves continually as teachers engage in TPACK reasoning. Therefore, it was suggested that pre/in-service teachers need to reconsider new ways learning of up-to-date technologies due to learning/teaching contexts being ever-changing. This fact leads to clarifying the importance of self-regulated learning for the acquisition of TPACK. Huang and Lajoie (2021) uncovered the relationship between self-regulated learning (SRL) patterns in TPACK development and the SRL processes of teachers' differentiation regarding their TPACK. Teachers with high TPACK perform self-regulative activities to advance their knowledge. Hence, pre/in-service teachers need ongoing support to be able to internalize the self-sustain learning progress of TPACK transformation (Bueno et al., 2023). However, it is a tough approach for teacher educators since pre-service teachers have different TPACK profiles (Tondeur et al., 2017).

Since praxeological learning is situated in a learning/teaching context, it promotes individualized learning paths, and making it a fresh approach to complement the constant need for TPACK development. Therefore, results are distinctive depending on the people's characteristics and their participative actions, which direct outcomes of the learning. However, these contextualized results have a repeated similar voice in terms of findings in different studies. Winterbottom and Mazzocco's (2016) study shows that praxeological learning directly influences pre-service teachers' self-actualization, pedagogical skills, social and moral development. Semenikhina et al. (2018) examined future computer science teachers' skills in the selection of technological tools reasoning by praxeological approach. Results revealed that their own way of rationally choosing the tools for their instruction was to consider effectiveness. Employing praxeology for upcoming primary school education specialists' professional development by Lyashova et al. (2020), the authors concluded that they showed better teaching practices, openness, motivation, professional self-determination, and interest as future teachers. Kulaksız and Toran (2022) utilized praxeological approach to extend pre-service teachers' technology integration skills. The results pointed out that not only their knowledge and skills improved during the course but also they showed a strong ability for peer mentoring, self-regulated learning, collaborative digital project development, motivation, and determination for further learning. Kulaksız and Toran (2022) research design was taken as a basis of this study and extended with OISS as a variable, to test its effectiveness including a mixed approach with the systematization of TPACK construction progress.

Research aim

In a previous study, instructional technology course was designed based on a praxeological approach and put forward the learning process for pre-service teachers' technology integration knowledge and skills Kulaksız and Toran (2022). In this context, this research

merges the course design following the praxeological approach and seeks evidence for pre-service teachers' technology integration knowledge and skills improvement. This study's purpose is to implement and test the praxeological learning process to enhance pre-service EFL teachers' TPACK and OISS. So, in the light of this main goal, the following questions were sought:

1) Are there any differences between pre and post-test scores of pre-service EFL teachers' TPACK?

2) Are there any differences between pre and post-test scores of pre-service EFL teachers' OISS?

Method

Research design

A convergent parallel mixed design, which allows the collection of qualitative and quantitative data concurrently, was used in this study (Creswell & Creswell, 2018). In this regard, TPACK and OISS scales were applied as pre-and post-tests, meanwhile, interactive slides beginning of the course, and students' projects and course evaluation forms at the end of the course were used to collect qualitative data. This approach investigated the research questions holistically via multiple data sources.

Background of participants

The participants of this research were 37 pre-service EFL teachers studying in their second year. The number of participants decreased to 28 people for quantitative analysis due to the incompletion of the surveys. Their ages vary between 18 and 30 ($N_{female} = 20$, $N_{male} = 8$). Their main purposes for using the internet were for fun such as social media, games (N = 17), daily work like shopping, e-mail (N = 8), education-related like research, homework (N = 2), and other (N = 1). Their primary sources of access to information on the internet were social media (N = 21), scientific papers (N = 4), newspapers' websites (N = 2), and other (N = 1). Meanwhile, pre-service teachers have completed or attended the courses during the Instructional Technologies course such as pedagogy (e.g., Principles and Methods of Teaching), content (e.g., English Literature), PCK (e.g., Approaches to ELT). Therefore, these knowledge areas were also considered their background skills.

Course design and implementation

This course design was built upon Kulaksız and Toran (2022) instructional technologies course design based on a praxeological approach. The suggested learning process was utilized as a course structure shown in Fig. 1. This Instructional Technologies course was implemented for 13 weeks for pre-service teachers' OISS and TPACK knowledge and skills construction and improvement.

The TPACK construction process in this study (Fig. 1) paid attention to theoretical criticism of TPACK and empirical research results have led to new notations of the TPACK diagram (Saubern et al., 2020). On the one hand, some studies questioned the TPACK's areas existence in practice (Graham, 2011; Saubern et al., 2020). However, TK and TPACK domains always stand as the main core of the theory and manifest themselves in various indicators in real-life classroom implementations. Therefore, this study focused on the transition from TK to TPACK with the support of PCK as background

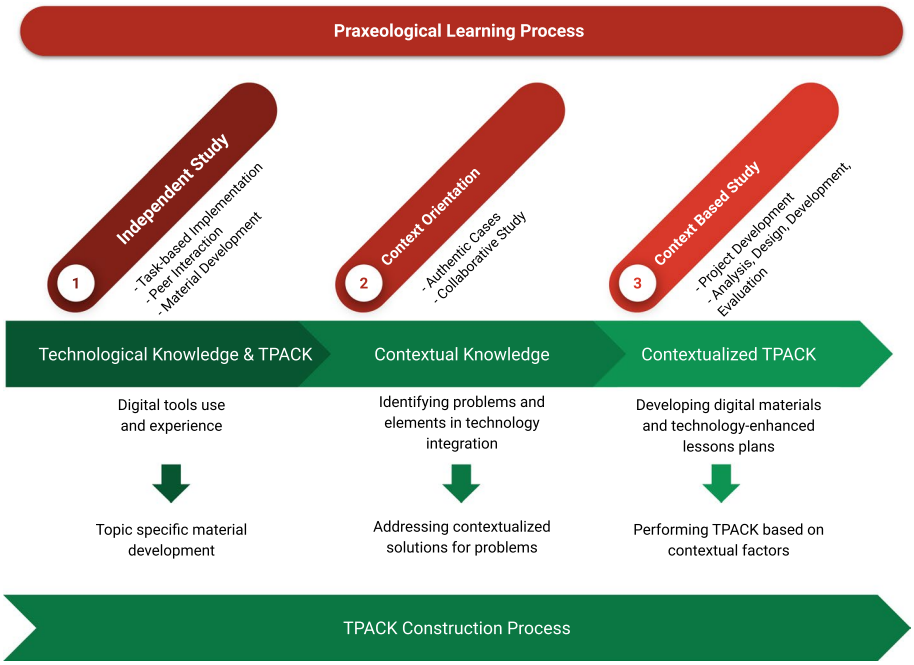

Fig. 1 The praxeological learning process was adopted from Kulaksız and Toran (2022), and enhanced with TPACK construction process

knowledge. On the other hand, the context of TPACK was also constantly defined as a neglected element in literature (Rosenberg & Koehler, 2015), which was recently called contextual knowledge (Mishra, 2019). Studies related to context show that TPACK relies on where it is situated (Brianza et al., 2022; Kulaksız & Karaca, 2022, 2023; Rosenberg & Koehler, 2015). So, the transition phase of TK to TPACK was aimed to be complemented with contextual knowledge of TPACK development of pre-service teachers in this research.

At the beginning of the course (1.-2. weeks), pre-service teachers' opinions about course structure were collected with interactive slides pseudonymously. These slides include questions about course objectives, digital tools selection to be taught, teaching–learning, and measurement-assessment methods. The answers were shared in the class and decisions were made collectively. That way pre-service students' common sense shaped the course content which was integrated into previous instructional technologies course design based on a praxeological approach. Also, an introduction to educational technology was presented and focused on 21st-century teachers' and students' competencies suggested by the International Society for Technology in Education. This course consists of the following course structure (Fig. 1):

The independent study part (3.-8. weeks) of the course focused on pre-service teachers' TK and TPACK. As content, it was decided to learn digital tools for collaboration, visual representation, interactive presentation, measurement and assessment, animation, and interactive video based on students' democratic participation. In-class activities helped students to gain experience and use practicing regarding TK. In these activities, students were distributed task-based learning online sheets to provide guidance about how to use the tools and insights into their features. These task lists also show some hints like

accessing the origin of the sources, and keyword selection to enhance their OISS to facilitate TK and TPACK progress. Peer interaction was promoted during activities as some tasks needed peer cooperation online. Also, the one who finished the task list earlier functioned as a peer mentor to support others. After-class activities required detailed implementation of TPACK, which was about topic-specific digital material development regarding learning outcomes.

The context orientation part of the course (9.-10. weeks) was aimed at the realization of contextual factors affection teachers TPACK unearth by Kulaksız and Karaca, (2023) and construction of contextual knowledge (Mishra, 2019) for TPACK. Pre-service teachers were assigned to investigate real-life technology integration problems of EFL teachers on social media platforms or in-person to discuss in class. Afterward, authentic cases involving problems were allocated to random groups by the instructor. Each group defines the contextual factors causing the problem(s) and addresses alternative solutions in the situations in given cases collaboratively.

Context-based study (11–13. weeks) conducted as a final project in a particular context chosen by students independently. Based on ADDIE instructional design steps scaffolded their digital material and technology-based lesson planning in terms of analysis, design, development, and evaluation. These projects were done singularly or double up to their choices. Finally, each project was demonstrated, and they received prompt feedback from peers and the instructor.

The instructor of the course took part as the facilitator of in/out class activities and collective decision-making, and supporter of their self-learning processes. She avoided showing direct one-way solutions, instead, advocated different voices of pre-service teachers through alternative perspectives explicitly in the classroom. In this way, democratic participation was ensured in the TPACK knowledge construction process of pre-service teachers from the lens of praxeological learning both individually and in groups.

Data collection tools and analysis

The quantitative data collection tools were demographic information form, TPACK-Practical Scale, and OISS Inventory; and qualitative ones were interactive slides, online course evaluation form, and students' projects.

Demographic information form

This form aimed to get pre-service teachers' some information such as gender, age, the primary purpose of using the internet, and the primary source of access to information on the internet.

TPACK-practical scale

This scale was developed by Yeh et al. (2013) and adapted to Turkish by Ay et al. (2015). This 5-point-Likert-type scale has 22 items and is composed of five factors, which are learners, subject content, curriculum design, practical teaching, and assessments. The maximum number of points that can be obtained from the scale is 110 and the minimum score is 22. Cronbach's Alpha reliability of the scale was reported as 0.89 by Ay et al. (2015). It was for the pre-test as $\alpha = 0.967$ and for the post-test as $\alpha = 0.952$ in this study.

OISS inventory

This instrument was developed by Tsai (2009) and adapted to Turkish by Askar and Mazman (2013). This inventory with 6-Likert-type response composed of 25 items and 7 factors. It has 5 negative items. Its factors are as follows: disorientation, evaluation, purposeful thinking, selecting main ideas, trial & error, control, and problem-solving. The scores of the inventory range from 25 to 150. The reliability was reported as $\omega = 0.942$ and $\alpha = 0.91$. Cronbach alpha value in this study was calculated for the pre-test as 0.849 and the post-test 0.816.

Interactive slides

Online interactive slides were utilized at the beginning of the program to get pre-service teachers' initial views and expectations about the course. Poll Everywhere as a tool helped to collect the data anonymously.

Course evaluation form

This online form was developed on Google Forms to collect opinions of pre-service teachers' regarding teaching methods, learning atmosphere, and content of the course anonymously ($N_{form} = 37$).

Student projects

At the end of the semester, students developed a final project individually or in 2-person groups. This project includes digital materials, at least two digital educational materials developed by student(s), and technology-enhanced lesson plans. Students followed ADDIE Model phases (including self-assessment report) for the instructional design process ($N_{project} = 26$).

The researcher designed a demographic information form, interactive slides, and course evaluation forms. Quantitative instruments, demographics form, and interactive slides were implemented in the first week for pre-tests, afterward, quantitative instruments for post-tests, which are course evaluation form, and students' projects. The analysis of this study was grounded on both quantitative and qualitative data as they were collected. To begin with, normality criteria were met for the pre-post-test of TPACK and OISS because of Shapiro–Wilk Normality Test ($p > 0.05$). Descriptive statistics and paired sample t-tests were performed. Afterward, interactive slides, course evaluation forms, and students' projects were read by the author verbatim. Qualitative data were examined through a deductive approach considering the scales' structures. The triangulation technique was used for the reliability of the research. For the triangulation, multiple data sources were included in the study for consistency and verification of the findings (Creswell, & Creswell, 2018). Qualitative findings were added in the shape of quotations to delineate and clarify the quantitative results. That way, the qualitative analysis presented complementary findings.

Findings

The findings were presented below according to research questions.

TPACK-related findings

Descriptive statistics and dependent t-test were applied to see the differences in pre-service teachers' TPACK pre-post-test scores (N = 28). As seen in Table 1, pre-service teachers showed meaningful development in their post-test scores of overall TPACK from their pre-test scores ($t_{(27)} = -5.883$, $p = 0.000$). Scores in sub-dimensions of TPACK, learners ($t_{(27)} = -6.527$, $p = 0.000$), subject content ($t_{(27)} = -4.327$, $p = 0.000$), curriculum design ($t_{(27)} = -5.947$, $p = 0.000$), practical teaching ($t_{(27)} = -5.405$, $p = 0.000$), assessment ($t_{(27)} = -5.155$, $p = 0.000$) were significantly increased. Furthermore, qualitative data supported this rise. Students' opinions were gathered about the course design anonymously by using interactive slides at the beginning of the semester. Their common goal at the course was like a consensus: "To be able to use the technological tools supporting learning in the classroom efficiently and effectively".

End of the course, pre-service teachers stated how they can engage students' attention and select technologies regarding students' interests and readiness levels.

> *I think that this course helps me to use technology more effectively in my future lessons and this will increase the students' interest in the lesson as I will add technology to the lesson properly. (Online course evaluation from)*
> *In the future, we can prepare activities by using Web 2.0 tools suitable for their level, which will enlighten students. (Online course evaluation from)*
> *The prepared material must be suitable for the target group's age. This is the issue that we paid the most attention to in our project. Because we wanted to not bore the students with the words we chose. Also, we wanted to harmonize the images we chose, the theme we used, the progress of the animation, images of flashcards for students' levels. (Final student project)*

Recognizing the importance of consistency between curriculum and technology is one of the most critical learning outcomes of this course for pre-service teachers. They also

Table 1 Pre and post-test scores of pre-service EFL teachers'TPACK

TPACK	Mean	N	Std. Deviation	t	df	p
Learners – pre-test	8.4643	28	2.96251	− 6.527	27	0.000*
Learners – post-test	12.3929	28	1.66309			
Subject Content – pre-test	6.2500	28	2.33532	− 4.327	27	0.000*
Subject Content – post-test	8.3929	28	1.06595			
Curriculum Design – pre-test	22.8571	28	6.93202	− 5.947	27	0.000*
Curriculum Design – post-test	33.2500	28	4.63181			
Practical Teaching – pre-test	18.7857	28	5.41847	− 5.405	27	0.000*
Practical Teaching – post-test	25.1071	28	3.14277			
Assessment – pre-test	9.3571	28	3.00881	− 5.155	27	0.000*
Assessment – post-test	12.4643	28	1.77393			
TPACK – pre-test	65.7143	28	19.33689	− 5.883	27	0.000*
TPACK – post-test	91.6071	28	11.07998			

*$p < 0.05$

demonstrated the use of digital materials in technology-based lessons properly, gained awareness of digital tools features for instruction, and selected effective teaching methods for technology.

> *I am aware now that to plan a lesson, to use material, many details had to be considered. I am happy to learn these. (Online course evaluation from)*
> *I learned how to associate these applications with the subject content in the teaching and learning process. (Online course evaluation from)*
> *When I was asked what I could learn in this lesson, I could have only answered "A few software or materials that I can use in my lessons", but this was not the case. Learning to prepare material was the most superficial and simple part of the study. I learned that the material should be created by taking into account variables such as class level, age, facilities, readiness level of students, attracting attention, focusing the learning goals, etc. Therefore, in my first assignments, I realized that although I was happy to use my creativity, I was surprised by my achievements and the age group I was addressing. (Final student project)*

They also became aware of technical problems during technology-based lessons, and the vitality of having alternative activities/plans. For instance, pre-service teachers chose a digital slide that allows up to 20 participants in a free plan. Here is recommended plan B in case of having more students' attendance: "If the class in which I will use the application is more than 20 people, I will group the students and cooperate, so that all students participate and benefit from the application." (Final student project). After examination of the final project and anonymous course evaluation form, it was revealed that pre-service teachers acquired TPACK skills and knowledge in a detailed manner.

It is possible to say that the consensus about the pre-determined learning goal was reached via praxeological learning. Throughout this goal, some students even though had a negative attitude at the beginning of the term, they stated that this changed at the end. The experiences they gained, guided practices, supportive environment by peers and instructors, and openness to making mistakes, all together created a safe atmosphere for pre-service teachers and boosted their self-confidence in terms of TPACK and their future TPACK development.

> *This course made me aware of myself, and what I can do despite all the pessimism and prejudices I had. (Online course evaluation form)*
> *The teacher got our opinions about how to conduct the lesson, which motivated us. (Online course evaluation form)*

Even though pre-service teachers consider the learning approach of this course in some way challenging, it built resilience, time management, and transferable knowledge into real context from their perspectives. These all ended up with satisfactory results for them and fun. They defined this course method as very effective.

> *I think it is an advantage although I waste a lot of time thinking and creating the designs while preparing the materials. I was stressed out times during the preparation phase of the project, but I am happy that the result was as I wanted and dreamed. (Final student project)*
> *I really learned a lot of useful information and had a lot of fun in this course.... She*

conducted lessons very well, and the instruction lists she gave us for applications were very useful. It was very nice that she prepared these before the lesson and put effort into us. (Online course evaluation form)
Preparing the lesson plan was quite hard. But that was the most satisfying for me. Because we imagined ourselves as teachers and prepared a comprehensive plan. Since it was a very realistic assignment, I had the impression that I was going to be a teacher in a class tomorrow. (Final student project)

So, the appreciation of the agony of failure and the effort of long-term goal archievements were promoted to strengthen their power for learning experiences in their professional lives. Also, facing challenging goals and witnessing others' efforts also provided collaborative perseverance as they mentioned.

OISS-related findings

Descriptive statistics and dependent t-test was calculated for differentiation between pre-service pre-online OISS and post-OISS (N = 28). As seen in Table 2, pre-service teachers showed significant development in their post-test scores of total OISS from their pre-test scores ($t_{(27)} = -2.465$, $p > 0.05$). Pre-service teachers' evaluation ($t_{(27)} = -24.298$, $p = 0.000$), selecting main ideas ($t_{(27)} = -2.757$, $p > 0.05$), trial & error ($t_{(27)} = -2.738$, $p > 0.05$) strategies in online information seeking process was meaningfully developed. While their disorientation, purposeful thinking, control, and problem-solving strategies did not differ from their pre-test scores ($p < 0.05$). Moreover, qualitative data provides more evidence regarding how OISS directs pre-service digital material development and technology-based lesson planning. Task-based studies and self and peer-instructed practices helped them to advance their low OISS skills, as disorientation, purposeful thinking, control, and problem-solving strategies were already at a prominent level. Even though existing OISS skills are based on their information-seeking and acquiring on the

Table 2 Pre and post-test scores of pre-service EFL teachers' OISS

OISS	Mean	N	Std. Deviation	t	df	p
Disorientation – pre-test	16.9286	28	3.20796	− 0.759	27	0.454
Disorientation – post-test	17.3571	28	2.57069			
Evaluation – pre-test	8.8571	28	2.46027	− 24.298	27	0.000*
Evaluation – pre-test	20.5714	28	2.64475			
Purposeful thinking – pre-test	18.5714	28	3.86272	− 2.045	27	0.051
Purposeful thinking – post-test	19.9643	28	3.20280			
Select main ideas – pre-test	13.8571	28	3.00264	− 2.757	27	0.010*
Select main ideas – post-test	15.0357	28	2.54562			
Trial & error – pre-test	14.2500	28	2.31940	− 2.738	27	0.011*
Trial & error – post-test	15.4643	28	2.26866			
Control – pre-test	18.6786	28	3.46467	− 1.681	27	0.104
Control – post-test	19.8214	28	3.07985			
Problem-solving – pre-test	13.5714	28	2.02628	0.343	27	0.735
Problem-solving– post-test	13.4286	28	2.23488			
OISS – pre-test	115.2857	28	13.94661	− 2.465	27	0.020*
OISS – post-test	121.6429	28	11.85160			

*$p < 0.05$

internet, it was revealed that task-based learning sheets provide guidance to both trial & error and selecting the main ideas during the searching process.

> *Since we are given a list of what to do step by step, I had no difficulty while practicing the application usage. (Online course evaluation from)*
> *I didn't know much about technology except Word and PowerPoint. But now, I learned many applications that can be used in lessons. It was very instructive that our teacher shared with us the steps to follow and let us discover them individually. (Online course evaluation from)*

These further OISS skills helped them to comprehend similar interfaces and how to look for data on other websites/programs. So, pre-service teachers were able to transfer these skills to other contexts.

> *I designed a poster for my project. Although Pictochart is a program that I have not used before, I could easily comprehend it. Because it is similar to other programs that we practiced. (Final student project)*
> *(To develop an animation) I was relieved after I found Animaker, because, it was similar to the Powtoon application we used in the lesson and it was easy for us. However, most characters and backgrounds were premium features. So, we downloaded almost everything from the internet and uploaded it to Animaker. (Final student project)*

They utilized strategies to find specific types of files, pictures, or subject content. These strategies also eased the exploration of tools and features as well as their tutorials regarding their needs during the search journeys.

> *When choosing the pictures for my project, I paid attention to the pictures with cropped backgrounds in order not to cause distractions for students. For this, I searched the images I wanted to download as *word* in cartoon style png. (Final student project)*
> *We did some research to find the new program, and then we tried the features of the programs we found. For example, we examined the paid programs, we explored which features we can use for free. (Final student project)*
> *On the H5P website, I learned how to use it easily, as there is a tutorial about the use of Image Hotspots content. (Final student project)*
> *First, we examined the curriculum of the Ministry of Education for the primary school English lesson. While reviewing the curricula, we also discussed the suitability of the topics for Web 2.0 tools. …. We prepared the animation by Animaker. However, since we had never used Animaker before, we watched tutorial videos on YouTube for better understanding. (Final student project)*

Enhancing OISS skills with a praxeological learning approach influenced pre-service teachers' several soft skills for future careers. Furthermore, it was one way to appeal to them that they "can" seek any information/knowledge they want, and they "can" also learn and use them by themselves. Therefore, OISS skills development in this course gave them confidence in life-long learning and motivation for learning needs.

I used to have some hesitations about applications we used in the course and learning how to use them. After seeing my abilities in class, I started to feel confident about them. I liked most of the apps we used and think I will use them in my future teaching career. (Online course evaluation form)
I can say that this course was one of the most productive courses I have ever attended since I started studying in this department. I took your approach as an example for myself. Learning by doing has helped me a lot. I gained knowledge that I can use actively in my future professional life. The weekly assignments and our self-discovery process taught me a lot. … Although I did not consider myself competent in technology before, what I could do made me very happy. (Online course evaluation form)
Thanks to you, we have always taken an active role in our lessons. You did not just demonstrate the program like others (instructors). Further, you helped us to comprehend and interiorize the programs thanks to your instructions. This made the course very enjoyable for me and I learned to use these programs really efficiently. In the future, I will make my students active and participate in the lesson, as you did. (Final student project)

Besides the positive comments, there were also some negative comments on the course evaluation form. One of them was negative attitudes towards technology as mentioned by a student on the course evaluation form "Since I don't like computers that much, I actually had a little difficulty in the lesson.". Few pre-service teachers stated that the allocated time was not enough for some applications displaying complex interfaces. Therefore, they suggested instructions for the task-based learning phase could be more detailed. So, some advanced OISS skill enhancement may be required.

Discussion and implications

Using a mixed research methodology, this research aimed to test the praxeological learning process to enhance pre-service EFL teachers' TPACK and OISS. The praxeological learning instructional design proposed by Kulaksız and Toran (2022) was considered for the course design. Since this learning approach advocates democratic participation (Pascal & Bertram, 2012), pre-service EFL teachers initially decided on the software/applications as course content, course teaching/learning strategies, and assessment-evaluation methods collectively. Therefore, they acted as co-creators of the course syllabus. With the support of OISS as pre-conditional skills, independent studies to learn educational technologies performed via task-based learning to develop TK and TPACK skills. Then, a context orientation study took place regarding contextual factors of the TPACK framework. Lastly, students implemented their knowledge and skills related to all TPACK elements in contextualized technology-based lesson plans. Pre-post-tests of TPACK and OISS scales with qualitative findings indicated that while learners' TPACK total score and all sub-dimensions were fostered, OISS' total score, evaluation, selecting main ideas, and trial & error strategies showed progress meaningfully.

The way of step-by-step deepening the TPACK framework constructed pre-service teachers' technology integration knowledge and skills gradually. Besides, pre-service EFL teachers were able to design technology-enhanced learning/teaching scenarios for their real-life-imitated imaginary students and classroom environment by pressing contextual knowledge into service. These context-sensitive cases with praxeological learning raise

awareness of digital opportunities but also avoid the lure of technology inclusion in the classroom without pedagogical value. Hence, cumulative TPACK construction via task-based practices and authentic cases ended up with successful results in this study. One of the meaningful technology integration skills development studies was that Baran and Uygun (2016) used a design-based learning approach for pre-service teachers' TPACK improvement. They found out that design-based learning principles facilitate growth in the TPACK involving lesson design decisions, bringing theory to practice, sustainable learning of TPACK, and contextual conditions in their educational settings. Therefore, accurately designed tasks for pre-service teachers can make it easier to comprehend TPACK-in-action situated learning in the real world.

Furthermore, recent studies also recommend context as a "missing knowledge component" of TPACK and highlight the importance of having situation-specific TPACK competencies to be able to use technology effectively in various educational environments (Brianza et al., 2022). However, the author could not measure the context knowledge quantitatively in this piece of study due to the lack of data collection opportunities. Yet, it can be said that the context orientation exercises were successful, and the lessons were planned by the students being aware of the contextual elements. Scale development of contextual knowledge and/or context awareness for technology-based lesson design is expected from future studies. Also, how pre-service teachers orchestrate technology-enhanced learning (see Prieto et al.'s framework (Prieto et al., 2011)) by accounting for contextual variables (e.g., Brianza et al., 2022; Kulaksız & Karaca, 2023) can be examined in detail for further.

On the other hand, participants' overall OISS scores improved significantly. Obviously, students were exposed to information searching on the internet more than in their previous activities due to the nature of this course, which boosted their OISS. Indeed, the more individual's daily internet uses the more advances in OISS (Çaka et al., 2015). Qualitative findings pointed out that pre-service teachers were able to notice new strategies during their independent task-based studies and peer learning. Meanwhile, it was seen that they already have some level of OISS (e.g., disorientation, purposeful thinking), which did not show significant development in this course. Furthermore, students used OISS effectively to discover both content and new tools to design digital materials and prepare technology-based lesson plans. Evidently, students primarily choose their keywords during the planning process, and they compare the material they received to their search objectives during the monitoring and evaluation phases (Karaoğlan Yılmaz, 2016). Students' OISS are related to their educational internet use self-efficacy beliefs (Hava, 2019) and metacognitive awareness (Karaoğlan Yılmaz, 2016). Hence, it is possible to say that guided searching activities enhanced their awareness while helping their metacognitive knowledge organization during task-based class activities. It is also important to bear in mind that OISS as a predictor of lifelong learning trends (Canan Güngören et al., 2019) can also mediate future EFL teachers' TPACK professional development.

Pre-service teachers believed that the praxeological learning approach forms a safe space where they make mistakes without hesitations, are able to seek help, and boost their self-efficacy level, whereas they took upon learning responsibilities on their shoulders in this course. Similar findings reported by Kulaksız and Toran (2022) also claim that self-regulated learning and persistence are one of the outcomes of praxeological

learning in an instructional technologies course. The association between SRL and TPACK (Huang & Lajoie, 2021) demonstrates the importance of a praxeological learning approach to promote sustainable interest and create individual professional development pathways in pre-service teachers' careers. On the other hand, students perceived the complexity of program interfaces otherwise due to individual differences such as previous technology experiences and attitudes. To be able to tolerate these issues via a praxeological learning approach, collaboration and peer support were encouraged in the computer lab, and extracurricular times by the instructor to complement time for their learning. The goal here was to establish a support system for students with negative attitudes or those with relatively low digital proficiency levels compared to their peers. This support relieved those students' intimidation by technical problems and decisive actions during TPACK construction. Wearing too many hats during TPACK development in different contexts, praxeological learning made them feel the need for critical skills in making authentic decisions. Therefore, praxeological learning provides experiential learning by outperforming natural learning curiosity and needs, rather than just reaching the learning objectives of the formal lecture. This sophisticated TPACK acquirement and OISS enrichment in this course widen the horizon of pre-service teachers thanks to transferability as real-life information in a way.

Limitations

In this study, pre-service EFL teachers' TPACK construction and change in OISS at the beginning and end of the semester were captured. However, no mid-evaluation or repeatedly measured longitudinal assessments were performed. Therefore, there is no statistical observation of which stages of the course structure (Fig. 1) and how these steps were affected respectively. Also, though one of the scopes of the study aimed at contextual knowledge, its knowledge construction process was not examined due to suitable scale scarcity. However, multiple data sources of pre-service teachers including self-assessment were reflected as qualitative findings for transparency. Indeed, peer interaction was promoted during the semester, but no specific follow-up action was done on the influence of pre-service EFL teachers' individual or collective TPACK (Yeh et al., 2021), therefore, it is strongly recommended for future research.

Conclusion

It was concluded that pre-service EFL teachers' TPACK and partially OISS have increased thanks to the praxeological learning approach intervention. Following TK, TPACK, and Contextual TPACK steps, this approach cumulatively scaffolds students' TPACK construction holistically and engages them in real-life experiences. Besides, OISS facilitated their TPACK development by fastening, providing accuracy, and validating during information-seeking activities while developing technology-based lesson plans and digital materials. The praxeological approach can guarantee long-term motivation for TPACK updates, and OISS can mediate their progress for sustainable professional development in their career. It is safe to say that this learning approach gives pre-service teachers a hunch into how to adapt technology to lessons by taking account in a context-sensitive way. Although challenging moments occurred during knowledge-building efforts, this study declares that praxeological learning allows students to benefit

from their failures, appreciate efforts, and turn their learning agony into perseverance, and supports Punya Mishra's (2023) words: "The one can argue that failure led to success. But I think that it will be missing the point. It will be missing the point that it ignores the pain and hurt that failure causes. It ignores the agony…".

Abbreviations

EFL	English as a foreign language
OISS	Online information-seeking strategies
PCK	Pedagogical content knowledge
TK	Technology knowledge
TPACK	Technological pedagogical content knowledge

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Competing interests
The author declares that she has no competing interests.

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Publisher's Note

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