

Fostering EFL Pre-Service Teachers' TPACK through Inquiry-Based, Technology-Saturated, and Flipped Instructional Model

Maulana Mualim*

Faculty of Languages, Arts, and Cultures, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

Email: maulanamualim.2022@student.uny.ac.id

ORCID iD: <https://orcid.org/0000-0001-7971-2032>

*Corresponding Author

Margana

Faculty of Languages, Arts, and Cultures, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

Email: margana@uny.ac.id

ORCID iD: <https://orcid.org/0000-0002-7680-641X>

Agus Widyanoro

Faculty of Languages, Arts, and Cultures, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

Email: agus_widyanoro@uny.ac.id

ORCID iD: <https://orcid.org/0000-0001-9677-0525>

Lu'luil Maknun

Faculty of Education and Teacher Training, Universitas Mercu Buana Yogyakarta, Yogyakarta, Indonesia

Email: lulu@mercubuana-yogya.ac.id

ORCID iD: <https://orcid.org/0000-0002-7407-7751>

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Abstract: As the English language and information and communication technology (ICT) enhance global interconnection, demands on educating the young generation with English language skills and technological competence increase exponentially. As the successor of education, pre-service English teachers need to be trained with technological pedagogical content knowledge (TPACK). This study aims to develop an instructional model oriented to pre-service English teachers' (PST) TPACK. This is design-based research carried out in three stages: informed exploration, enactment, and evaluation. This study employed a multiphase mixed method. A qualitative design was done in the informed exploration stage, and an explanatory sequential mixed design was used for the evaluation stage. Nine PSTs, three lecturers, and 4 experts were invited as the participants of this study. The qualitative data were analyzed thematically on NVIVO software while the quantitative data were analyzed using descriptive statistic calculation. The results showed that the PSTs need an instructional model that facilitates student agency, learning agency, self-reliance, innovation, and cooperation. An instructional model called Inquiry-based, technology-saturated, and flipped instructional model (INSTALL) was developed. The expert validation result showed that the products of this development study were in the "Very Good" category. The results of the expert judgment indicated that INSTALL could be utilized to enhance the PSTs' TPACK by blending inquiry-based learning and technology-saturated flipped instruction.

Index Terms: Flipped classroom, INSTALL model, Inquiry-based learning, Pre-service English teachers, TPACK

1. Introduction

Along with the growing demands of information and communication technology (ICT) and English language skills for global communication and interconnection, technological competence has become indispensable in today's English teacher training curriculum [1]. That is because teaching English as a Foreign Language (EFL) is dependent on

information and communication technology (ICT) to some extent. ICT not only facilitates the delivery of English teaching [2], intensifies assessment [3], and enhances students' motivation [4], but it also serves as a sole way to bridge the gaps between the learners' location and the target language. For instance, training listening skills cannot be fulfilled without ICT [5]. Therefore, the technological competence of EFL teachers and pedagogical and linguistic competencies are essential for efficient EFL teaching in the 21st century.

The competence in harnessing ICT for teaching is often associated with technological pedagogical content knowledge (TPACK) [6]. TPACK is a knowledge construction that describes teachers' proficiency in integrating ICT into teaching [7]. A number of research studies have proven the appropriateness of TPACK in measuring teachers' technological competence [8]. Hence, understanding EFL teachers' competence in harnessing technology for teaching can be seen from their TPACK.

Taking a closer look at the Indonesian context, research shows that in-service EFL teachers' TPACK needs enhancement [9–11] leaving an urge to prepare EFL PSTs with intensive technology integration training. Meanwhile, the existing TPACK training encounters challenges such as the contextual discrepancy between the training in universities and the real implementation in schools [12], low level of technological affordance and digital literacy [13], [14], and the need for more familiarization training on harnessing technologies for English teaching [15]. Many schools in rural or underserved areas in Indonesia face inadequate ICT infrastructure, teachers often struggle to align technology use with pedagogical goals and EFL content, leading to ineffective, superficial integration [16].

Analyzing the field's problems, we proposed integrating inquiry-based learning (IBL), technology-saturated learning, and flipped classrooms (FC) as a novel instructional model oriented to EFL PSTs' TPACK. Unlike traditional teaching, IBL allows students to construct knowledge through probing, discovering, and research [17,18]. IBL emphasizes student agency in learning. The students are given a vast space to explore the knowledge based on prompts and questions [19]. Conversely, FC has the potential for a more engaging rather than alienating the students by flipping the in-classroom and out-of-classroom activities [20]. While student assignment in traditional classrooms is carried out after the physical classes and treated as a confirmation of what the students have studied, FC puts the assignment before the physical classes and is considered as preparation [21]. In this way, the students come to the classroom equipped with knowledge and readiness for exploration. Both learning approaches are associated with 21st-century education as they closely relate to technology-assisted learning. However, the two learning approaches were underutilized in TPACK acquisition studies, especially in the Indonesian context. Hence, the purposes of this study are (1) to investigate the target needs and learning needs concerning a novel instructional model oriented to EFL PSTs' TPACK, (2) to describe the design and development of the inquiry-based, technology saturated, and flipped instructional model (INSTALL), and (3) to find out the validity scores of the model provided by experts as well as their feedback.

2. Literature Review

2.1. Teaching English in the 21st Century

In the 21st century, the widespread use of ICT and the invention of the Internet transformed the world significantly from an industry-based economy to an information-based economy [22,23]. Consequently, a new set of skills was needed as more and more innovations were invented, new jobs were created, and new ways of living were introduced [23]. As a result, education was renewed to prepare students for the challenges of the 21st century. Training students with traditional subjects such as math, language, science, and arts were insufficient, so they had to be equipped with critical thinking, problem-solving, collaboration, creativity, decision-making, and digital literacy [24] to increase their preparedness, employability, and marketability in the 21st-century job market.

Likewise, English teaching has to adapt to new techniques compatible with the challenges of the 21st century. As English is one of the core subjects in the school curriculum [24] and it is, together with mathematics, regarded as a prerequisite academic domain for developing 21st-century skills [25], English teachers play critical roles in learners' acquisition of the skills. English teachers nowadays should emphasize more collaborative, communicative, and innovative learning. English teaching for the 21st century in the Indonesian context should be carried out by injecting the principles of 1) successful communication, 2) authentic assessment, 3) ICT integration, 4) rigorous content mastery, 5) character basis, and 6) cultural basis [26].

2.2. Technological Pedagogical Content Knowledge

Technological Pedagogical Content Knowledge (henceforth, TPACK) is a knowledge concept that combines the knowledge of the field/content, pedagogy, and technology [6]. This concept was formulated by Koehler and Mishra in 2006 as a continuation of the construction of Pedagogical Content Knowledge (PCK) developed by Schulman, where technology is included amid Pedagogy and Content. TPACK is considered inevitable due to the unavoidable use of ICT in human life [27].

TPACK is at the nexus between technology, pedagogy, and content. It conceptualizes the idea that the content (material) delivery should align with pedagogical approaches and technological faculty [6]. Seven components of knowledge become a single unit in realizing learning using technology: 1) Technological Knowledge denotes one's knowledge of operating technologies and dealing with their intricacies; 2) Content Knowledge refers to one's knowledge about a particular field of study, such as English and Math; 3) Pedagogical Knowledge is knowledge about

approaches, methods, strategies, and techniques of teaching a subject; 4) Pedagogical Content Knowledge is one's faculty in delivering materials with appropriate teaching procedures; 5) Technological Content Knowledge is one's knowledge to integrate technologies into subject matters; 6) Technological Pedagogical Knowledge is one's knowledge about harnessing technologies to enhance teaching and learning process; and 7) Technological Pedagogical Content Knowledge represents one's knowledge in how to teach a subject with appropriate technology efficiently [7].

However, several researchers questioned whether or not the framework is a "just right" concept, not too small or too large, to describe knowledge for technology integration. Brantley-Dias and Ertmer recognized that this concept is too large by covering seven knowledge domains. At the same time, the individual domains are too small, vague and ambiguous. For example, the TK and TCK have very closely related descriptions, so it was hard to distinguish whether an action belongs to TK or TCK [28]. Sang et al. opined that there are no clear boundaries between the seven knowledge domains of TPACK [29]. Furthermore, Özgen & Narlı, through a rough set analysis, found that TPACK domains could not provide accuracy regarding their actual influence on the PSTs' knowledge set [30].

Despite the doubts, TPACK has been the most referred construct to describe the interconnectivity among content, pedagogy, and technology so far [29,30]. Publications on this framework continue to grow [31], providing evidence that the framework has a valuable impact on technology integration into education research.

2.3. *Inquiry-based learning as a newfangled learning in the 21st century*

Inquiry-based learning (IBL) is a learning approach that places students at the center of the learning activity by posing questions and allowing them to search for them in the suggested resources, synthesize the investigation results, and present them [32]. Against the backdrop of the constructivist theory, IBL promotes students' active exploration, critical thinking skills, and problem-solving skills for research and constructing knowledge [33].

Called an avant-garde learning strategy, IBL has distinct learning characteristics compared to traditional learning [34]. While traditional learning puts teachers as the authoritative source of knowledge, IBL treats students as the main actors to experience orientation, formulate questions, explore the possible answers to the questions, construct arguments, and expose them to peers and teachers [33]. Therefore, the learning is engaging rather than alienating [32], [35]. Implementing this series of activities could shape students' self-reliance, metacognitive and critical thinking skills, and, eventually, a more profound understanding of the subject matter. As proven by research, students will likely register knowledge more profoundly when they are more engaged in the learning process [36].

2.4. *Technology-saturated instruction*

Today's classes and classrooms should be equipped with technology [37]. Technology integration into education becomes very essential as a preparation for the 21st-century job market. Education and training should emphasize ICT literacy so that students can benefit from ICT advancement for more efficient and effective utilization in the future [38]. World Economic Forum stipulated 16 skills, one of which is ICT literacy, that need to be mastered by the young generation to elevate their competence in the industry in the 21st century [39].

Teaching English needs technology integration. Especially in countries where English is considered a foreign language, technology comes as an aid to shorten the distance between English and the learners [40]. Technology has disrupted English learning and teaching activities through showing, listening, researching, and practicing [5]. Computers and projectors have replaced boards and chalks with multiple times enhanced visual quality, listening inputs have become more varied on the Internet, finding out materials can be done seamlessly on search engines like Google and Bing, and English practice can be done from real to virtual spaces and its continua such as virtual reality, augmented reality, and the Metaverse [41].

2.5. *Flipped classroom to enhance students' readiness*

A flipped classroom is an instructional approach reversing in-class and out-of-class learning [42]. While traditional instruction provides lectures and exercises in the classroom and is followed by take-home assignments, a flipped classroom begins with learners doing assignments at home. It is followed by confirmation and exploration in the classroom [43]. The activities in the classroom stress the learners confirming their discovery, exchanging different ideas, and exploring examples [44]. Foldnes [45], Strelan et al. [46], and Vitta and Al-Hoorie [47] uncovered that a flipped classroom is, in general, more effective than the traditional one in enhancing the learners' knowledge, academic performance, and skills though its extent varies depending on the context.

A flipped classroom is associated with the constructivist theory, which underpins that learners should be at the center of the learning activity. Learners should take a dominant proportion of the whole instructional activity by inviting them for exploration, discussion, and creation [48]. A flipped classroom relies on learners' self-regulation and their technological competence. Therefore, it is best implemented in senior high schools and higher educational institutes to help students navigate self-directed learning and technology affordance [42].

2.6. *Existing models for TPACK development*

Research and development (R&D) projects on instructional models in light to enhance EFL teachers' and pre-service teachers' TPACK have been carried out across the globe. Lachner et al. [49] developed a subject-specific TPACK module in Germany whose syntax comprises role models, design practices, and authentic experience. The

TPACK module was declared effective after finding the PSTs' TPACK in the experimental group surpassed those in the control group. Cheng et al. [50] developed the DECODE model in Taiwan. The instructional activity includes teachers demonstrating the CloudClassroom (CCR) website, students co-training CCR, students co-designing a lesson, and students co-teaching a lesson on the CCR. The PSTs exhibited an increased TPACK, as shown by the higher score of the TPACK post-test and the high quality of the lesson design. Chaipidech et al. [51] developed a personalized learning system (PLS) to support teacher professional development training. PLS was proven effective in improving the TPACK of 161 teachers across Thailand. The PLS training was done in 4 stages: motivation, conceptualization, consolidation, and recommendation. Finally, Zhang and Zhou [52] developed the Bridge-in, Outcome, Pre-assessment, Participatory Learning, Post-assessment, and Summary (BOPPPS) model to enhance novice teachers' TPACK in China. After undergoing the BOPPPS intervention, the respondents' post-test results were higher than the pre-test.

The existing instructional models were proven effective in enhancing the teachers' and pre-service teachers' TPACK through experiment inquiries. However, there are essential points in the models that could be enhanced. The role-model videos of Lachner et al.'s TPACK module were done in the classroom when it could be done before the classes to increase student and learning agency. Cheng et al.'s DECODE model could invite the PSTs to discover the CCR by themselves to strengthen student agency. Besides, Chaipidech et al.'s PLS could consider problem-solving activities to instill 21st-century skills during the consolidation phase. Finally, Zhang and Zhou's BOPPPS model could leverage their microteaching through a technology-rich classroom so the students get used to operating digital technologies. The current study attempts to fill these gaps by synergizing inquiry-based learning, technology-saturated learning, and flipped learning.

The current study aimed to address the following research questions, building upon the previously discussed research background.

- 1) What are the target needs and learning needs concerning a novel instructional model oriented to EFL PSTs' TPACK?
- 2) How is the design and development of the inquiry-based, technology-saturated, and flipped instructional model (INSTALL)?
- 3) What are the mean scores of the model's content validity provided by experts and their feedback?

3. Methodology

This study aims to develop an instructional model oriented to the TPACK of higher education students. This study takes the first and second stages of a design-based research (DBR) model developed by Bannan [53] called the Integrative Learning Design Framework (ILDF) model. The ILDF comprises three stages: informed exploration, enactment, and evaluation with local and broader impacts.

DBR allows researchers to design interventions (e.g., inquiry-based, technology-integrated, flipped models) that are tested and refined in real-time, providing contextually rich insights [54,55]. DBR embraces an iterative design, implementation, evaluation, and refinement cycle. This characteristic makes it ideal for adapting instructional approaches like inquiry-based, technology-saturated, and flipped instructional models to the contextual needs of EFL pre-service teachers, ensuring continuous improvement and alignment with educational objectives [56].

Therefore, DBR is an appropriate approach for studying EFL pre-service teachers' TPACK enhancement within the development of Inquiry-Based, Technology-Saturated, and Flipped Instructional Models due to its iterative, practical, and collaborative nature. It bridges the gap between theory and practice, facilitating the creation of robust, context-sensitive instructional designs that evolve in response to the unique demands of EFL teaching and learning contexts [54]. However, this study is part of a more extensive doctoral dissertation focused on the stages of inform exploration (needs analysis) and enactment (development and expert validation).

This study started with an informed exploration stage where the target needs and learning needs in the ICT in English Language Teaching (ICT in ELT) course were explored. The needs analysis includes literature and field (context) investigation. The finding served as the basis for the enactment stage, which included developing and validating the model. The model development was documented in three products. They are a model book, a user manual book, and a set of learning kits comprising a syllabus, a teaching material book, video materials, worksheets, and an assessment rubric. Subsequently, the products went through expert validation and product revision procedures.

3.1 Research Participants

For the informed exploration stage (need analysis), we purposefully selected nine pre-service English teachers and three lecturers from three universities as informants by conducting an interview to find out their needs. The pre-service teachers are senior-year students of the English education department. They have completed the English language-related and pedagogy-related courses. Meanwhile, the lecturers are those who teach courses on the integration of technology into English teaching.

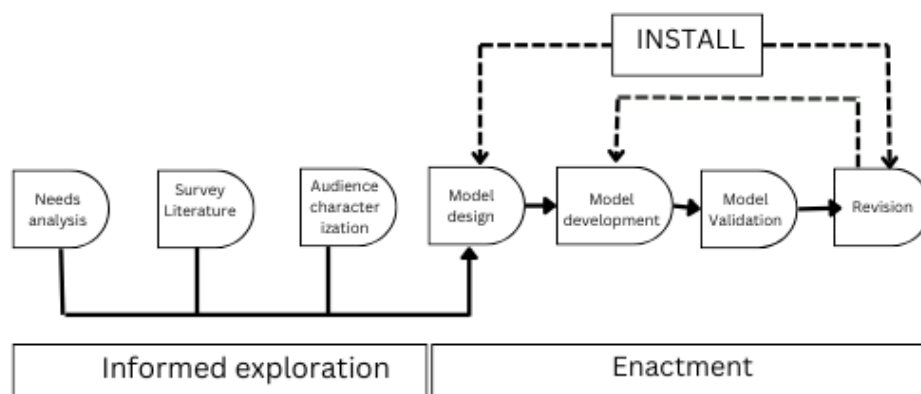


Fig. 1. The development model adapted from Bannan [53]

For the evaluation stage, four experts were invited to validate the content and the construct of the model. The qualifications of the experts are as follows. They are senior researchers and lecturers in ELT studies with a particular interest in technology integration, who have PhD in ELT and have more than 10 years of experience in ELT. Meanwhile, the practitioners are lecturers in ICT in ELT courses. They have at least a master's degree education and two years of teaching experience.

Table 1. Qualification of The Experts

Experts	Sex	Education	Teaching Experience	Academic Rank
Exp. 1	Male	PhD in Applied Linguistics	38 years	Professor
Exp. 2	Male	PhD in Educational Technology	39 years	Assoc. Professor
Exp. 3	Female	M.A. in English Education	5 years	Lecturer
Exp. 4	Male	M.A. in Applied Linguistics	10 years	Lecturer

3.2 Data Collection Techniques

The needs analysis data were collected through interviews, class observation, and teaching document analysis. The interview protocol was constructed following Hutchinson and Waters' needs analysis model [57]. Based on this model, an instructional model's needs should be analyzed from two viewpoints. They are the target needs comprising necessities, lacks, and wants, and the learning needs consisting of goals, input, setting, teacher's role, and student's role. The necessities are the destination of the model development, the lacks are its starting point, and the learning needs are its route to achieve the destination. The interviews are audio-recorded by utilizing the voice memo application of iPhone 14 Plus.

The evaluation data were gleaned through validation sheets comprising close-ended questions and open-ended feedback spaces. The experts were to rate the products based on their compliance with the criteria of acceptable instructional models. All of the product components were assessed for clarity, completeness, accuracy, coherence, and practicality. The scores given were in a range between 1 to 4.

3.3 Data Analysis Techniques

The audio-recorded interview data were transcribed with the help of goodtape.io for the needs analysis data. The machine-transcribed data were then reread and revised by the researchers. The revised data was then returned to the informants for internal validation. Finally, the transcribed interview, observation notes, and documentation data were analyzed thematically following Braun and Clarke [58] model with the help of NVIVO software. The reason for using NVIVO is its ability to organize extensive qualitative data and its coding features. The thematic analysis procedure is as follows: First, the interview audio recording files were transcribed by the help of goodtape.io and reread manually by the researchers (R). The transcribed interview data were then imported to NVIVO and named S1 for student 1, S2 for student 2, etc. R gets familiar with the data by reading it several times. R then forms initial codes of the recurring topics by blocking sentences and giving them codes. R subsequently identifies themes and subthemes from the codes. R reviews the decided themes. Next, R rereads the data and, if necessary, rearranges the themes. R subsequently names the themes. Finally, R reports the results.

Meanwhile, the gleaned quantitative data in the evaluation stage were analyzed descriptively by finding their mean and standard deviation for the evaluation data analysis. The mean scores of the assessed aspects were then categorized into four categories, namely very good, good, poor, and very poor. Table 2 presents the scoring criteria. Table 3 summarizes the research stages, the participants, the data collection technique, the instruments, and the data analysis technique.

Table 2. Validity Score Range and Its Categories

Score	Category
$3.25 \leq x < 4$	Very Good
$2.5 \leq x \leq 3.25$	Good
$1.75 \leq x \leq 2.5$	Poor
$1 \leq x \leq 1.75$	Very Poor

Table 3. Research Method Summary

Research stage	Participant	Data collection	Instrument	Data analysis
Informed exploration	3 lecturers and 9 PSTs (n=12)	Interviews, observations, and document analysis	Interview protocol, observation sheets, and documentation sheets	Thematic analysis of NVIVO
Enactment	2 academia and 2 practitioners (n=4)	Questionnaire	Validation sheets	Descriptive statistic

4. Results and Discussions

4.1 The Needs Analysis for an Instructional Model Oriented to PSTs' TPACK

The interview, observation, and documentation data analysis on NVIVO revealed several codes of the target and learning needs. The informants opined that the necessities for a new instructional model are that learners have to catch up with the current technological advances, that today's learning should be adjusted to the learners' current social condition, and that technologies should support today's classrooms. The PSTs lack in harnessing technology for ELT, ELT teaching strategies and techniques, AI for pedagogical purposes, and creativity for designing a lesson plan. The PSTs want to learn more technologies for ELT teaching, training in AI-supported ELT, and ethics when using technology or AI for teaching and learning.

Interview Excerpts:

"I think, ICT is extremely needed in education today. We observed that ICT is developing very fast and cannot be avoided. For example, the teachers today should take the emergence of AI as a stimulus for teaching enhancement." (Lecturer 3)

"Technology is there to help our life. There is AI that can work for us and I think their use in education will be very good for us." (Pre-service teacher 2)

"As globalization becomes more intense, the need for technology and English language is growing fast." (Pre-service teacher 5)

Table 4. Target needs for a new instructional model oriented to TPACK

Theme	Subtheme	Code
Target Needs	Necessities	- Aligning learning with students' profile - Catching up with current technological advances - Training Tech-savvy teachers
	Lacks	- Knowledge of teaching strategies and techniques - Ability to utilize technology for teaching - Skills in AI for teaching - Creativity in designing a lesson
	Wants	- Technologies for teaching - Teaching with AI - Ethics in using AI and technologies for teaching and learning

Meanwhile, the learning needs as the route for reaching the necessities are as follows. The goals of ICT in ELT courses are training tech-savvy teachers, equipping teachers with TPACK, and training innovative ELT techniques. The input for this course includes books, eBooks, journal articles, and workshop materials. Theoretically, the course needs inputs on English language teaching and Computer-assisted language learning. The teachers are expected to act as facilitators, motivators, and collaborators. The students' roles are explorer, lead actor, collaborator, and knowledge receiver. The settings are insufficient time, students' unreadiness, and infrastructure.

Interview excerpts:

"The goal of this course is to train the PSTs to be tech-savvy English teachers. First, they can review various technologies so they know the characteristics of each technology. Then, they can design lesson plans by mentioning some appropriate technologies and, later on, they can harness the technologies for teaching in the classroom". (Lecturer 1)

“Various learning resources were used such as book on English language teaching and journal articles. But I think it will be more beneficial if we focus on learning the technologies rather than discussing the theories, it's kind of boring”. (Pre-service teacher 4)

“I think we need a multimedia room to tackle the infrastructure problems. Incompatible mobile phones, insufficient credits, and poor Internet network often hinder our learning. If there is a room with computers with connected Internet, that will be a great help”. (Pre-service teacher 1)

Table 5. Learning needs for a training model oriented to TPACK

Theme	Subtheme	Code
Learning Needs	Goal	• Being tech-savvy English teachers • Acquiring sufficient TPACK • Training innovative ELT techniques
	Input	• ELT theory and CALL theory • Book, ebook, journal articles, and workshop materials
	Teachers' role	• Facilitator, motivator, and collaborator
	Students' role	• Explorer, main actor, collaborator, and knowledge receivers
	Setting	• Insufficient time for discussion and presentation • Students are not ready for the discussion • Insufficient infrastructure

The needs analysis in the enactment stage concluded that the needs in ICT in ELT are activities that not only allow them to catch up with recent technological advancements but also equip them with skills for teaching in the 21st century. The activities emphasize student agency, learning agency, self-regulation, meta-learning, innovation, and cooperation.

4.2 The Design and Development of the INSTALL Model

As a newfangled teaching method, inquiry-based learning provides wider exploration opportunities for students than traditional teacher-centered teaching. It enables learners to control their learning completely [32], promotes critical thinking, utilizes technology, and foregrounds collaboration. Hence, it is associated with 21st-century learning [32]. The current advancement of ICT facilitates the application and boosts the potential of IBL [34]. Access to digital technologies has enabled today's students to find information seamlessly. It should be taken as an opportunity to instill scientific thinking methods in the students through IBL [59]. Research shows that the combination of IBL and ICT increases the learning results. Here are some instances. Through experimental research, Abdi proved that the students taught through IBL gained better results than those taught through traditional methods [60]. Nunaki et al. used a group pre-posttest on single-group research, demonstrating that the IBL enables their students to elevate their metacognitive skills [61]. Finally, Shih et al. delineate that IBL combined with mobile phones has been proven effective for teaching social science [62].

On the other hand, FC, which works differently from traditional learning, has many advantages. As the name suggests, in-class and out-of-class activities are flipped. Out-of-class activities are done before the in-class ones, whereas the traditional classroom arranges the in-class activity first and the out-of-class activity after the school hour, which is usually called homework. This way, the in-class activity explores and enhances what has been done outside of the classroom. Among the advantages of the FC are enhancing the students' preparedness, maximizing in-class interaction, giving more challenge to the students, and allowing more student engagement [44].

Besides, technology saturation in the TPACK instructional activities is needed to facilitate the IBL and FC efficiently. Teaching materials, including instructional videos and e-modules, are better accessed by the PST when they are sent to them virtually. Technology-saturated classrooms could give the PSTs an experience of what it is like to be in a teaching session with full use of technology. As the well-known proverb “tell me and I forget, teach me and I remember, involve me and I learn” [63,64] suggests, the PSTs are involved so they can figure out how to teach English with technology with the hope that they are more ready with the integration and can anticipate the hindrances in the future when they become professional English teachers.

The name of the developed instructional model is INSTALL, which is the acronym for INquiry-baSed, Technology-saturated, and flipped instructionAL model. The syntax of the INSTALL model encompasses four integrative activities: Flipping, Modeling, Designing, and Role-playing. In the Flipping phase, the PSTs learn the material through reading, watching, or listening to audio files sent to them a week before the designated session on a learning management system (LMS). At the end of the video, the PSTs are instructed to investigate some applications/websites for English teaching. In the Modeling phase, the PSTs first present their findings from the application/website exploration to their peers in a Jigsaw group discussion. Afterward, they act as students, receiving some examples of teaching English with technology from the lecturer. Therefore, they get ideas on what they would design and perform in the other two activities. In the design phase, the PSTs are divided into several small groups, and they design a lesson plan. The PSTs mention the learning objectives, materials, technologies, teaching steps, and assessment methods in the lesson plan. The teaching design should first emphasize the pedagogical aspects, *i.e.*, delivering material for a specific group of students systematically and attractively. The type of technology is decided based on the teaching design. Finally, the role-playing phase provided ample space for the PSTs to demonstrate teaching using technology. In this phase, it is expected that the PSTs demonstrate their TPACK.

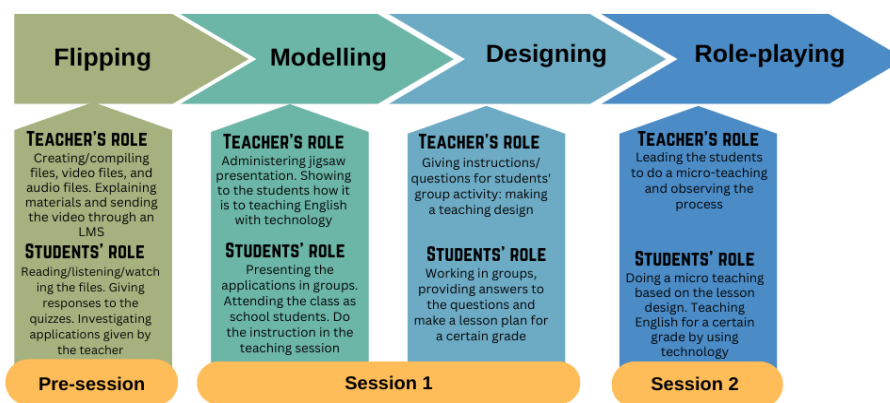


Fig. 2. The Syntax of INSTALL

One round of INSTALL intervention lasts in two sessions. The Flipping phase is delivered in the pre-session, i.e., a week before the actual session. The Modeling and Designing phases are carried out in one session. In practical terms, this two-credit session (100 minutes) is divided into four activities. The recommended time distribution is 5 minutes for opening, 30 minutes for IBL through Jigsaw group discussions, 30 minutes for modeling, 30 minutes for designing, and 5 minutes for closing. Finally, the role-playing phase is conducted in the following session. This whole 100-minute session was provided entirely for teaching simulation with formative feedback. It is expected that through performing a teaching session, the PSTs could acquire a more realistic knowledge of technology integration into English teaching, and as a result, the PSTs' TPACK is enhanced.

4.3 Expert Validation of INSTALL

The INSTALL model was developed and written using three inseparable products. They are a model book, a user manual book, and a set of learning kits. The model book contains the rationale of the model development, the underlying model theory, the model syntax, and the tasks to be done by the lecturers and the PSTs. The user manual book contains procedures for implementing INSTALL, starting from what to prepare, steps in doing INSTALL, and how to evaluate the PSTs' performance. The learning kits comprise a syllabus, video material, text material, worksheets, and an assessment rubric. The three components of the model are within one inseparable unit.

The results of the model book evaluation are as follows. The clarity of the model chart is at a very good level ($M=3.5$; $SD=.58$), the completeness of the book components is very good ($M=3.7$; $SD=.24$), the accuracy of the model to address the problems is very good ($M=3.6$; $SD=.13$), the coherence among the chapters and subchapters of the book is very good ($M=3.8$; $SD=.50$), and the practicality of the learning model is very good ($M=3.8$; $SD=.50$).

Table 6. Experts' evaluation of the model book

No.	Aspect	Result		Category
		Mean	S.D.	
1	Clarity	3.5	.58	Very Good
2	Completeness	3.7	.24	Very Good
3	Accuracy	3.6	.13	Very Good
4	Coherence	3.8	.50	Very Good
5	Practicality	3.8	.50	Very Good
	Total mean	3.7		Very Good

Meanwhile, the results of the user manual book evaluation by the experts are as follows. The clarity of the book is very good ($M=3.5$; $S.D.=.35$), the accuracy of contents in directing users is very good ($M=3.5$; $S.D.=.41$), the coherence among the chapters and subchapters of the book is very good ($M=3.5$; $S.D.=.58$), the practicality of the manual book is very good ($M=3.5$; $S.D.=.58$), the suitability of the manual to the problems being addressed is very good ($M=3.5$; $S.D.=.58$), and the meaningfulness of the book is very good ($M=3.5$; $S.D.=.58$).

Table 7. Experts' evaluation of the user manual book

No	Aspect	Result		Category
		Mean	S.D.	
1.	Clarity	3.5	.35	Very Good
2.	Accuracy	3.5	.41	Very Good
3.	Coherence	3.5	.58	Very Good
4.	Practicality	3.5	.58	Very Good
5.	Suitability	3.5	.58	Very Good
6.	Meaningfulness	3.5	.58	Very Good
	Total mean	3.5		Very Good

The results of the learning kits evaluation by the experts are as follows. The syllabus for implementing the model is very good ($M = 3.8$, $S.D. = .17$), the video materials are very good ($M = 3.6$, $S.D. = .24$), the worksheets used for formative and summative evaluation in the model are very good ($M = 3.8$, $S.D. = .29$), the assessment rubrics are very good ($M = 3.4$, $S.D. = .48$), the text materials are very good ($M = 3.6$, $S.D. = .29$), and the project assignment is very good ($M = 3.4$, $S.D. = .48$).

Table 8. Experts' evaluation of the learning kits

No.	Products	Mean	S.D	Category
1.	Syllabus	3.8	.17	Very Good
2.	Video materials	3.6	.24	Very Good
3.	Worksheet	3.8	.29	Very Good
4.	Rubric	3.4	.48	Very Good
5.	Text materials	3.6	.29	Very Good
6.	Assignment	3.4	.48	Very Good
	Total mean	3.6		Very Good

The experts provided notes for the quality enhancement of the model.

“After investigating the design of INSTALL, here are some notes and recommendation to elevate its quality and more suitability for implementation. The strengths of this model lies in its emphasize to constructivism and student-centeredness. Besides, by providing the three products (book, user manual, and learning kits), the authors have sufficiently presented and offered the model to its potential users. However, there are some weaknesses that the authors need to address. First, the three products are supposed to complement each other rather than providing similar information. There is a repetition of information on implementing INSTALL in the book and the user manual. Besides, the video materials need to contain an extended insight from the text material rather than a summary of it. Second, though the authors claimed that INSTALL provide an equitable TPACK training, but the user manual shows a tendency to be technocentric. Third, it is good to add infographics in addition to the guidelines. Fourth, INSTALL blends flipped and inquiry based learnings with multiple activities and tasks for the pre-service teachers, some users might find this mechanism overwhelming”.

The development of INSTALL serves as an initiative to address the needs and problems in the context of Indonesia relative to the enhancement of EFL PSTs' TPACK. The development of INSTALL is attempted to produce an instructional model incorporating FC and IBL in technology-saturated classrooms. The blending of these three learning approaches is the novelty of this model. INSTALL features activities that were not found in the previous models. The flipping activity was not utilized by Lachner et al. (TPACK Module) [65], Cheng et al. (DECODE model) [50], Chaipidech et al. (PLS model) [51], and Zhang and Zhou (BOPPPS model) [52]. Besides, while the previous studies introduced new technologies in teacher-centered activities, INSTALL instructed the pre-service teachers to discover them on their own before sharing it to their peers under the lecturer's guidance. Moreover, Jigsaw discussion, which the previous studies did not consider, was carried out in this study to amplify the students' ownership to their tasks.

The core underpinning of INSTALL is two newfangled learning models for the 21st century, namely FC and IBL. FC promotes student agency and facilitates student-centeredness in learning. It allows learners to construct understandings through exploration and interaction in the physical classes [66], while the materials were delivered virtually before the classes [20]. Relative to English as a foreign language learning, FC was proven effective in improving students' vocabulary, listening, and speaking skills [67], grammar [68], and overall final exam scores [69]. Research has delineated that FC has been used to enhance PSTs' subject-specific TPACK [44,70]. The inclusion of FC in INSTALL is aimed at providing significant opportunities for in-class exploration. It attempts to address one of the NA findings, such as the lack of student readiness.

Furthermore, the results from self-exploration in the FC were confirmed through an IBL where students share their knowledge, construct, confirm, and revise their understanding, as well as their peers. IBL is effective in training metacognitive skills [61] and critical thinking skills [71], which are very important for successful student-centered learning. Besides, IBL has a significant effect on English learning, including on speaking skills [72–74], reading skills [75,76], and writing skills [77,78].

The INSTALL implementation for EFL PSTs in Indonesia is crucial for two reasons. First, English in Indonesia is perceived as a foreign language, implying that all aspects of the language are foreign matters. The sounds, forms, structures, and intonation of the English language are not those dealt with in everyday life. ICT is there to "shorten" the distance between Indonesia and the English-speaking worlds, and TPACK, as the competence necessary for technology integration into English teaching, is, by all means, a basic necessity for today's EFL PSTs.

Based on the literature and experts' validation, INSTALL is a promising instructional model for EFL PSTs. It suits the current development of technology. It goes hand in hand with the social and cultural condition of today's digital native students. Furthermore, its syntax is proportionally structured, providing ample space for students' exploration and interaction.

5. Conclusion

This study describes the development of INSTALL, a training model oriented to EFL PSTs' TPACK. The development was done through design-based research's first and second stages: informed exploration (needs analysis) and enactment (development and expert validation). The needs of the PSTs and lecturers include the goal of being technologically competent English teachers in the future, insufficient time for receiving theory and practice, and inadequate teaching practice. The INSTALL model blends IBL and FC in technology-rich classrooms. The model syntax encompasses four integrative steps: flipping, modeling, designing, and role-playing. The model was developed in three products. They are a model book, a user manual book, and a set of learning kits consisting of a syllabus, video materials, text materials, worksheets, an assignment, and assessment rubrics. Four experts validated the model considering the criteria of its clarity, completeness, accuracy, coherence, practicality, suitability, and meaningfulness. The quantitative results showed valid criteria for the model. For the model enhancement, the experts provided suggestions in regard to avoiding repeated and overlapping information in the three products, avoiding technocentrism, and detailing the user manual with infographics.

The limitations of this study are its stop to the needs analysis and expert validation. As part of a broader DBR research, this study satisfies the first (informed exploration) and second (enactment) stages of the DBR. The third stage (evaluation) involving iterations will be reported on a different publication venue. Based on the findings, INSTALL can be used by lecturers to enhance the pre-service teachers' TPACK by, first, learning its academic manuscript and guidelines from the three products and second, implementing it by considering the learning time frame. The pre-service teachers might find the syntax of INSTALL confusing, lecturers' guides and monitor is therefore paramount for the learning process to run smoothly and meaningfully.

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Authors' Profiles



Maulana Mualim, M.A. is a doctoral student of Language Education at Yogyakarta State University, Indonesia. His research area includes Computer Assisted Language Learning (CALL), AI in English learning, TPACK in English Language Teaching, and motivation and belief in English language learning. He is also an assistant professor at the Department of English Education, The State Islamic University Profesor Kiai Haji Saifuddin Zuhri Purwokerto, Indonesia.



Margana, M.Hum., M.A. is a full professor of Linguistics at Universitas Negeri Yogyakarta, Indonesia. He received his doctoral degree in Linguistics from Gadjah Mada University, Indonesia. His master's degrees were in Linguistics (M.Hum.) and Applied Linguistics (M.A.) from Gadjah Mada University and University of Newcastle respectively. His research interests include linguistics, bilingualism, second language acquisition, and English language teaching.



Agus Widyanthoro, M.Pd. is a senior lecturer at Universitas Negeri Yogyakarta, Indonesia. Both of his doctorate and master's degrees are on English language education. His areas of expertise are teaching English as a Foreign Language, teacher education, language skills, and teacher professional development.



Lu'luil Maknun, M.Pd. is assistant professor at Universitas Mercu Buana Yogyakarta, Indonesia, and a doctoral student at Universitas Negeri Yogyakarta, Indonesia. Her research area includes English language teaching, language assessment (AaL, AoL, and AfL), technology-enhanced language learning, and student motivation.

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