A Teaching Practice Design Based on a Computational Thinking Approach for Prospective Math Teachers Using Ed-Tech Apps

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Abstract—The pandemic situation forces us to use technology in learning. Likewise, prospective teachers who do field practice must prepare themselves to learn to use technology. So to overcome this, research was carried out to analyze the validation process, practicality, and the improvement of teaching practice before and after using the Computational Thinking (CT) based teaching practice model. This study uses Research and Development (R&D) with the ADDIE model, validation sheets, and practicality questionnaires used. The results showed that the design of teaching practice based on the CT approach was very feasible to use, marked by valid category, as indicated by the percentage value of 96% of teaching mathematics experts and 94% of technology experts, and practical use with a value of 95%, as well as an increase in the creativity of teaching practice. We recommend a CT-based teaching practice model using Ed-Tech on a hybrid learning system. This research is still limited to the mathematics department, and for future researchers to carry out this practice in other majors in the university environment.

Keywords—computational thinking approach in teaching mathematics, hybrid learning, Ed-Tech App in learning mathematics

1 Introduction

Education remains an essential part of human life. Given the importance of education, then make efforts in this field. Before the pandemic, most learnings occurred in classrooms with educators and students physically present. Mixed learning is gradually replacing conventional learning, a combination of online and face-to-face teaching activities [1] to stimulate and support student-teacher learning [2], [3]. In addition, the increased use of technology has resulted in teachers being able to operate technology as a teaching aid. The technology used by children to adults as [4] advances in education using mobile phones so rapidly, preliminary findings show that children under two years old can play and learn using mobile devices and multi-touch displays and that children two years old can play and learn using mobile devices and multi-touch displays. Our initial observations in the field provide information about the time that children and adults spend more using sellers than using other technologies. So, we think it is necessary to take advantage of cell phones as a learning tool.

The Covid-19 pandemic requires the world of education to design curriculum and learn in a blended learning manner [1], [5] able to create students who have the skills and can be global. Competitive advantage by utilizing technology [6]–[8]. Teachers and prospective teachers continue to explore teaching knowledge. They need the knowledge contained in the Pedagogic Content Knowledge (TPCK) component, which is a piece of pedagogic, content, and technological knowledge [9]. TPCK focuses on the connections and interactions between content, pedagogy, and technology [10]–[12]. A teacher must design a learning device plan to achieve the desired goals [13]. This ability is commonly called Pedagogical Knowledge (PK) which is in-depth knowledge about how to teach teachers and the art of teaching children to achieve learning goals [14].

Research has reported an increase in the TPACK of prospective mathematics teachers through various activities, such as [15] telecollaboration showing great potential to direct students' attention to TPACK. [16] Leadership as a facilitator increases the knowledge of lecturers' skills about TPCK. [17] student-centered beliefs, teachers, and technology values reported significant correlations with TPCK.

The problems that occur today are teaching practices during the pandemic, and it is not easy to measure the teacher's pedagogy, how are prospective teachers able to use technology so that they can convey material well, how to measure lesson plans that are designed before teaching, how do we measure the movements of prospective teachers when teaching, what approach which they use to convey the material well.

Our observations found that pedagogy is difficult to explore when learning only uses a distance learning system. We find it difficult to explore the eight teaching skills practiced by prospective teachers, they can make technology-based teaching materials, but we find it difficult to measure whether they can teach the applications they use to students.

The increasing use of technology during the pandemic requires teachers and students to think computationally. Students face problems that need to be solved with CT. CT abilities are expected to be explored in subject areas other than computer programs. Therefore, research has been carried out to bridge these problems to analyze how the design of TPACK practices using the Ed-tech application in preparing prospective mathematics teachers to teach with technology during the pandemic is valid, practical, and the improvement of teaching practice before and after using the Computational Thinking (CT) based teaching practice model?

2 Literature review

Teaching without written preparation will result in ineffective classroom learning [18] because teachers have not thought about what and how the learning process occurs [19]. The ability of teachers to develop lesson plans requires knowledge of learning theory [20], models, strategies, learning methods, and an understanding of evaluation tools [21]. The ability to choose learning theories, models, strategies, learning methods, and question indicators can determine what kind of learning the teacher wants to create [9] so that they expect learning outcomes to include affective, psychomotor, and cognitive aspects [19]. We will discuss relevant research and the literature that is our reference material in conducting research.

2.1 Research relevant

Technology is growing rapidly, becoming a challenge for learning. The ability of students to solve problems is required to be able to think like a computer work program, how students can think by providing clear stages, how students can abstract something into the concept of symbols, how students can solve big problems by first making the problem easy to solve. The ability to be explored is the ability to think computationally. For this reason, it is necessary to prepare how teachers can explore computational thinking skills. Researchers support the idea that exploring CT does not have to focus on process skills but instead can provide children with new ways to express themselves, support cognitive, and explore their socio-emotional development through computer application programs [22].

Research conducted [4] revealed that an enhanced teaching experience using robots is beneficial for improving children's computational thinking skills. The implications for designing the right curriculum using robots for children. Studying the Development of Computational Thinking in Young Children With Educational Robotics BeeBot, in addition, a study in Greece during the 2019–2020 period reported statistically significant learning gains between baseline and final assessments, appeared to perform well on CT tests when involved in the treatment of robotic interventions. Teachers currently have challenges to be able to provide teaching and learning to explore CT, one of which is using Classcraft this technology is very interesting for students to use technology games to develop a learning environment for their students [23]. Research findings Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2021) propose integration of mobile devices based on three levels of realistic mathematics education (RME), targeting concepts and basic mathematics. Applications with these three levels are well run according to the development of children [24].

Teachers have difficulty integrating technology into their teaching. One of the contributing factors in the initial survey results is network connections. Not all students access technology properly due to the erratic signal network, in line with the research results of [25] reported that one hundred and seventy-six teachers in Greece indicated reasons for refusing to deal with Digital Learning Objects (DLO) and Digital Simulation Tools (DTS) due to lack of training and associated lack of trust. To curriculum content.

2.2 Teaching practice

Teaching practice aims to equip prospective teachers with complete teaching skills, competencies and experiences and make teaching practice an initial instrument to assess the ability of prospective professional teachers [26]. Teaching practice has a strategic role in the implementation of teacher education because this program is a preparation for prospective teachers to enter the world of the education profession through a series of teaching exercises that include the introduction of practical knowledge about the teaching and learning process, including preparing lesson plans, materials, class management, presentation skills, and evaluation.

Learning and personality are needed by a professional teacher [16]. Professional teachers can be produced when carrying out learning activities effectively. Educational practitioners' coaching and supervision for prospective experts must be carried out during teaching practice activities. The results of Aminah research show a gap between theory and practice when teacher candidates will teach in a classroom where prospective teachers will face realities in the field that may not be encountered during teacher education lectures [27].

Many think that if a teacher deepens the material well, he can teach well. This assumption is not necessarily achieved if a teacher does not have pedagogic knowledge. This combination of understanding and knowledge of good and appropriate teaching methods is commonly referred to by Shulman [11] as pedagogical content knowledge. For mathematics teachers to become professional teachers, they must master seven aspects, namely: knowledge of mathematical material, general pedagogical knowledge, knowledge of pedagogic content, curriculum knowledge, learning knowledge and its characteristics, knowledge of teaching strategies, and knowledge of learning contexts, even now prospective teachers must master technology—pedagogic Content Knowledge [28].

Based on research conducted by [29], there is an influence between teaching experience and the development of the teaching process design of a prospective mathematics teacher in the field experience program, which is proven by the results of monitoring teaching practices in the classroom. Teaching practice activities have been given guidance and input regarding preparing in class.

2.3 Computational thinking (CT)

Computational thinking skills also need to be possessed by students. So the teacher feels the need to make learning tools according to these demands. The strategy to include CT in the classroom can also be an alternative for learning during a pandemic, even giving students CT skills. CT education can be more developed. It is necessary to be prepared systematically about: how to design CT learning activities, how to teach CT, how to assess CT, and how to use technology to teach CT concepts [30]. So it is necessary to design lectures that lead to these skills. The concept of CT can be used in the learning process of decomposition, algorithms, recognition, and abstraction [31]–[33].

A teacher must be able to package learning that involves student activities. Create questions and relate them to real-life problems. The use of technology to complete assignments also needs to be considered so that students can participate in meaningful learning activities [34]. In order to prepare prospective teachers who can involve technology in their learning, universities that produce teacher candidates must immediately consider a post-industrial perspective related to curriculum surgery and prepare prospective 21st-century [35]. [36] have investigated the use of technology in learning, providing information on the effect of Scratch on the acquisition of mathematical concepts and the development of computational thinking. The results show that Scratch can develop students' mathematical ideas and computational thinking [37].

The operational definition of CT in the context of K-12 education is very challenging because it must be accompanied by examples that can show what CT looks like in the classroom [38]. To define CT specific to the K-12 context, ISTE collaborated with the Association of Computer Science Teachers (CSTA) [39], leaders who discussed definitions of the core concepts of CT and provided examples of how the concept could be implemented in various fields of study. Concepts include: (a) decomposition (b) algorithmic thinking (c) abstraction (d) data collection, analysis and representation (e) automation (f) parallelization [40]. Operational definition of CT in the context of K-12 education is very challenging because it must be accompanied by examples that can show what CT looks like in the classroom [38]. To define CT specific to the K-12 context, ISTE collaborated with the Association of Computer Science Teachers (CSTA), leaders who discussed definitions of the core concepts of CT and provided examples of how the concept could be implemented in various fields of study. Concepts include: (a) decomposition (b) algorithmic thinking (c) abstraction (d) data collection, analysis and representation (e) automation (f) parallelization [40].

2.4 Educational technology application (Ed-Tech App)

The Covid-19 pandemic has given a new color to the world of education, providing new challenges to get to know technology (Chick et al., 2020). Educational Technology app (Ed-Tech app) has become one of the most important for teaching, training and human resources [41], [42]. In recent years to support the learning of many websites, mobile applications, and other ed-tech emerging as a place of implementation of education [1], [43], [44]. Even many platforms that have emerged and can be used for free from The Google Play Store (iOS), of course, has been tested and well received by the community to support pedagogical support, make it easier for students to receive materials, design materials, interact during learning, discussions, and even for assessment [45].

Digital devices can gradually contribute significantly to facilitating distance learning. Ed-Tech applications provide benefits in various fields of education [43], [46]. Virtual video communication tools can now be easily used (e.g., Google Meet, Zoom, WebEx), collaboration platforms created by Google (e.g., Google Docs, Google Classroom), and social media that used to be limited to showing our photos. It can be used for educational information tools (e.g., Instagram, YouTube, EdPuzzle), expanding the interaction between teachers and students. With the help of technology, learning activities continue [47], [48], build students to be creative [49], set students to choose to learn goals them [50], create their study plans, and can even monitor their progress. Research that has been conducted by [1] gives the result that independent learning is very compatible with digital media quickly.

Learning mathematics requires teaching materials integrated with technology to ensure the work that has been done has the right answer. Some *edu-tech* applications used in learning mathematics include GeoGebra, Mathcitymap, scratch programs, and many others. The edu-tech application is expected to be able to explore computational thinking skills; as stated [22], the scratch program is not a very good application, but this application can explore children's CT and coding skills.

3 Methodology

This study uses research and development with the ADDIE model. The stages in the development of this teaching practice model begin with analyzing the needs to see current conditions, analyzing the applicable curriculum, and analyzing the characteristics of students [51]. In early identification to obtain data on student needs, we observed micro-teaching courses. Through interviews and field observations, we produced data to identify suitable learning models for the target and thought of practical learning models that were suitable to be developed. The next step is to design the concept of a practical learning model that will be developed. After the concept of the design model, the next stage is the development stage which is the process of making the design into a product. Products that have been made are implemented to test the products offered. The final stage is evaluation, which is the stage to find out whether the teaching practice model that has been made has succeeded as expected, namely facilitating prospective teachers to teach during the pandemic with a blended learning system.

At the implementation stage, observational data on the teaching practice of prospective teachers were obtained in the form of written notes and teaching videos, recordings of researcher interviews with selected subjects, and in the form of video and audio. The research instrument was a questionnaire of willingness to become a respondent, and a teaching observation sheet with TPCK indicators that had been previously researched and had been valid [21] had been adapted to current conditions. Interview guidelines are used to explore processes that require clarity from the results of observations, the results of questionnaires and observations are visible, and all instruments have been validated and declared valid.

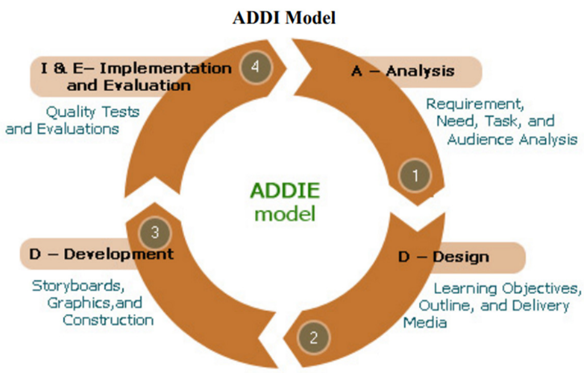

Fig. 1. ADDIE model development procedure [52]

Figure 1 illustrates the stages carried out using the ADDIE model, starting from analysis, design, development, and implementation. According to Branson 1975 [52] The formative evaluation stage occurs at each stage in this study in the form of expert validation and practicality. The summative evaluation stage occurs at the end of the activity. In this study, a student's success after learning with a practical model is implemented.

3.1 Participant

The implementation stage is carried out on participants who have fulfilled the TPCK assessment, namely 6th-semester students who take micro-teaching courses. The research sample uses a purposive sampling technique, considering students who will carry out teaching practices in the field. Two student-teacher candidates took the research subjects with considerations taken from high and moderate cognitive abilities (initial observations recorded that students' abilities were in two categories) female students aged 21 and communicated fluently. because cognitively, individuals begin to think interpretively [53].

4 Findings

The research on the development of this teaching practice model provides findings that it has been declared valid, practical, and has an excellent response to the developed model through the validation process. In detail will be discussed one by one.

4.1 Analyze stage

The analysis results are in the form of needs analysis by looking at the conditions of learning needs during the pandemic, analysis of the applicable curriculum, namely the independent learning curriculum, and analyzing prospective teacher characteristics. The results of our analysis are used as a reference in compiling a teaching practice model during the pandemic.

Needs analysis. This research requires several analyzes covering the need for media technology, the need for an approach to learning, and the need for the right practice model to be used. Media technology is one of the main needs needed to overcome teaching problems during the pandemic. Schools with internet connection are still not evenly distributed; the use of technology has not been utilized, especially in relatively rural schools. The technological media used is only at the info stage in the WhatsApp group. This situation is difficult to explore students' cognitive abilities, especially in mathematics. In addition, the results of our initial research provide information about the CT process for prospective teachers when solving problems, resulting in four CT components being explored, namely reflective abstraction thinking, decomposition, algorithmic thinking, and evaluation. The results of this analysis became our basis for designing a teaching practice model to prepare prospective teachers to meet the needs of students.

Curriculum analysis. We use the "Independent Campus Curriculum" to guide teaching practice models, where students learn to have skills outside of their professional career and can think computationally in solving problems. Therefore, a teaching practice model is needed to explore students' CT.

The analysis of the characteristics of prospective teachers. The data for analyzing prospective mathematics teacher students' characteristics were obtained through interviews with lecturers who teach in the mathematics education study program. We came to conclusions: 1) prospective teachers come from various regions whose signal conditions are not as expected. 2) prospective teachers still have not mastered mathematics application technology. 3) prospective teachers find teaching mathematics difficult through technology media, 4) prospective teachers are less enthusiastic when practicing only through the zoom meeting room. Based on our analyses, the researchers designed a teaching practice model using technology based on the CT approach concerning the analysis results described above.

4.2 Design stage

The design of the teaching practice model begins with collecting several ed-tech applications before being given to students. The initial steps were 1) compiling a lesson plan that was uploaded to the Learning Management System (LMS) provided by the campus, 2) designing application media for synchronous meetings, 3) punctuality of lectures with ed-tech that will be studied, 4) the accuracy of the tasks given, 5) preparing media that provides practicality for students to access. 6) Pedagogical accuracy designed to explore computational thinking skills.

The design of the CT-based teaching practice model we named the Plan Activity Reflection (PAR) model consisting of 1) teaching preparation, 2) the core of teaching using CT components which include teaching decomposition, teaching algorithms, teaching abstractions, and introduction to teaching, the technology used, and evaluation, 3) closing teaching, including reflection. The technology presented in the exercise model is adapted to the mathematical material, as shown in the following Table 1.

Table 1. List of math applications to be studied during the course

Name	Application Material	Name	Application Material
GeoGebra	Geometry, line equations	Free Universal	algebra
Scratch	Algebra, educational games	Spe Q	Functions
Math Labs	Statistics	Math	Calculus, algebra, graphing functions
SPSS	Statistics	Myscript Calculator	Basic Mathematical, Trigonometry, Logarithm, and Exponential
Mathcitymap	mathematical modeling	Algebra	differential, linear equations, matrices, vector
Microsoft math	Graphing calculator	QMentat	math multiplication, division, subtraction, addition
Point learning	Calculus, linear equations	Math Tux	Helps Students Count
Math Expert	Mathematic, Electro	Malmath	Integral

4.3 Development stage

The teaching practice model is designed concerning the TPCK framework, and the learning stages use the CT approach. The observation sheet to measure student teaching practice is packaged with TPCK components, namely 1) Technology knowledge, 2) Content Knowledge, 3) Pedagogic Knowledge, 4) Technology Content Knowledge, 5) Pedagogic Content Knowledge, 6) Technology Pedagogic Knowledge, and 7) Technology Pedagogic Content Knowledge. At the development stage, through several series of validation tests assessed by mathematics teaching experts, the process in which revisions are made based on expert suggestions. The detailed validation results can be seen in Table 2.

Table 2. Teaching mathematics expert validation results

Aspect	Score Validator			Information
	1	2	3	
Relevant to the characteristics of prospective teachers	4	3,75	4	1,00–1,50: Less valid 1,51–2,50: enough valid 2,51–3,50: valid 3,51–4,00: very valid
Relevant to the "Independence Campus" curriculum	4	3,75	4	
Exploring knowledge of technology, pedagogy, and content	3,75	3,75	3,75	
Each step of learning core thinking for computational thinking	3,5	4	3,75	
Examiner evaluation for computational thinking in preparing for learning	3,75	3,50	3,75	
Learning to get used to using Ed-Tech	4	4	4	
Total	23	22,75	23,25	
Average	3,83/Very Valid			
Identified as	96%/Very Valid			

Test the validity of the practice model by technology experts which can be seen in Table 3.

Table 3. Validation results by technology expert

Aspect	Score Validator			Information
	1	2	3	
Relevant to math material	4	4	4	1,00–1,50: Less valid 1,51–2,50: enough valid 2,51–3,50: valid 3,51–4,00: very valid
The application used is easy to access	4	4	4	
Exploring the CT process	3,75	3,75	3,75	
Easy to use	3,50	3,50	3,75	
As a learning aid	3,75	3,50	3,75	
Can be used at middle and high school level	3,5	3,75	3,5	
Total	22,5	22,5	22,75	
Average	3,76/Very Valid			
Identified as	94%/Very Valid			

The scores obtained from experts in teaching mathematics and technology show that the design of teaching practice is in the very valid category. This statement shows that the quality of the teaching practice model developed is considered valid and possible from the assessment of teaching experts and technology experts. Developing teaching practice models through revisions carried out according to directions and input from experts. The repairs were made according to expert advice.

Expert advice. This data is obtained from experts who are considered capable of providing input and suggestions for the developed teaching practice model. Suggestions or input at the validation stage of teaching experts so that the teaching practice model is better than before. Suggestions given by teaching and technology experts can be seen in Table 4.

Table 4. Advice by teaching and technology expert

N	Aspect	Advice
1	CT Stages	It is better to give examples of teaching with CT concepts at each stage
2	Details of activities	To make it more clear, it is better to make stages from the core to the end of the lesson
3	Using Ed-Tech	In order to show the ability of prospective teachers when operating technology, a project should be made

Researchers perfected the learning design according to the direction of the learning expert validator. To improve different thought processes, as shown in the following figure (shown in Figure 2).

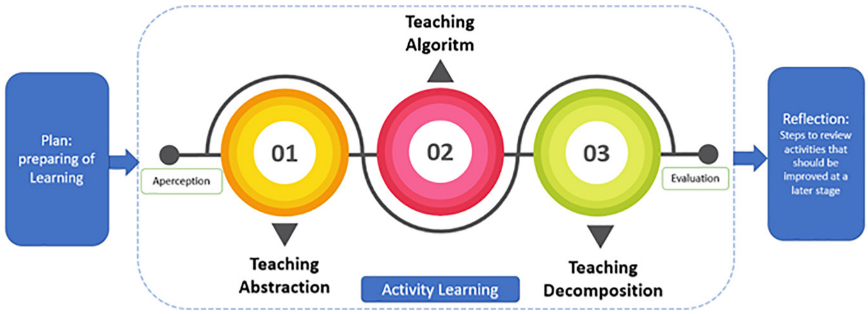

Fig. 2. The design of the teaching practice

Teaching practice According to the directions from the learning and technology expert validators, which we have compiled in Table 5 as follows.

Table 5. Stages of learning design practices for teaching mathematics based on CT using Ed-Tech before and after revision

No.	Stages of Activity	Details of Activities Before Revision	Details of Activities After Revision
1.	Plan	Makes lesson plan, make media, situation learning.	The lecturer makes a lesson plan uploaded on the LMS page, explains the lecture plans to be passed, prepares the media and teaching materials, and prepares the situation.
2.	Activity, apperception	Give motivation.	lecturers give challenging questions to build motivation, or give interesting stories about the history of mathematics related to the material.
	Activity, Decomposition teaching	Lecturers of various problems that allow to generate many ways and facilitate to assist students in solving problems.	Lecturers of various problems that allow to generate many ways and facilitate to assist students in solving problems. Real activities: The lecturer explains the recovery scenario to find Ed-tech applications that are suitable for learning mathematics.
	Activity, Teaching abstraction	Abstraction focuses on information that is appropriate to the material and is important. Throwing away some unnecessary information.	Abstraction focuses on information that is appropriate to the material and is important. Throwing away some unnecessary information. Real activities: Lecturers can encourage students to seek information and guidance by assigning tasks to identify student characteristics, analyze the curriculum, and find suitable learning models for mathematics material.
	Activity, Teaching Algorithm	Activities to think do something in solving problems step by step.	Activities to think do something in solving problems step by step. Real activities: The lecturer asks students to think about making teaching materials. What should be done first? Second?
	Closing Evaluation	Lecturers provide exercises, Lecturers give assignments to make lesson plans with CT-based learning steps.	Lecturers give assignments to make lesson plans with CT-based learning steps and are required to use Ed-tech applications by the mathematics material to be studied, assignments are collected on the LMS page, and prospective teachers make tutorials on using Ed-tech, videos are uploaded on YouTube links. and this stage is included in the core learning.
3.	Reflection	Steps to review activities that must be improved at the next stage.	The lecturer gives the results of observations to prospective teachers as consideration for seeing the results obtained at today's meeting, in order to improve the next meeting.

The design of this teaching practice is made in hybrid learning, using synchronous and asynchronous systems. We use the old LMS for asynchronous learning, while video conference media such as g-meet, zoom, and face-to-face regularly according to the applicable health rules are used for the synchronous system. The following is an example made by the lecturer at the beginning of the lecture (see Figure 3).

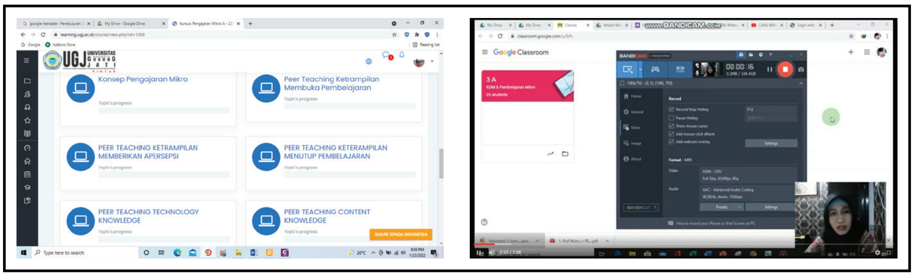

Fig. 3. The use of technology during micro-teaching courses
Note: https://learning.ugj.ac.id/course/view.php?id=1358; https://youtu.be/w42Q1oXxOQo

Practicality of teaching practice models-Tests are used in this study to state that practical teaching practice designs are used. The data is taken from three lecturers as practitioners. Here are lecturers who have taught micro-teaching courses. Apart from lecturers from within the university, we also take micro-teaching lecturers from neighboring universities with mathematics education study programs. The results of the study show that the teaching practice model is very practical to use with an average percentage of 95% presented in Table 6.

Table 6. Validation from practitioners

Aspect	Score Subject			Information
	1	2	3	
The media used is easily accessible	3,75	4	3,75	1,00–1,50: Less practice 1,51–2,50: enough practice 2,51–3,50: practice 3,51–4,00: very practice
Convenience of lecture strategies	4	3,50	4	
Usefulness	3,75	3,75	3,75	
Total	11,5	11,25	11,5	
Average	3,80/Very practice			
Identified as	95%/Very practice			

After the design, the practice of teaching mathematics using CT-based Ed-Tech was developed to obtain valid and practical results. Furthermore, the teaching practice model is implemented to see the effectiveness according to the researchers' expectations.

4.4 Implementation stage

The design of teaching mathematics practice using CT-based Ed-Tech get the final result valid and practical. Then the model was implemented in the micro-teaching class in the even semester of March–June 2021. The implementation of the model consisted of 32 students who previously had a pretest related to TPCK knowledge and problem solving with the CT process. Two students took the research subjects, students from the high category were named PST05, and students from the medium category were coded PST15.

The results showed that the average value of the activities in practice varied from 1.00 to 5.00. A standard deviation of 3.50 indicates adequate variability across all sub-indicators. This value indicates that the activities of prospective teachers vary in carrying out their duties. The teacher candidates were very enthusiastic about participating in these activities. The activities of prospective teachers are observed and assessed. The portfolio of prospective teacher activities while using Ad-tech got an average score of 36.21.

The average activity of teacher candidates making reports on the results of Ed-tech investigations is 32.46, while the average activity of teacher candidates making technology-integrated learning tools is 34.80. Prospective teachers take initial and final teaching practice tests. After the intervention, the teaching practice skills of prospective teachers were 85.22 higher than the practical teaching skills before the intervention of 19.56. The standard deviation of 4.736 and 4.452 indicates adequate variability across all variables. The following are examples of assignments uploaded by prospective teachers when using different Ed-tech on System of Two Variable Linear Equations (STVLE) materials in exploring mathematical problem solving skills.

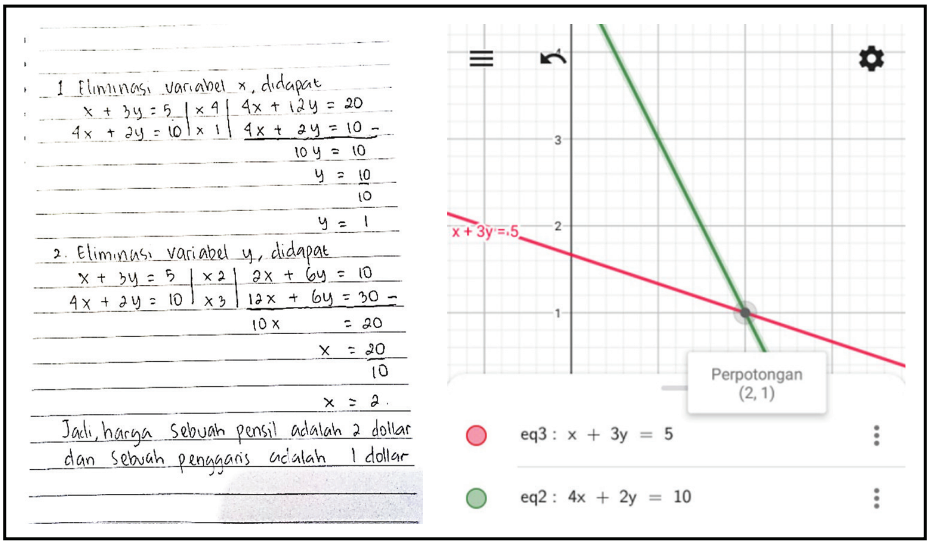

Fig. 4. An example of using GeoGebra for STVLE material

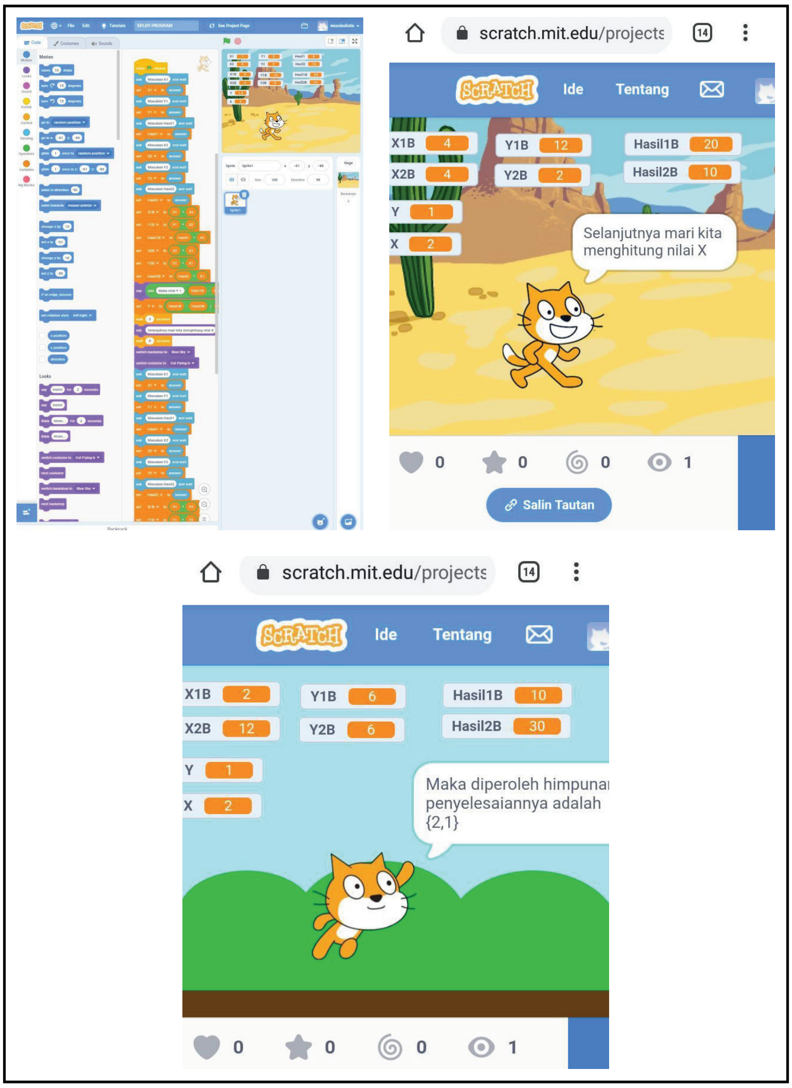

Fig. 5. An example of using scratch for STVLE material

Research findings get data that students can use technology well. However, it is necessary to examine more deeply whether prospective teachers understand what concepts appear in the tools used, along with the results of the interviews we collected, from interviews with the question, why use the application? What abilities emerge in students? What are the benefits for you?

> *"I find it easier to use GeoGebra (see Figure 4), communication skills* arise *because students are asked to be able to read the line determined by the values of x and y, I got many benefits in this lecture session, I accidentally forced myself*

to be able to use technology well, as well as investigating more deeply the use of technology for learning mathematics. by using GeoGebra, I can manually review the answers I got from the calculations. (PST 05, March 13, 2021).”

“I enjoy teaching using scratch programs. Students' abilities are extensive. Students calculate manually first. Using scratch programs becomes check answers (Figure 5). When making a simple calculator with scratch programs, students explore abstraction skill, algorithmic skills, decomposition, and evaluation. After attending this lecture, I feel happy, and I get many benefits. Finally, I can use ed-tech applications as teaching aids. (PST 015, March 13, 2021).”

The results of the interviews above provide information in this study that students are very comfortable using the applications they learn and feel helped by the practical learning system that the lecturer has arranged.

4.5 Evaluation stage

The evaluation stage has been carried out in an integrated manner from the various stages that have been presented above, starting from the analysis stage to implementation. The results have shown the evaluations that have been carried out by teaching and technology experts, the satisfaction from the use of the practicality of the teaching practice learning model, and the increased mastery of student competencies after implementation. Based on these results, it has successfully designed a CT-based model using Ed-tech.

5 Discussion

The CT-based teaching practice model by utilizing Ed-Tech can be used to prepare prospective teachers to teach online and offline during the pandemic. In this study, the CT-based teaching practice model has a valid category, as indicated by the percentage value of 96% of teaching mathematics experts and 94% of technology experts. In line with the research results of Lisa et al. (2021), who designed a TPACK model for pre-service students during a pandemic, it is suitable for use [54]. The development of this practice model has become an innovation for lecturers of micro-teaching courses during a pandemic, improving students' pedagogic abilities and improving technological abilities through application learning available both offline and online, especially for teaching mathematics.

The teaching practice model developed is included in the practicality criteria shown by 95% of users, in this case, the lecturers of the mathematics education study program who teach micro-teaching courses. The available stages make it easier for lecturers to carry out learning well, synchronous and asynchronous systems are planned to provide convenience to lecturers, and the Ed-Tech application used is easily accessible by both lecturers and students. The class went smoothly. This practice model can be developed in other colleges or other study programs. The results of this study are in line with Ronel Callaghan 2018 who developed teaching practices using cell phones that teachers practically used [55].

Utilizing the developed Ed-Tech, the CT-based teaching practice model received a positive response from students. Thirty-two prospective teachers take in micro-teaching courses with a stage design developed achieved mastery learning. The results of this study are in line with Kelly in 2019, who developed teacher pedagogic knowledge for teaching practice on online forums, getting a positive response, and increasing teacher knowledge [56]. Lu 2019, who developed an inquiry learning flow for teaching practice, received a positive response [57]. Mouza 2017 developed TPCK with CT that can be combined with content and pedagogy to promote meaningful student outcomes [58].

6 Conclusion

The teaching practice model with a CT approach using Ed-Tech, which we named the Plan Activity and Reflection (PAR) model, has been validated by mathematics and technology teaching experts with valid results. The user trial results obtained practical categories in assessing a good response from prospective teachers. The value of teaching practice got a very good category. The results showed that the PAR model positively impacted knowledge of technology, pedagogy, and content as well as the creativity of prospective teachers in preparing teaching practices during the pandemic. The results showed that the PAR learning steps used were planning before teaching, core activities which included apperception, teaching abstraction, teaching algorithms, teaching decomposition, and evaluation.

In contrast, the last step was a reflection, namely self-correction for improvement, at the next meeting. So it can be concluded that the PAR teaching practice model is appropriate to be used as a practice model for prospective teachers to prepare teaching practice in the classroom. This research is still limited to the department of mathematics, and further research can be carried out in other departments within the university.

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