Developmpment of Inquiry Learning Model based on Technological Pedagogical and Content Knowledge (TPACK) in Developing 4 C Skills (Cricital Thingking, Creativity, Communication, Collaboration) Early Childhood

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Abstract. This study aims to develop a TPACK-based Inquiry Learning Model in developing skills, critical thinking, creative thinking, communication, and collaboration (4 C) for Early Childhood. This research is a type of research and development (Research and Development) by following the Borg and Galldevelopment model which consists of 10 steps and will be grouped into 4 stages, namely, the preliminary stage, planning and development, evaluation and revision, and dissemination. The instrument used is a validation sheet to test the feasibility of the model by Education Technology experts, a response sheet filled in by the teacher, andan observation sheet to see the 4 C skills of Early Childhood. The model trial was conducted at TK ABA 05 Medan. The results of the expert assessment of the model are in the very high category, namely 87%, meaning that the learning model is feasibleto be applied. The results of the first-stage model trial on 5 children showed that therewas an effect of 40%.

Keywords: Inquiry Learning, TPACK, 4 C Skills for Early Childhood

1 Introduction

Early Childhood Education is a form of education that focuses on laying the groundwork for physical growth and development (fine and gross motor coordination), intelligence (thinking power, creativity, emotional intelligence, spiritual intelligence), social-emotional (attitude and religious behaviour), language and communication, following the uniqueness and stages of development that early childhood goes through.

Furthermore, the competencies to be achieved in every aspect of development accordingto the stages of child development are contained in the 2013 Early Childhood Education Curriculum which iscurrently still used in Early Childhood Education institutions, especially kindergartens. The basic competencies described in the 2013 Early Childhood Education curriculum illustrate that early childhood essentially has the ability to think critically, be creative, be able to communicate, and havethe ability to collaborate or work together. Early childhood educators should be able to develop learning activities that can stimulate the development of these four aspects of ability.

In accordance with the development of science and technology, as well as the demands of the 2013 Curriculum at all levels of education, including Early Childhood Education, 21st-century

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learning focuses on several skills that students must possess, including critical thinking skills, creative thinking, communication, and collaboration. (4C). *The Partnership for 21 Century Skills* identifies the 4C, namely *Critical thinking,Communication skills, Collaboration/team building, Creativity, and Innovation* as skills needed in 21st-century learning (Joseph Bishop). Likewise, Trilling and Fadel (2009) state that 4C skills are the key to unlocking lifelong learning. Instilling 4C skills in earlychildhood is expected to be a provision for children in living their daily lives so that theyare competitively able to adapt to the environment. The challenges that will be faced by children in the future will be increasingly complex, so developing new skills from an early age will be a must so that children can play a major role in dealing with problems faced in society. Various models and learning approaches can be applied by Early Childhood Education teachers in developing the 4 Cs in early childhood, one of which is the Inquiry learning model. 21st-century learning also requires Early Childhood Education educators/teachers to be skilled in applying several learning approaches, one of which is the TPACK (*TechnologicalPedagogical and Content Knowledge) approach.*

Based on the results of direct observations and through analysis of research resultsabout learning in Early Childhood Education, especially in Kindergarten, in general, teachers are still less varied in learning models, learning methods, and the use of learning media. Learning tends to be conventional, with an emphasis on children being able to read, write and countand prioritize children doing activities through children's worksheets. When explaining concepts or learning materials to children, teachers generally use the lecture and question and answer method without being assisted by media that attract children's attention. Learning does not train critical thinking skills, creative thinking, communication, and collaboration skills. Group model learning carried out in schools is underutilized so that children collaborate and communicate with each other, children are in groups but do things individually

Based on the problems stated above and seeing the importance of applying inquirylearning with the TPACK approach in developing the 4 C skills of early childhood, research has been carried out on the development of the TPACK-based inquiry learningmodel in developing the 4 C skills of early childhood. The problem formulations answered in the research are: (a) How is the Development of the TPACK-based InquiryLearning Model in developing the 4 C skills of Early Childhood?; (b) How is the validityof the TPACK-based inquiry learning model in developing the 4 C skills of early childhood? ; (c) How Effective is the Development of the TPACK-based InquiryLearning Model in developing the 4 C skills of early childhood.

The inquiry learning model is influenced by the cognitive flow which views learning as essentially a mental process and a thought process by optimally utilizing all the potentials of each individual. Learning is not just a process of memorizing and cultivating knowledge, but how the knowledge gained is meaningful for students throughthinking skills. The role of the teacher is to place himself more as a mentor or learning leader and learning facilitator. Thus, students do more activities alone or in the form of groups to solve problems. Sanjaya [2011, 137] states that the main characteristic of inquiry learning is "encouraging students to solve problems, and the activities that appearare children explaining, revealing facts according to their experiences, giving convincing arguments". Other characteristics of inquiry learning are 1) emphasizing student activities maximally to seek and find; 2) All activities carried out by students are directed to seek and find something in question so that they can grow children's confidence;

TPACK is a theoretical framework that is the development of PedagogicalContent Knowledge (PCK) which was first initiated by Shulman. Shulman (1986)explains that content knowledge

includes knowledge of concepts, theories, ideas, frameworks of thought, methods of proof, and evidence. While pedagogical knowledge is related to teaching methods and processes which include knowledge of class management, assignments, learning and learning planning, and students. According to Shulman, a teacher must master Pedagogical Knowledge (PK) and Content Knowledge (CK). By combining PK and CK, a teacher must not only master content/material but alsopedagogy in creating learning. The combination of PCK capabilities and technology is called Koehler & Mishra [2009] Technological Pedagogical Content Knowledge (TPACK).

Critical thinking skills as the ability to analyze, interpret, evaluate, summarize, and synthesize all information and then apply the results to solve problems. Trilling and Fadel [2008] The behavior shown by students in critical thinking are: 1) Identifying and defining authentic problems and important questions for investigation; 2) plan andmanage activities to develop solutions or complete projects; 3) collect and analyze data to identify solutions or make informed decisions; 4) using various perspectives to explorealternative solutions. ***Creative and innovative thinking*** is the ability to do something new to solve a problem. Rahmawati [2010] concludes that creativity is an individual mental process that gives birth to effective new ideas, processes, methods, or products that are imaginative, aesthetic, flexible, integrated, which are efficient in various fields for problem-solving, and the ability to see various possibilities for solving problems. ***Communication*** is a message delivery activity. The process involves two communicating parties, each of which aims to build meaning so that both of them understand what is being communicated. In learning activities, good communication skills can be trained by paying attention to the basics of communication such as correct speech, fluent reading, and clear writing [Trilling and Fadel, 2009]. ***Collaboration*** is an important skill to be taught in early childhood. High-quality collaboration can encourage students' thinking and create more meaningful learning opportunities. Collaborative learning activities can be done through discussion, exchanging ideas, exchanging different points of view, seeking clarification, and participating with a high level of thinking.

2 Research Methods

This study uses the Research and Development method. This study resulted in a TPACK-based inquiry learning model for developing the 4 C skills (Critical Thinking, Creativity, Communication, and Collaboration) for Early Childhood. The Research and Development Model carried out refers to the research and development model of Borg and Gall [1983: 775] which includes 10 steps, namely: 1) Research and Information Collecting (Research and data collection); 2) Planning (Planning); 3) Develop Preliminary Form of Product (Development of product draft); 4) Preliminary Field testing(initial field trials); 5) Main Product Revision (revising test results); 6) Main Field Testing(field testing); 7) Operational Product Revision (improvement of field test products); 8) Operational Field Testing (field implementation test); 9) Final Product Revision (refinement of the final product. 10) Desimination and implementation. However, this paper is still limited to improving the product from field tests in small classes. (Step 7),
The research was conducted in Kindergarten in Medan City. The model trialwill be carried out in 2 kindergartens, namely TK ABA 05, on Jalan Mustafa Medan,and Phase 1 and Phase 2 trials will be carried out at TK Pembina 2 Kota Medan, on Jalan Martubung Medan. The instruments used in this study were: (1) Validation Sheet for the TPACK-based Inquiry Learning Model in developing 4 C skills for Early Childhood; (2) Skills Observation Sheet 4 C for Early Childhood (Kls B Kindergarten Children/Age 5-6 years); (3) Early Childhood Education TK Teacher

Response Sheetregarding the implementation of the TPACK-based Inquiry Learning Model in developing the 4 C Skills of Early Childhood.
The data analysis techniques that will be used are: (1) Data Validity. The results of the validation of all validators on the assessed aspects are presented in tabular form.Then look for the average score using the formula:

$$R = \frac{i=1^{n}Vi}{n}$$ (Muliyardi, dalam Eza, 2014)

(2) 4C Skills Observation Data for Early Childhood
The range of children's 4C Skills scores will be classified into, score 1: Undeveloped (BB) ; Score 2: Starting to Grow (MB) ; Score 3: Developing as Expected (BSH); and Score 4: Very Good Development (BSB).

3 Research Results and Discussion

In accordance with the Model steps of this research, the results obtained are:

a Introduction Stage

This stage is carried out to collect information and data related to (a) Application ofthe Technological Pedagogical Approach and Content Knowledge (TPACK) in EARLY CHILDHOOD EDUCATION; (b) Application of the Inkuiri Learning Model in EARLY CHILDHOOD EDUCATION; and (c) Critical thinking skills, creative thinking, communication and collaboration (4C) in Early Childhood. Informationabout the three things above is done by digging into sources from literature studies and articles in the Journal. Facts related to the implementation of the three things above wereobtained through qualitative data (observations and interviews) of 10 Kindergartenteachers in 2 schools, especially teachers who have been certified. The research results obtained are as follows

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The results of the researcher's interviews with 10 teachers regarding the implementation of TPACK are as follows:

1) All teachers (100%) know the importance of implementing TPACK in learning.
2) During online learning, all teachers use the Zoom, Google Meet, and WA Group applications. After PPKM or entering class for a limited time, and until now, teachersonly use WA groups in communicating with parents of children, such as in sending assignments from teachers, guidance instructions that parents must help to continue guidance and training in school, then the parents return the tasks the child has done tothe teacher.
3) Most (60%) teachers use the Internet in developing teaching materials according to the theme and learning objectives. Development of learning tools, educative, application of effective play methods in learning.
4) Only a small portion (20%) of teachers use technology as a learning medium, such asthe use of Video, PowerPoint, Audio (CD) in learning. The reason why teachers do not use technology in learning is that they are less skilled in using computer equipment, even though schools have computer and LCD facilities

5) Some teachers (50%) understand the inquiry learning model, which is a learning model that can develop critical thinking skills, creative thinking, and children's socialization.
6) Only a small part (30%) of teachers understand the steps in applying the Inquiry learning model;
7) Only (10%) or 1 teacher has ever carried out Inquiry learning activities even though the implementation has not really been in accordance with the Inquiry learning stages.
8) All teachers (100%) Conduct group learning systems, and teach by applying the lecture method, question, and answer, storytelling, experiments, demonstrations, andexercises or by filling out LKPD
9) Learning activities are generally carried out in the classroom, not utilizing the environment around the school.

b Planning Stage

Developing an Inquiry Learning Model. Based on the literature analysis and discussions with early childhood education experts and educational technology experts, the inquiry learning model that has beendeveloped that can be applied to early childhood (TK) is as follows:

Table 1. Inquiry Learning Model for Early Childhood /Kindergarten

No	Phase	Teacher's Role
1	Preparation phase	a. Prepare materials, media, tools, and learning resourcesthat will be used in learning b. Arrange children's seats according to the form ofactivity (groups, centers) c. Prepare children's worksheets d. Prepare computer equipment that will be used inexplaining the material
2	Preliminary Phase	a. Invite children to pray before studying, short prayers that are used daily, sing good morning, and songs about honoring teachers, parents, and friends. b. Talking about the child's morning activities with the family, until the child is ready to come to school. c. Delivering the theme/sub-theme to be studied d. Building children's thoughts about the sub-themes to be studied (constructivism), for example by asking questions about the material to be studied. e. Perform apperception f. Delivering the learning objectives to be achieved by the child. g. Invite children to sing by doing movements accordingto the sub-themes to be studied
3	Core ActivityPhase	a. Orientation Ask the child to observe pictures/videos/objects directly (real) or take the child to the surrounding environment according to the sub-theme (material) being studied b. Formulating the problem Together with formulating the problem to which the answer will be found. Problems revolve around the daily life of children by the learning material. Questions were asked using the words what, why, andhow c. Formulate the Hypothesis Together with the child formulate a hypothesis or temporary

		answer to the problem that will be tested fortruth by the child. d. Collecting data This activity is asking questions related to the activities carried out by the child; may also conduct experiments, and projects, in proving a hypothesis in question, for example, mixing colors. Children playing with APE (beams, plasticine, used materials for drinking glasses, etc.) Data collection activities were carried out in groups. e. Test the hypothesis This activity is asking questions related to the Children report the results of data collection carried out through experiments, demonstrations f. Formulating conclusions Children convey conclusions from their work or findings obtained from activities carried out by children. g. When children play and do assignments, the teacher evaluates the achievement of children's development (according to the goals that are expected to develop every day)
4	Core ActivityPhase	a. Orientation Ask the child to observe pictures/videos/objects directly (real) or take the child to the surrounding environment according to the sub-theme (material) being studied b. Formulating the problem Together with formulating the problem to which the answer will be found. Problems revolve around the daily life of children by the learning material. Questions were asked using the words what, why, andhow c. Formulate the Hypothesis Together with the child formulate a hypothesis or temporary answer to the problem that will be tested fortruth by the child. d. Collecting data This activity is asking questions related to the activities carried out by the child; may also conduct experiments, and projects, in proving a hypothesis in question, for example, mixing colors. Children playing with APE (beams, plasticine, used materials for drinking glasses, etc.) Data collection activities were carried out in groups. e. Test the hypothesis This activity is asking questions related to the Children report the results of data collection carried out through experiments, demonstrations f. Formulating conclusions Children convey conclusions from their work or findings obtained from activities carried out by children. g. When children play and do assignments, the teacher evaluates the achievement of children's development (according to the goals that are expected to develop every day)

Table 2. Critical Thinking, Creative, Collaboration and Communication SkillsInstrument

Children's Name :

No	4C Skill Indicators	Value Scale				Desc.
		BB	MB	BSH	BSB	
I	**Critical Thingking**	1	2	3	4	
	1. Asks what, why, and how questions aboutobjects and events. 2. Provide a simple explanation or reason forthe opinion or action taken. 3. Plan experimental activities or observationsto obtain information. 4. Formulate conclusions based onobservations. 5. Accept opinions or observations that differfrom other friends					
II	**Creative Thinking**	1	2	3	4	
	1. Fluency, namely the ability to express similar ideas to solve a problem. 2. Flexibility, namely the ability to generate various kinds of ideas to solve a problem outside the usual category. 3. Originality, namely the ability to provide a unique or extraordinary response. 4. Elaboration, namely the ability to state the direction of ideas in detail to make ideas intoreality. 5. Sensitivity, namely the sensitivity to catch and produce problems in response to a situation.					
III	**Communication**	1	2	3	4	
	1. Then show what is meant by using media(children convey their work) 2. Children write, talk and demonstratesomething. 3. Children communicate to resolve conflictswith their friends. 4. Make a graph or map to explain something. 5. Draw or paint the object being observed.					
IV	**Collaboration**	1	2	3	4	
	1. Work productively with others. 2. Participate and contribute actively. 3. Balanced in listening and speaking. 4. Flexible and willing to compromise. 5. Work collaboratively with different types of people. 6. Respect other people's ideas. 7. Demonstrate the skill of taking one view orperspective. 8. Commit to putting group goals first. 9. Takes into account the interests and needsof the larger group. 10. Shared responsibility for getting the jobdone.					

Expert Validation Instrument

Table 3. Early Childhood Education Expert Validation Instrument

No	ASSESSMENT ASPECT	1	2	3
1	The suitability of the learning model with the developmentallevel of Early Childhood Education			
2	The suitability of the learning model with the child'sdevelopmental aspects			
3	Adaptation of the learning model with the development ofchildren's critical thinking skills			
4	The suitability of the learning model for the development ofchildren's creative thinking skills			
5	Conformity of the learning model with the collaborativedevelopment of children			
6	Suitability of the learning model with the ability to communicate			
7	Compatibility with the scope of Early Childhood Education material (Science)			
8	The suitability of the model with the learning model of theCenter			
9	Compatibility of the learning model with the group learningactivity model			
10	Conformity with the classical learning model			
11	Compatibility with the type of group game			
12	Compatibility with the type of creative game			
13	Application of the model according to the media and gametools in Early Childhood Education			
14	Learning model can be done inside and outside the classroom			
15	Learning model according to the ability of Early Childhood Education teachers			

Table 4. Media Expert Valdiation Instrument

Aspect	Indicator	KS	S	SS
Language	1. Appropriate use of the term media 2. The suitability of language with the level of thinking of Early Childhood 3. Ease of understanding the flow ofmaterial through the use of media			
Learning Strategy	1. Ability to encourage children'scuriosity 2. The ability of the media to increaseknowledge 3. The ability of the media in increasingchildren's understanding 4. The ability of the media to increasechildren's motivation to learning 5. Media support for children's creativethinking skills			

Development Stage. Activities carried out in the development are: a) Validating learning models for Education Technology experts and Early Childhood Education experts. The results obtained are as follows:

Table 8. Media Expert Assessment Results

No	**Material Criteria**	**Score**	**Description**
1	Language	88	Very valid
2	Learning strategy	93	Very valid
3	Relevance to Software	80	Valid
	Average	87	Very valid

From the table above, it can be seen that the average expert assessment is in the Very valid category. This means that the Media Technology device used by the teacher for inquiry learning can be applied. However, there are some items that will improve thequality of the language.

Table 9. Assessment Results of Early Childhood Education Experts

No	**Material Criteria**	**Score**	**Description**
1	Conformity with EARLY CHILDHOOD EDUCATION Objectives	100	Very Valid
2	Compatibility with Skills 4 C	83	Very Valid
3	Compatibility with AUD learning materialsand models	83	Valid
4	Compatibility with the type of AUD game	88	Very Valid
5	Conformity with the teacher's abilities	83	Valid
	Average	87	Very Valid

From the table above, it can be seen that the average EARLY CHILDHOOD EDUCATION expert assessment isin the Very valid category. This means that the Inquiry Learning Model can be applied toearly childhood education. Or Kindergarten Children. Inquiry learning can be applied. However, there are several items that will improve the quality of the language

4 Conclusion

The results of the research development are still at the development stage, whichis to test the validity of the TPACK-based Inquiry Learning Model Design in Early Childhood Education. Although a small class trial has been carried out, (5 people) but the results are very low (40%). or only 2 children are at the Beginning to Develop ability (MB). The small trial results suggest that teachers who will conduct trials on large classes should be trained aswell as possible.

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