

# Implementation of ABC Model Integrated 4CS on Learning Math

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**Abstract:** ABC model that integrates 4CS in mathematics learning. ABC is an acronym for anticipation, building knowledge, and consolidation. Whereas 4CS is an acronym for critical thinking skills, communication skills, collaboration skills, and creative thinking skills. This model is one of the guidelines for teachers or teaching staff to teach students, in terms; critical thinking, creative thinking, communicative, and collaborating. The components of ABC mathematics learning model that are integrated with 4CS are syntax, social system, reaction principle, and support system. The syntax of this mathematical learning model includes; are: identifying and justifying concepts, solving problems, generalizing and analyzing algorithms, and making conclusions. Some of the results obtained from the implementation of this model include: students can work collaboratively, respond to questions well and have true value, provide unbiased comments, and are able to assess the correctness of the answers.

## 1 INTRODUCTION

The framework for 21<sup>st</sup>-Century learning is a learning and innovation framework to develop several capabilities, critical thinking skills, communication skills, collaboration skills, and creative thinking skills, at 4CS. This framework is supported by several opinions of researchers, including; States that A student acquisition of high order thinking (critical thinking, communication, and creative thinking) is now a national goal (Thinking, 2015). That every learning manager must equip students with the ability to think critically, creatively, communicatively, and collaboratively as future competencies.

In learning practice, 4CS lacks the full support of educators. State that not a few teachers only present subject matter, and provide examples (Wong & Lai, 2013). State that most students do not take the meaning of the process of solving the problems that have been passed so that their knowledge is not fully mastered (Prayitno, 2010). As a result, the process of building knowledge is less successful, and there is a tendency to always be guided, given instructions, in solving problems.

Critical thinking is an activity to assess the truth of an argument. According to arguments are statements that are supported by evidence and data, arranged logically, and the truth can be trusted

(Sternod & French, 2016). Arguments with consideration, fulfill, and accompanied by logical reasons. State that the method of obtaining arguments or reasons must be clear, so that they are easily understood and believed to be true (Bartolomeo-Maida, 2016; Dewitt, Alias & Palraj, 2017).

Communicative ability is one of the goals to be achieved in mathematics learning, through giving the widest possible opportunity to students to develop and integrate oral and written skills, for example, modeling, speaking, writing, talking, drawing, and presenting what has been learned. That communicative importance in mathematics learning is the overarching of connected mathematics is all students should be able to reason and communicate proficiently in mathematics (Lavie & Dalton, 2014; Garrett, 2008).

The collaborative is a philosophy of interaction and personal lifestyle, everyone is responsible for their actions, and respects the abilities and ideas of their peers. That collaborative learning is an effort made to combine students' intellectuals with students, or students with teachers (El-hussein & Cronje, 2010; Li & Lam, 2013). State that creativity is the ability of a person to produce any composition, product, or idea that is basically new, and previously unknown to the maker (Willemse, et.al, 2015). Some conditions and situations of mathematics learning that support 4CS include; teach students to make and compile arguments, problem-solving, individual work, and

collaborative work (Konar, Halder & Chakraborty, 2015). Other activities that support 4CS are: justifying information, identifying concepts, and presenting evidence (Keys, et.al., 2015). A combination of attitudes, knowledge and skills as an effort to identify problems, and seek evidence (Bajracharya, 2010).

Based on the results of the study of mathematics learning, it appears the role of students in learning mathematics to make and compose unclear arguments at each stage of learning. So, it requires a model or pattern of learning mathematics that can anticipate various weaknesses of students, then build knowledge, and make consolidation through the activities of how to make and compile arguments. Thus, it is interesting to study more theoretically or empirically in the implementation of the ABC model that is integrated with 4CS in mathematics learning.

## 2 METHOD

The research method is carried out in several stages, namely: problem identification and needs analysis, design and implementation, and evaluation (Nieveen & Folmer, 2013). Problem identification and needs analysis, activities, including; studies of mathematical learning models, learning theories, critical thinking theories, Communicative theories, collaborative theories, and creative thinking theories. The design, implementation, and activities include; design an ABC model that integrates 4CS in mathematics learning and implements based on the design results. In the evaluation phase, activities at this stage are limited trials to obtain models that meet effective criteria. Especially at the design and implementation stage, researchers will conduct a review of the implementation of syntax, namely: anticipation (A), building knowledge (B), and consolidation (C).

## 3 RESERACH RESULT

### 3.1 Rationalization of the ABC Model

A model of teaching is a plan or pattern that we can use to design face-to-face teaching in class rooms or tutorial setting and to shape instructional materials-including books, films, tapes, computer-mediated programs, and curricula (long term courses of study) (Joyce, Weil & Calhoun, 2011). Each model guides us as we design instructional to help students achieve various objective”.

Learning models for learning mathematics are defined as strategies in the perspective of mathematics learning that are designed to achieve the objectives of mathematics learning (Dewitt, Alias & Palraj, 2017). Learning model refers to the learning approach that will be applied to the learning environment of mathematics (Arends, 2008). Furthermore Arends stated that there are 4 characteristics of learning models, namely (1) theoretical rationales that are derived from the design, (2) have a rationale for the mathematics learning tasks to be achieved and how students learn to achieve these goals, (3) activities teaching teachers that are needed so that the mathematics learning model can be implemented effectively, and (4) the learning environment needed to achieve goals.

The term ABC is an acronym for the word anticipation, building knowledge and consolidation. The practice of ABC models in learning, including; assign students to investigate, actively solve problems, work cooperatively, and support students to express ideas orally. The role of students to create and compile arguments is very potential in developing students' ability to think critically, think creatively, collaboratively, and communicate. Therefore, it is very rational to complement the ABC model that is integrated with 4CS in learning. 4CS is an acronym for critical thinking skills, creative thinking skills, collaboration skills, and communication skills. However, there needs to be an in-depth study both theoretically and practically in mathematics learning.

### 3.2 4CS (Critical thinking skills, Communication Skills, Collaboration Skills, and Creativity Thinking Skills)

Some skills that must be possessed to face challenges in the 21<sup>st</sup>-Century, including 1) critical thinking and problem solving, 2) communicating and collaboration, 3) creativity and innovation, 4) information literacy, 5) media literacy, 6) ICT literacy, 7) flexibility and adaptability, 8) initiative and accountability, 9) leadership and responsibility (Benner, Hughes & Sutphen, 2008). In line with Williams & Dickinson (2010) the Partnership for 21<sup>st</sup>-Century Skills identifies 21<sup>st</sup>-Century skills including critical thinking, problem-solving, communicative and collaboration. Likewise, the National Education Association that achieves success and can compete in the global community, students must be experts and have the skills as communicators, creators, critical thinkers, and collaborators.

Critical thinking is a mental activity that tests, questions, connects, and evaluates all aspects related

to a situation or problem (Setyadi, 2017). Critical thinking is an intellectual process that is active and skilled at conceptualizing, applying, analyzing, synthesizing, or evaluating information from observations (Association for Mathematics Education of South Africa, 2017). For example, when someone is reading a text or listening to information, he will try to find out and try to find or detect any special or important things.

Lavie & Dalton (2014) stated that the overarching of connected mathematics is that all students should be able to reason and communicate proficiently in mathematics. Communicative verbally (mathematical conversation) is a tool for measuring growth in understanding, allowing participants to learn about mathematical constructions from others, and giving participants opportunities to reflect on their own mathematical understanding. Communicative is the ability of a person to speak, explain, describe, hear, ask and work together (Carson, 2007). A person's ability to explain an algorithm, construct and explain the presence of real-world phenomena in graphs, words/sentences, equations, tables and physical presentation.

The collaborative is a philosophy of interaction and personal lifestyle that everyone is responsible for their actions, including activities in learning, and mutual respect among their peers. Collaborative learning is a term that encompasses several educational approaches that involve efforts to combine intellectual students with students or students with teachers. While other opinions state that collaborative learning uses social interaction to build knowledge.

Cooperative learning which is a group structure that is handled carefully is the end of the continuum of collaborative learning (Li & Lam, 2013). So, it can be concluded that collaborative learning is a term that encompasses several learning approaches that involve social interaction as a means of building knowledge. States that collaborative is a group that almost all members have a responsibility, whereas in cooperative the emphasis is on the structure of interactions designed to facilitate the completion of tasks/products/goals, while the teacher only maintains or exercises full control. Collaborative involves reciprocal agreements between participants in coordinating efforts to solve problems, while cooperatives are resolved through the division of labor between group members.

### 3.3 ABC model that integrates 4CS in mathematics learning

Based on the results of the study of several learning theories, learning model theory, mathematics learning theory and 4CS innovation, the integrated 4CS ABC model syntax consists of 3 phases, namely: phase 1 anticipation, phase 2 building knowledge, and phase 3 consolidation (consolidation). More details can be seen in the following table.

Table 1: ABC Model syntax integrated 4CS

Phases	4CS	Indicators
Anticipation	Critical thinking	questioning, connecting, conceptualizing, applying
	Communication	talking, explaining, describing, hearing, asking, working together
	Collaborative	Responsible, respectful, involved in discussion activities
	Creative Thinking	smoothness, flexibility, originality, decomposition, assessment, redefining, and sensitivity.
Building Knowledge	Critical thinking	questioning, connecting, conceptualizing, applying
	Communication	talking, explaining, describing, hearing, asking, working together.
	Collaborative	responsible, respectful, involved in discussion activities
	Creative Thinking	smoothness, flexibility, originality, decomposition, assessment,

		redefining, and sensitivity.
Consolidation	Critical thinking	connect, evaluate, conceptualize, synthesize
	Communication	explain, describe, hear, ask.
	Collaborative	Responsible, respectful
	Creative Thinking	smoothness, flexibility, originality, decomposition, assessment, redefining, and sensitivity.

1. Provide opportunities for students to explore and transform knowledge between students and students, provide opportunities for students to make predictions and hypotheses, try other solutions and discuss them.
2. Provide opportunities for other students to present and reflect findings in front of the class. This allows for differences between solutions obtained from each group.
3. Directing students to answer the problems contained in the assignment sheet, convey the steps of completion, provide an explanation of each algorithm, monitor, and re-examine the completion.
4. Appreciate all student activities that support the learning process (positive reinforcement) and direct student activities that hinder the learning process (negative reinforcement).

### Social System

The social system of the ABC 4CS integrated model is to adopt a balanced relationship pattern between the teacher and students, or students with students. The relationship is reflected in each phase of the model. In the anticipation phase, students construct concepts, facts, operations, and principles that are packaged in an activity described as an effort to find out and understand the mathematical material.

The phase of building knowledge, the form of activity at this stage students collaborate in completing the tasks given by identifying problems (known, asked, lack of elements), making mathematical models, and solving them.

Consolidation phase. In this phase students explore a problem presentation by examining/correcting the inappropriate completion steps, completing supporting data which is considered lacking, and explaining how to obtain it from each problem-solving procedure.

### Reaction Principle

The principle of reaction is an activity pattern that describes the teacher's response to students, both individually and in groups and as a whole. The principle of reaction relates to the technique applied by the teacher in reacting to students' behaviors in learning activities, such as asking, answering, responding, criticizing, disturbing friends, being less serious, and so on.

The way the teacher looks at student behavior. The teacher gives a rather strict direction so that student behavior can be shaped by the teacher's actions. However, on the other hand, the teacher can also let student activities develop for specific purposes. The teacher simply comments on this condition, provided that the comment has a positive impact on the objectives to be achieved. The following are some of the teacher behaviors contained in this model as follows.

### Support System

A support system is a tool that supports the learning process. Supporting tools in the model include learning plans, learning materials, and student worksheets. The learning plan consists of four components, namely; question or assignment of the teacher, this component contains the command or instructor of the teacher to the student, the expected student response or answer, this component contains the answer or response to the teacher's command, the teacher's reaction to the student's answer, this component contains the teacher's reaction to the student's answer to the question asked and teacher's reflections / notes.

The teaching material contains a description of the mathematical material that is prepared with consideration of the aspects of critical thinking. Teaching materials are designed to invite students to know and understand concepts in mathematics, present their findings, use algorithms, and harmonize technical skills. Furthermore, mathematical processes, interpreting, developing their own models and strategies, expressing arguments or reasoning logically, finding general patterns, conjectures and formalizing formally. While worksheets specifically designed require students to learn mathematics that is relevant to the problem or task is given. In the sheet section, a working column is prepared, as a form or column of answers for students to write down the results of their work.

## 4 DISCUSSION

The discussion of the implementation of the ABC model that is integrated with 4CS in learning

mathematics is focused on syntax, namely: Anticipation, building knowledge, consolidation.

In the previous study, it was explained that the 4CS indicator in the anticipation phase can be achieved through the activity of selecting or defining the main concept, then giving an explanation with its own complete words, and true value. Then interpret and make assumptions, then explain to his friends.

Several supporting factors for the implementation of learning activities at this stage, among others; giving freedom to students to explore and build knowledge, a description of the activities contained in teaching materials, directing students to find out information in their own ways, encouraging students to discuss and ask questions, giving opportunity for students to present their findings in front of a group of friends. These results enrich previous findings; like Thinking (2015) and Bajracharya (2010).

Some student activities in the building knowledge phase are identifying problems (known, asked, the sufficiency of elements) and making mathematical models correctly, then solving them correctly. In this phase students are assigned to think about making solutions or answers, and making ideas, expressing opinions or ideas (Thinking, 2015).

Some activities were carried out during the consolidation phase, including; examine, correct, and explain each step of the problem-solving algorithm completely and correctly, and complete supporting data, determine general rules, and provide an explanation of how to obtain it completely and correctly.

## 5 CONCLUSIONS

In the previous study, it was explained that the 4CS indicator in the anticipation phase can be achieved through the activity of selecting or defining the main concept, then giving an explanation with its own complete words, and true value. Then interpret and make assumptions, then explain to his friends. In the phase of building knowledge, students identify problems (known, asked, the sufficiency of elements) and make mathematical models correctly, then solve them correctly. In this phase students are assigned to think about making solutions or answers, and making ideas, expressing opinions or ideas. Furthermore, activities at the consolidation phase, among others; examine, correct, and explain each step of the algorithm to solve the problem completely and correctly, and (2) complete supporting data, determine general rules and provide an explanation of how to obtain it completely and correctly.

Other benefits of implementing this model include increasing mastery of mathematical material, students more quickly and easily understanding the material, finding linkages between concepts, and being able to apply concepts that have been understood in other fields.

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