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Research Based Learning to Improve Students 6C Skills During the Pandemic

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***Abstract*—The Covid-19 pandemic has forced learning to take place virtually for safety and health reasons. This is not an obstacle in education, because a quality learning process can still take place with the right method. Mini research can be used by teachers to develop the 6C skills that students must possess. The research is based on theoretical studies conducted and is related to the 6C ability indicators. Each indicator of ability is juxtaposed with the stages in research activities, namely pre-research and reporting of research results. The results of the study show that each 6C ability indicator can be taught, accustomed, and developed by students through research activities. In pre-research activities, students will learn to develop communication, collaboration, and critical thinking skills ideally. Meanwhile, in research activities and reporting research results, students learn to develop six 21st century skills, namely communication, collaboration, critical thinking, creative thinking, computational thinking, and empathy skills. These skills are obtained through a series of research activities and research reporting. Based on this, it can be understood that mini-research can improve students' 6C skills. The more often doing research activities, the 6C ability will be successfully owned by students.**

Keywords—miniresearch, 6C ability, miniresearch in the pandemic, 21st century ability

I. INTRODUCTION

Current learning requires the development of 21st century skills, including 4C skills (Communication, Collaboration, Critical thinking, and Creativity). This ability is a support for students to develop their quality in global competition [1]. However, in the current virtual learning era, 4C skills are not enough to be a modality for students. Currently, 6C skills have been developed which must be taught and become learning outcomes. Then, what is the additional 2C? In this study, additional skills refer to the policies of the Ministry of Education, namely computation thinking and compassion. These two skills will further equip students to become complete academic beings, namely to form students who are creative-innovative and have academic moral responsibilities [2]. 6C skills are starting to be encouraged in various learning concepts, especially during virtual learning today. Virtual learning, especially in Indonesia, has been forced to take place due to the Covid-19 pandemic. Learning must be designed that prioritizes the development of students skills, even though learning takes place virtually [3].

Mini research is a learning alternative that can train students to maximize their cognitive skills. Mini research is a necessity for academic people because their conceptual and empirical skills will work together [4]. Mini research is a way for students to analyze problems, design solutions, and test to produce practical solutions that can be utilized [5]. This (solution) will be realized if students have higher-order thinking skills. A solution will be created from the power of analysis and creativity in thinking based on data. In addition, the current research culture has changed for the better, which requires multidisciplinary collaboration. This means that students must be able to collaborate and have adequate communication skills in order to create harmonious cooperation. In addition, computational thinking skills, which are based on problem-solving aspects, are very relevant to the concept of mini-research learning. Then, the ability to love is aimed at feeling the problems experienced by other people/society in order to be able to produce appropriate solutions [6]. Based on this, 6C ability becomes an urgent need for students to be able to contribute positively wherever they are.

II. 6C SKILLS

A. Communication

The ability to communicate is undeniably a very important ability in various aspects of life, such as social-society or the professional world [7]. Someone who has good communication will find it easier to convey his ideas and build a good network. Good communication skills will be attached to a person so that it can represent himself. Communicating is not limited to conveying ideas verbally, but can also use written media or even image media [8]. The more qualified a person's communication skills, the better the transfer of information received. This is an important element for students, because they must be able to convey various kinds of opinions so that they are accepted and understood as they wish. Sometimes,

many good ideas cannot be understood because of the inability to convey them effectively [9]. Verbal and non-verbal communication can be provided to students through research activities, reporting research results, and delivering research results. Based on this, the ability to communicate is supported by several aspects, namely: 1) communication ethics; 2) effective in word selection; 3) systematic; and 4) based on data [10,11]. Communication skills can be trained simultaneously through problem-based learning that requires discussion, for example in research activities and scientific presentations.

B. Collaboration

Working together in completing a task or job, is now a demand [12]. In fact, the current academic culture in Indonesia requires multidisciplinary collaboration in learning and research. That is, in learning it is required to bring up different disciplines as additional points of view, as well as in research. Group learning is often used to practice collaboration skills. Collaborating is not only combining several people into one group, but also must create harmonious conditions in order to achieve goals [13]. Harmonious conditions in groups can be interpreted as ideal conditions in heterogeneous groups that respect each other's opinions, are responsible, contribute, support joint decisions, and provide good communication [14]. These aspects support success in working together. The ability to collaborate can be trained through joint problem-based activities, such as conducting field research. Thus, the ability to collaborate is very important for students because they must be able to adapt to a variety of people's backgrounds, suppress personal egoism for a common goal [15,16].

C. Critical Thinking

The ability to think critically has long been considered a very important ability for everyone, especially students or academics [17]. Critical thinking is not only on the ability to analyze, but also be able to determine a decision based on reason [18]. This ability is increasingly urgent now because a lot of information is created and spread that is easily accessible and not known to be true. Many community members are still easily deceived by information that is not clear, based on issues, and does not have data power. Critical thinking skills will be very useful for someone in understanding explicit or implied information [19]. Critical thinking is aimed at analyzing information or problems, connecting with relevant data, evaluating, and making conclusions or decisions [20]. Therefore, critical thinking skills are considered as higher order thinking skills. People who are accustomed to critical thinking will be difficult to deceive, have stability in thinking, and make wise decisions [21]. This ability can be obtained through problem-based learning and conducting study activities.

D. Creativity

Creative thinking ability is the next stage of critical thinking ability. That is, someone who is not able to think critically, it will be difficult to enter creative thinking [22]. Creative thinking requires someone to maximize his thinking power by producing something new in a different way or openness in thinking [23]. Many inventions in this world are based on the ability to think critically and creatively. The ability to think creatively is needed by someone in solving problems by producing appropriate solutions [24]. Originality is an important indicator in creative thinking because. Originality can be interpreted as the ability to present ideas in new ways, new perspectives so as to produce a new thinking product [25]. This can be raised by connecting various concepts, theories, data, so as to produce something new. How to think creatively must be accustomed to students to develop their potential and be able to produce various solutions to problems in the field. Students' creative thinking ability can be developed by presenting problem solving learning [26].

E. Computational Thinking

Computational thinking skills are not an attempt at computer programming, but are a way of thinking that leads to problem solving [27]. Computational thinking is very useful when dealing with complex problems. The way computational thinking works begins with identifying and analyzing the problems encountered [28]. These problems are based on real and relevant data. Then, the computational way of thinking will familiarize its users to think systematically in addressing problems and trying to develop effective solutions [29]. The last stage is to implement the solution that has been designed, to see its effectiveness in solving the problems that are currently happening. Basically, computational thinking ability includes three main elements, namely: 1) defining the problem; 2) solve the problem; and 3) analyze the solution [30]. The three stages consist of ten computational thinking skills: problem formulation, abstraction, problem reformulation, decomposition, data collection and analysis, algorithmic design, parallelization and iteration, automation, generalization, and evaluation. Computational thinking is considered an indispensable skill in various categories, such as academics. In the academic world of higher education, the way of computational thinking must be mastered by students to implement their conceptual knowledge in solving problems [31]. Thus, computational thinking is very relevant when juxtaposed with problem-based learning models.

F. Compassion Skills

The ability to empathize (compassion) is closely related to one's behavior in respecting others, feeling the difficulties experienced by others, and understanding one another [32]. This ability implies a high level of concern for others consciously and voluntarily [33]. People who have empathy skills will always be wise in acting, speaking, and making decisions . That is, before he takes action, he puts himself in the position of someone who is experiencing difficulties or problems. Someone who has the ability to love will feel proud when his friend gets a positive achievement [33]. There will be no opposing actions, such as hindering the success of others or being a stumbling block to others. The ability to empathize can be developed by students through capable groups. meaning that he is involved and active in the success of the group's goals

voluntarily and understands the problems experienced by the group.

III. FINDING AND DISCUSSION

The ability to communicate is not limited to direct oral activities, but includes writing activities. The ability to communicate is also supported by the regularity of language and based on data [34]. The ability to collaborate includes several indicators, namely students must contribute positively to their groups, respect differences of opinion, respect joint decisions based on mutual agreement [14,15]. These indicators show the ideal in group activities. Critical thinking skills are considered special because not everyone can achieve this higher-order way of thinking. An indicator of a person's critical thinking is reviewing the information obtained, connecting it with real data to produce an assessment of its truth [18]. Thus, critical thinking skills require someone to think based on the results of the analysis and data so that they are able to understand the information contained therein [20]. The ability to think creatively is the next stage of critical thinking. Creative thinking requires good analytical skills so as to be able to produce a new thought or new idea [32]. The ability to think creatively is characterized by openness in thinking, connecting various concepts to produce solutions and originality [25]. Critical-creative thinking skills will support the development of computational thinking skills because it will lead users to think systematically to produce solutions. Based on this it is understood that computational thinking is a researcher's way of thinking, starting from analyzing problems, formulating solutions and implementing them so that their reliability will be known [33]. Thus, research-based learning will support and develop computational thinking skills in students. The ability to empathize (compassion) is another important thing in the 6C ability. Research activities accompanied by empathy or compassion will produce a group capability and effective solutions based on a sense of sharing.

The 6C ability becomes a vital component for student self-development. Each ability is connected to other skills, so that it becomes a complete package if students succeed in obtaining it. This connection can be interpreted that critical thinking skills are closely related to creative thinking, the ability to collaborate, communicate, are closely related to the ability to empathize, as well as the ability to think computationally has synergy with others. Based on this, a learning method is needed that is able to present 6C skills at once, not partially. In this study, the project-based learning method or mini-research is used as an example in presenting 6C skills. Why do you need a mini-research? It has been explained previously that the 6C skills will be more effectively trained to students when learning is based on problems. Mini research is an alternative problem-based learning method that can be used to invite students to think comprehensively to solve problems in their research. Mini-research activities have three categories of activities, namely pre-research and reporting of research results. Pre-research activities include determining problems, determining and explaining the urgency of research, and determining research data collection methods. Meanwhile, research reporting includes follow-up of pre-research activities, namely conducting data analysis and discussion until all components of scientific work are completed.

Each category of activities carried out in the mini-research is juxtaposed with the 6C ability indicators that appear in student activities. Based on this, each category of research activities carried out by students has a contribution to familiarize and bring up 6C skills. Pre-research activities are described in table 1 below.

TABLE I. PRE-RESEARCH ACTIVITIES AND SKILLS 6C

Category	Activity Subcategory	Student Activities	Ability Indicator
Pre-research	Determining research problems and urgency	Students discuss in their groups to determine the problems to be discussed in the research. Students discuss to identify the urgency of the research to be carried out. The urgency of research becomes the basis of a study because not all problems must be carried out by a field study.	Communication Collaboration Critical thinking
	Determine the data collection method	Determine the type of instrument needed to collect research data. Errors in choosing research instruments will have an impact on the validity and reliability of the resulting data.	Communication Collaboration Critical thinking
	Gather relevant reference sources	Determine reference sources that can be used in research. Relevant reference sources will assist researchers in reviewing theories and developing alternative solutions.	Communication Collaboration

Based on table 1, it can be seen that the pre-research activities carried out by students are related to training and habituation of some 6C skills. The 6C skills that emerged in the pre-research activity were based on the indicators of these skills. The ability to communicate always appears in the sub-activities because the communication aspect is not limited to oral, but also written aspects. The ability to communicate becomes the focus of every sub-activity because the communication aspect cannot be separated from one's activities. The ability to think critically arises when the activities carried out by students require a study or analysis, for example in determining the urgency of research activities. It takes critical thinking from each group member to be able to explain and show the urgency of the research being carried out. Planning and design activities must be carried out so that research activities are well organized and obtain quality data. After that, students can enter the research phase and report research results which have different sub-activities. The

categories of reporting research results and their relation to 6C skills are described in table 2 as follows.

TABLE II. REPORTING ACTIVITIES AND 6C SKILLS

Category	Activity Subcategory	Student Activities	Ability Indicator
Reporting research results	Determination of research title; preparation of research urgency; and proof of originality	Students discuss in groups to formulate an appropriate research title by taking into account the research variables. After that, students develop the urgency of research based on the data of previous research that has been published. Then, the evidence of originality is compiled by analyzing various relevant previous research results. Students in their groups share tasks proportionally and are responsible for their part.	Communication Collaboration Critical thinking Creativity Computational Compassion
	Preparation of data collection instruments and data collection	develop data collection instruments and formulate question indicators in order to produce appropriate and relevant data. After that, students collected field data using the prepared instruments. Data collection can be done directly or using technology-based media in order to get more answers from respondents. During the current Covid-19 pandemic, data collection is prioritized using technology media.	Communication Collaboration Critical thinking Compassion
	Analysis of research data and discussion of data and research novelty	Displaying research data in an attractive and easy-to-understand way and reviewing the data that has been obtained to answer research questions. Students conduct discussions based on data, problem formulation, and theories used in research so as to produce alternative solutions and elements of novelty in research (if any)	Communication Collaboration Critical thinking Creativity Computational Compassion

Based on the explanation presented in table 2, it can be understood that each activity subcategory presents indicators of 6C skills. The 6C ability indicator appears through activities carried out by students, for example creative thinking is produced from evidence of the originality of research submitted by students in their scientific works. Research originality will be obtained when students successfully analyze and think about solving problems based on previous research submitted by other researchers. The activity includes three skills at once, namely critical thinking, creative thinking, and computational thinking. In addition, in compiling titles, research urgency, and proof of originality, students are trained to bring up and develop communication skills, collaboration-capability.

In the second sub-activity, namely the preparation of research instruments and field data collection activities covering several 6C skills. Critical thinking is certainly a supporter in producing quality data collection instruments that are relevant to research needs. Students who are wrong in preparing research instruments will have an impact on the reliability of research results and discussions presented. Therefore, research instruments determine the type of data and the quality of the data produced. In data collection activities, students will feel the atmosphere of research problems directly in the field so that they can trigger the ability to empathize. If data collection is done using technology media, then the ability to empathize (compassion) will appear when analyzing answers from respondents. Thus, the quality of research instruments greatly supports the success of research and the development of students' 6C skills.

The third sub-activity is the part of displaying data, giving meaning to the results of the analysis, and formulating research solutions. At this stage, 6C skills become a pillar to produce quality discussions and generate research novelties. Higher order thinking skills are needed to analyze data and design solutions, of course this requires critical-creative and computational thinking skills. Solutions can be offered by researchers when they are able to open their way of thinking and see problems from various perspectives. The solutions that are compiled must also have empathy-compassion implications to be effective and more useful. Solutions must really be solutions, not just abort research obligations that must lead to solutions. These indicators become a basis for developing students' 6C abilities simultaneously through research activities and reporting their research results.

IV. CONCLUSION

Virtual teaching is basically not an excuse for not being able to deliver quality learning. The right method is the main foundation in producing the expected learning outcomes in the 21st century. 6C skills (communication, collaboration, critical thinking, creativity, computational thinking, and compassion) are aspects that are expected to be achieved in every lesson. It is undeniable that 6C skills will produce students who are complete and have self-quality. This is also an important aspect in the world of education, social society, and the world of

work. 6C skills can be taught implicitly to students through research activities. Research activities are always problem-based so that students are invited and trained to understand research problems, formulate solutions, and speak based on data. Students who are not able to improve their 6C skills will experience problems in pre-research activities and reporting of research results. Based on the results of the study, it was shown that every step taken in the research contributed to developing the 6C abilities of students. Based on this, learning with research methods can improve students' 6C skills.

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