Exploring Collaborative Problem-Solving Competency of Junior High School Students

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Submission date: 15-Aug-2020 01:30PM (UTC+0700)
Submission ID: 1369802214
File name: Friska_revisi_PROOFREAD.docx (40.29K)
Word count: 3538
Character count: 20777

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ABSTRACT

The 2013 curriculum implemented in the learning process demands students to be able to develop every aspects owned by each individual; one of them is Collaborative Problem Solving (CPS) competency. The global competition after finishing education is also a concern for learning outputs. Collaborative problem-solving does not only sharpen the students' cognitive competency but also their social attitude. Education is a process that involves students through their thinking to continue to innovate in order to solve the surrounding problems properly. Every time, it is necessary that students are prepared to obtain skills that they will need in the future. The purpose of this research is to studyhow to solve collaborative problems in middle level students. How these skills contributetowards students understanding process on learning itself, both individually andin groups. This study was performed at a State Junior High School in Lampung during the odd semester of the 2019/2020 akademic year. Samples used in this research were determined using random sampling techniques. The research sample was 63 students'. The instruments used in data collecting were observation, interview, and test, without any treatment towards the sample. The research results showed that every aspect in CPS, i.e., participation, perspective-taking, social regulation, learning and knowledge building, and task regulation on Junior High School students, were still at low category. Therefore, subsequent studies are necessary to develop the learning process with emphasis on CPS.

Keywords: Collaborative, Problem-Solving, Science.

INTRODUCTION

Education is the process to shape students through their thoughts to keep innovating in solving the problems around them properly (Kybasyuk & Blessinger, 2013; Schinkel, De & Aviram, 2016; Pugh, 2017; Pallarès, Planella, Chiya&Albar, 2019). Education is the platform expected to form human resources for the future (Kwon, 2018; Thomson, 2019; Christie, Beames& Higgins, 2016). One of the educational needs in the era of industry 4.0 is the human resources literacy that consists of leadership, cultural agility, teamwork, and entrepreneurship (Malik, 2019; Lestari & Santosa, 2019; Rosa, et.al, 2019; Rahayu, Warto, Sudardu & Wijaya, 2020).This condition shows the readiness of the next generation in facing rapid progress of knowledge without ignoring the social side of human resources themselves. The need to work collaboratively/ teamwork to solve a problem, bringing up the leadership trait as the form of confidence of each individual as well as cultural agility and entrepreneurship which are also the important attitudes to be conceived by every individual (Vishnumolakala, Southam, Treagust, Mocerino& Qureshi, 2017; Morcom, 2016; Reeves, Pun, & Chung, 2017; Lestari &Santoso, 2019). Establishing a habit of a child to work in a team becomes one of the efforts that can be done by educators in preparing human resources to face future challenges (Pun & Chung, 2017; Kaendler, Wiedmann, Rummel & Spada, 2015; Chen & Chang, 2016; Yadin & Or-Bach, 2019).

The kind of education undergone by Indonesia is the implementation of the 2013 curriculum by using scientific approaches. This system is one of the efforts conducted by the government, especially in the education sector, to prepare human resources who should be ready to compete in the broadening work sector due to the global market challenges. The demand is not only to have decent intellectual competencies, but also the attitude and capability to be collaborative with the team in achieving a certain goal. Scientific approaches demand students to be capable of solving an issue and concluding the acquired solution (Merritt, Lee, Rillero, & Kinach, 2017). This phase will surely be affected by the competencies of students in solving problems. Problem-solving competency is the ability of an individual to solve an issue that involves critical and systematic thinking. The importance of problem-solving competency is the part of the 2013 curriculum that being implemented by Indonesian education. In the learning process, students are encouraged to obtain experiences by using knowledge and skills owned by the students to be implemented to solve problems during the learning process.

Problem-solving is a crucial matter in science learning (Akben, 2018; Eyisi, 2016). Problem-solving is a strategic competency aimed for students to be capable of understanding as well as selecting problem-solving approaches and strategies. Problem-solving will become an influential thing toward the success of science education at schools; therefore integrating problem-solving during the course of learning is a must (Karatas & Baki, 2017). The learning processes done by teachers often demand the students to listen, take notes, or memorize. Students are yet to be trained in identifying problems and elements included in the encountered problems, formulating strategies, then solving the problems.

Collaboration can be defined as teamwork in a learning or cooperation between groups. The term collaborative learning can sometimes be defined as the medium to pour ideas, opinions, andthe skills owned by each individual, to be used collectively in improving the comprehension of the entire group. Collaborative learning can sometimes be identified as cooperative learning. Collaborative learning involves both intellectual competencies of students and teachers in which students often work in a team consists of two members or more. Activities of collaborative learning vary and generally dig the capabilities of students in understanding a concept. Activities, like taking notes and listening to teacher's explanations, are still there; however discussions and activities of students are more dominant.

Problem-solving is a mandatory process to be capable of solving an issue. Learning is a process that provides experiences to students in encountering a problem and finding the solution, therefore, in the learning process, students should understand the problem-solving process and become competent in choosing and identifying the problem and the relevant concepts, designing the problem, solving it, as well as organizing the skills and knowledge that they have (Rahim, et.al, 2019; Saputro, et.al., 2019; Yanti, Kuswanto, Rosa, 2019). Through problem-solving, students are expected to stimulate their critical-thinking, perseverance, curiosity, and confidence. Problem-solving could bring benefits to students in solving daily problems or after entering the work sector in the future.

One of the primary purposes of the learning process is the students' problem-solving competency (Gol, 2015). This condition occurs because problem solving is the cognitive activity of students who participate in the learning process (Kim, 2012; Bogard, Liu, & Chiang, 2013). The problem-solving competency is associated with the ability to think, knowledge aspect, and reasoning ability of students (Chang, 2010). These skills are required by students as the stimulus to establish the reasoning based on the observation result or data, formulating hypotheses, designing problem-solving strategies, testing hypotheses as well as bringing up proper cooperation within the team (Sitika, Muharjito, &Diantoro, 2015; Markawi, 2013). The teacher-centered learning that is yet to involve students' cognitive activity during the learning process will tend to make students passive and insufficiently triggers the competency of students in solving problems (Sahyar&Fitri, 2017; Sylaj & Sylaj, 2020).

Collaborative learning is crucial to be developed continuously in the present era. The education outputs no longer requires students' intellectuality only, but also regards how students can collaborate properly when they are on the field or being in the work sector. Collaboration itself bears a meaning as an activity performed by a group or several individuals, cooperating with each other in accomplishing the same goal (Diellenbourg, 1999; Omari & Oliver, 2001; Jones & Vall, 2014; Jowkar & Kamalifar; 2014). Collaborative skill will demand students to develop the social attitude because this matter is a crucial component. Collaborative skill can be sharpened at individual or organizational level (Fiore et al., 2010; Stahl, 2006) and the advantage of working in collaborative activities shows that problem-solving competency is better reached compared to individual (Aronson & Patnoe, 1997; Dillenbourg, 1999; Schwartz, 1995).

Learning that is integrated with the purpose of collaborative problem-solving will give the potential toward the mechanism of a complex learning process. This learning combines the component of the students' social attitudes with the cognitive component in problem-solving process. This condition illustrates that every student will require social skills in problem-solving to create a condition that understands the group member and take actions (Jakel& Schreiber, 2013; Funke,2010; OECD,2013). In the learning of sciences, the ability to build and maintain the acquired comprehension is required to develop collaborative problem-solving competency (Bowers&Salas, 2001; Dillenbourg, 1999; Dillenbourg & Traum, 2006; Fiore & Schooler, 2004). When collaborative learning works properly, students will show their capability in the cognitive aspect as well as the capability to interact with others in solving problems or tasks.

METHOD

Research Design

This research used a qualitative-descriptive approach aimed to describe the collaborative problem-solving competency of students in Junior High School.Qualitative research is aimed to present overview on

the real condition of education process, thus it can be used as reference to analyze facts or educational phenomenon in order to conduct improvement. This research used qualitative approach where empirical facts were used as initial data obtained by researcher directly from the field by observing ongoing learning process, taking notes, analyzing, and making conclusion based on data collected.

This study did not perform any treatments on the subject but only provided results based on the instrument given toward students.

Research Sampling

This research used random sampling technique to determine the sample. The research population was eighth-grade students at SMP Negeri 3 Batanghari (State Junior High School 3 Batanghari). The number of population was 158 students, divided into five classes. Sampling process used traditional random technique, by deciding two classes using lottery. The research sample consists of 63 students'.

Research Instruments

Test and observations were the instruments used in this study. Observation sheet was used to observe the collaborative problem-solving competency through five elements, i.e, participation, perspective-taking, social regulation, learning and knowledge building, and task regulation(Hesse, et al., 2015; Care & Griffin, 2014; OECD, 2013).

Table.1. The Competency of Collaborative Problem-Solving Skills

Element of CPS	Indicator
Participation	Students can identify and get involved in collaborative problem-solving.
Perspective Taking	Students adapt the contribution or clues from other members of thegroups as the solution in collaborative problem-solving.
Social Regulation	Students can evaluate themselves in the collaborative problem-solving.
Task Regulation	Students can understand and implement problem-solving strategies systematically.
Learning and Knowledge Building	Students can link parts of information and plan a problem-solving strategy collaboratively.

Table 2. The Rubric of Collaborative Problem Solving (CPS) Assessment

CPS	Low (1)	Moderate (2)	High (3)

Participation	Maintaining the involvement in collaborative problem-solving.	Identifying and putting efforts in the collaborative problem-solving.	Persevering in the collaborative problem-solving as shown by occasionally attempting several strategies.
Perspective Taking	Only receiving the contributions or clues from other group members.	Adapting and converting the contributions and clues from other members into actions.	Contributions or clues from other members are used as the potential that possibly be made as part of the solutions.
Social Regulation	Recording his/herown performances in collaborative problem-solving.	Comments as part of feasibility and sufficiency in collaborative problem-solving.	Inferences of competency levels based on self-performance in collaborative problem solving.
Task Regulation	Trials and action errors.	Sequencing the purpose of action.	Possible systematic solutions
Learning and Knowledge Building	Focusing on explicit parts of information. Besides, activities done with a minimum or without the comprehension of the sequence of actions.	Relating the existing elements of information and able to identify the short sequence of cause and effect.	Formulating the form of multiple parts of information multi-representation) and capable of planning a strategy based on the generalization of the comprehension of cause and effect.

Data Analysis

This research used qualitative approach, where the data obtained based on direct observation by researcher at the school. Data analysis was conducted in three stages (figure 1) namely data reduction, data presentation, and conclusion (Miles & Huberman, 1992).Observation to obtain data used observation sheets with footnotes on each process. Observation conducted multiple times, about three meeting times as a form of data validation. Reduction stage was conducted after research. Data reduction is a part of analysis to sharpen and eliminate unnecessary parts of the results to make data more organized and verified. Data presentation stage is a step to report data for easier conclusion making and follow up. In this research data are presented in tables to allow easier categorization and student numbering in each categories, therefore conclusion is easier to obtained.

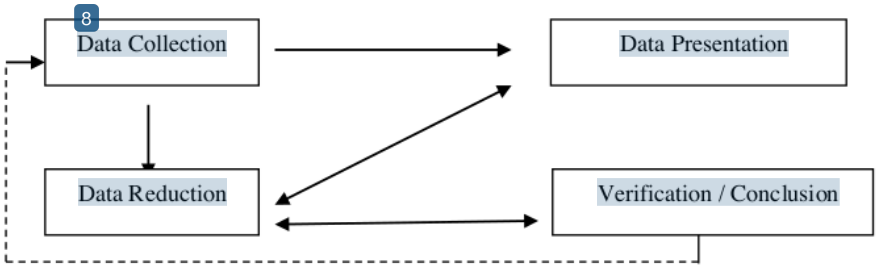

Figure 1. Miles and Huberman's Interactive Data Analysis Model

FINDING AND DISCUSSION

The observation results and the performed analysis provided initial description of students' competency in solving collaborative issues in the learning of sciences in the eighth grade of junior high school that entirely shown in table 3. The numbers in the table represent the number of students in each category after the test. The collaborative problem-solving (CPS) competency itself has two parts, i.e., social and cognitive aspects (Hesse, et al., 2015; Care & Griffin, 2014; OECD, 2013). Social skills in the CPS itself consist of participation, perspective taking, and social regulation aspects. Then, the cognitive skills consist of task regulation and learning, and knowledge building. Table 4 and 5 present each percentage of social and cognitive aspects within CPS.

Table 3. Students' Competency in Collaborative Problem Solving

CPS	participation	perspective taking	social regulation	task regulation	learning and knowledge

					building
Low	23	28	23	30	31
moderate	28	19	17	19	19
High	22	16	23	14	13

Several researches provided an overview that students' problem solving capabilities in science at Junior High Schools are categorized as good after given some models of treatment (Ubay & Rosdiana, 2018; Sadiqin, Santoso & Sholahuddin, 2017; Lewa, Susanto & Marwoto, 2018). Table 3 illustrates how the average competency of students in collaborative problem-solving (CPS) on each aspect is still low. It can be seen from the five aspects of PCS which are dominantly low in three of the aspects. This fact is supported by prior studies concluding that students' problem solving capabilities are still low although the students have good self-confidence level (Putra, Thahiram, Ganiati & Nuryana, 2018; Putra, Putri, Fitriana & Andayani, 2018). This matter surely requires special concern for the learning process at schools, especially at the level of Junior High School. According to the figure, it can be seen that there are two aspects; participation and social regulation which have almost the same mean. This result gives a positive trend in which a minimum gap occurs between the number of students and low competency and between the number of students and high competency. It is expected that this will become an early evaluation for future researchers to optimize these two aspects to improve other aspects. These two aspects are the social aspect within the CPS itself. This fact also becomes a good capital that the social aspect of students at the Junior High School regarding CPS-based learning is already decent. This condition will surely become the task for educators to keep providing platform for students to be capable of sharpening those skills/competencies.

The aspects that require more concern are perspective-taking, task regulation & learning, and knowledge building. The competency of students in understanding information, associating the correlation between information, then, determining the measures required to be done in solving problems collectively need to be re-emphasized (Putri, Fitriana & Andayani, 2018; Andayani & Lathidah, 2019). This is in line with a research by Putri, Fitriana & Andayani (2018), analysis results concluded that students' problem solving capabilities are still low in planning solution, problem solving, and interpreting solution. This condition also provided a correlation with the low level of perspective competency of those students.

Table 4. The Percentage of Social Skills in CPS

Social Skills in CPS	Criteria (%)		
	Low	Moderate	High
Participation	36.51	28.57	34.92

Prespektive-taking	44.44	30.16	25.39
Social Regulation	36.51	26.98	36.51

Table 4 presents the percentage composition of different number of students at low, moderate, and high levels. Social skills in CPS have three aspects in which those three aspects are correlating with the competency of students in interacting with each member of their group during the collaborative problem-solving process. Besides, it shows how active activeness the students are in interaction, and how each individual attempts to contribute in the given problem-solving process. On the participation aspect, there were 23 students (36.51%) at the low category, 18 students (28.57%) at the moderate category, and 22 students (34.92%) at high category. On the perspective-taking aspect, there were 28 students (44.44%) at low category, 19 students (30.16%) at moderate category, and 16 students (25.39%) at high category. On the social regulation aspect, 23 students (36.51%) were at low category, 17 students (26.98%) at moderate category, and 23 students (36.51%) at high category. According to these data, the aspect of perspective-taking was still low in general with 44.44%.

Social skills itself is defined as sensitivity towards others within a group to solve an issue by respecting each other,and understanding the perspective of other group members as a way to accomplish mutual goals (Csoti, 2001; Arend, 2012). The data obtained on this social aspect shows decent results, of which participation and social regulation of students are seen adequate. This condition needs to be developed further as a subsequent effort (Suswandari, Siswandari, Sunardi & Gunarhadi, 2020). Students need to be directed continuously toward activities reflecting the behaviors that emphasize on social relationship and allow individuals to work effectively with others. It has been revealed as well that social skills that are lacking in children and adolescence are sharing, participating, and communicating skills (Arend, 2012). According to the Government Regulation No.19/2005 concerning the education of life skills, one of the skills includes social skills (Department of National Education, 2007). Thus, in the learning activities, students need to be directed and accustomed to enhance the social skills they have properly. In order to embody such a goal, improving the learning activities by choosing models, strategies, media, techniques, and learning approaches compatible with CPS is a must. As mentioned in theory expressed by Dewey, classes during the learning process are the reflection of a broader community and are functioned as laboratories. Therefore, teachers create a social system within them through scientific process.

Table 5 presents the composition of students' cognitive skills in CPS, which consist of the aspects of task regulation & learning as well as knowledge building. The task regulation aspect demands students to be capable of understanding and implementing a strategy in a problem solving systematically. Then, on learning and knowledge building aspects, students are demanded to be able to link the parts of various information and planning a problem-solving strategy collaboratively. Both aspects still show that the average competency of students was still at the low category. On the task regulation aspect, there were 30

students (47.61%) at low category, 19 students (30.16%) at moderate category, and 14 students (22.22%) at high category. Finally, on the aspect of learning and knowledge building, there were 31 students (49.21%) at low category , 19 students (30.16%) at moderate category, and 13 students (20.63%) at high category. Both aspects show that more than 40% of students were still at the low category in the cognitive skills of CPS.

Table 5. The Percentage of Cognitive Skills in CPS

Cognitive Skills in CPS	Criteria (%)		
	Low	Moderate	High
Task Regulation	47.61	30.16	22.22
Learning and Knowledge Building	49.21	30.16	20.63

Competency in solving encountered problems can be influenced by several factors and they are different for each student. The disparity between individuals can be seen through several elements, including intelligence, logical-thinking skill, creativity, cognitive style, attitude, and many others.Cognitive style refers to one's characteristics in thinking, using information, processing and responding to the encountered problems (Brown, 2006; Kozhevnikov, 2007).

The research results showed that the performances of students in solving collaborative issue were still experiencing a lot of mistakes, including the difficulty in understanding the presented questions, writing the discovered variable, transforming information into equation symbols, or regarding the selection of strategies that will be implemented in solving the given problems. These matters will surely become a point that should be concerned during the learning process; social aspects need to be developed without putting aside students' individual side because it gives an impact of the social reaction that would be expressed further.Several studies presented results that by conducting learning method which supports problem solving by students will help emerge and improve the skill. (Supiyati, Hidayati, Rosidi & Wulandari, 2019; Taqiyyah, Subali & Handayani, 2017). This certainly makes a good foundation for conducting further research in the future. The research results can be used as references on the importance of implementing collaborative problem solving oriented learning process.

The observation process then continued with the interview towards teachers of science subjects, and the results showed the limited time for teachers to implement group learning process that emphasize on collaborating problems given during the science learning. Therefore, students are not accustomed to collaborative learning.

CONCLUSION

Collaborative problem-solving is a competency that should be owned by students in learning sciences as the fundamental of thinking and capital to undergo higher education level as well as to work in professional sector. Collaborative problem-solving competency consists of two main aspects, i.e. cognitive and social, in which both aspects have crucial contributions towards students' learning process of students in a specific learning class either for students'individual learning or collective learning in groups. Considering the importance of the aspects within CPS in the learning of sciences and the compatibility with the outcome of the 2013 curriculum to substantiate the global competition, therefore, further actions during the learning process by emphasizing CPS from various supporting aspects are required.

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