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Students' Cognitive Engagement in Problem Solving and Online Learning

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Abstract.
One indicator of the success or failure of a learning process in the classroom is whether there is an increase in student learning outcomes, which can be seen from an increase in problem solving abilities. Furthermore, in online learning, student involvement is needed to support the learning success. The obstacles of the online learning process can be examined with the involvement of students (cognitive engagement). So, it is very important for lecturers to grow student involvement in online learning activities to achieve learning goals and maximum learning outcomes. By using qualitative research methods and involving two research subjects, this study aimed to determine how involved students are in the online lecture process and the level of students' problem-solving abilities. Interviews and questionnaires were used to collect the data. The results showed that three types of student engagements were found thus far: supportive learning communities, engaging multimedia, and active online discussion forums.

Keywords: cognitive engagement, problem solving, sequences, pandemic

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1. Introduction

Changes are expected to occur as a result of the learning process experienced by students, not only changes in knowledge but changes in attitudes, skills, skills, interests, behavior, and self-adjustment where all of these things lead to student learning outcomes. Student learning outcomes are influenced by various factors which are summarized into two factors, namely internal factors, and external factors. Factors from outside such as the family environment and school environment. While the factors that come from within students are intelligence, interests, talents, emotions, and fatigue. These two factors must work together so that one's learning outcomes are maximized.

In addition, as we have agreed together that there are five abilities that are demanded in learning mathematics, namely: communication skills, connection skills, representation abilities, reasoning abilities, and problem-solving abilities. Conditions in the world today are still facing the Covid-19 virus outbreak which is experienced in almost all countries

and has brought major changes in the field of education. In Indonesia and in other countries, learning is carried out using a distance learning system. Distance learning uses various platforms such as Google Meet, Zoom, and the Learning Management System (LMS) owned by each campus. The obstacles that are often faced by students, especially those who live in areas far from the city, are the availability of an adequate internet signal, availability of electricity, and the readiness of lecturers and students in carrying out online learning. In fact, one of the keys to the success of online learning is student involvement. Why is that? Because with the involvement of students, it is expected that learning can run optimally in order to achieve learning objectives and it is somewhat doubtful how to practice problem-solving skills during online learning.

Student involvement is classified into three dimensions as follows: behavioral engagement, which is a description of the motivational quality of students displayed through learning activities that are inside or outside the classroom that are academic. The second is a picture of positive emotions or emotional engagement displayed by students in learning and assignments they get from lectures, and the third is student involvement in the learning process (cognitive engagement) [1-4].

[5] also believes that one of the three dimensions of engagement, namely emotional involvement, actually refers to relational engagement because it includes the need for acceptance and a sense of belonging to the campus where the student is studying. The cognitive involvement of students is one of the important components in learning, apart from lecturers and teaching materials. Some experts define student cognitive engagement as usually including attention, motivation, and interest. Student cognitive involvement is not only how often students respond, but how the quality of the response is, namely the quality and intensity of participants in classroom activities.

[6] defines student cognitive engagement as the level or degree of attention, curiosity, optimism, interest, and passion. So cognitive involvement is the involvement of students or students during the learning process, not only physically present but their minds are also present following the learning and paying attention, focusing, concentrating, and participating actively [7]. According to research [8], there are six levels of cognitive engagement emerging from research data, as shown in chart 1 below.

Chart 1 six levels of cognitive engagement

The following is a description of each of the above levels:

1. Lurking or non-response-zero or minimal cognitive engagement, where there is personal involvement with course content but no evidence of (hidden) engagement.

2. Agreeing-little cognitive engagement. Express agreement with other students' answers that show some thought, especially when other session participants express ideas, desire to connect with others, cover one's lack of understanding, or so that one's presence can be felt in class.

3. Connecting. The student tries to respond but only bases his answer on personal opinion or experience and thus has no knowledge.

4. Extending. Students answer questions and show interest by asking questions.

5. Expanding. Students answer questions by expanding while also (a) adding fresh ideas to the discussion material, b) applying the concepts learned to new situations, or (c) considering implications in other areas of the material being studied (series).

6. Emancipating. Evidence of mastery of the material is shown by practicing critical thinking and making personal beliefs about the problems at hand. At this stage, students are able to engage in intellectual conflict without fear of being judged badly or disliked by others. This is the highest level of cognitive engagement.

2. Method

Student involvement is an observable behavior consisting of participation and time spent by students on the tasks given by the lecturer. In this study, two students were selected as subjects. In online lectures, lecturers use the Google Meet platform for virtual face-to-face media. During recovery, the lecturer explains the material, followed by throwing a problem that was discussed in the class Google Meet or reversed, namely at the beginning of the lecture the lecturer throws a problem, and students are asked to think of a way out the problem. As we all know, if this is done in offline learning in real classes, then we can see firsthand how the discussion process, the question and answer process, and the process of lecture participants argue. However, because this happens in a virtual classroom, it takes more effort for lecturers to find out whether almost all students focus on lectures, focus on problems presented by lecturers, and whether all students play an active role in thinking about solutions to these problems? Researchers conducted interviews with two selected subjects followed by filling out a questionnaire about cognitive involvement after they worked on the questions given. The question is given after the lecturer delivers the material as an introduction.

3. Result and Discussion

The questions used in this research are as follows:

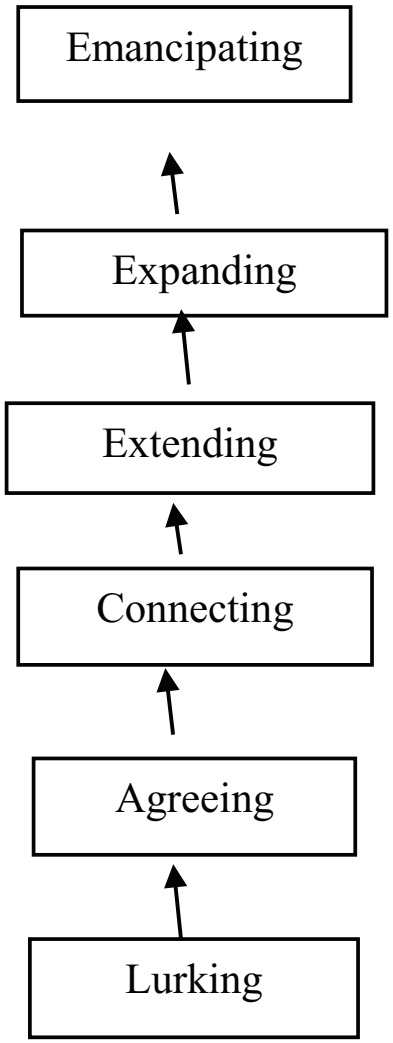

Figure 1: Instrument / question.

After students work individually and while working, students stay in Google Meet, while lecturers wait if there are students who want to ask questions and consult. Furthermore, all students collect their work through the google form. The next stage is the lecturer appoints representatives from students to show the results of their work in front of other participants.

The purpose of this study was to find out how the involvement of students in the online lecture process and how the description of students' problem solving abilities on series material. From the results of the work of the first subject, make finite series and infinite series questions. In fig 2 and fig 3 are the answers from the subject of E1 and it can be seen that the subject did not succeed in making a series of questions of

rank and executing them correctly. But on the second question, E1 managed to make a question and solve it well.

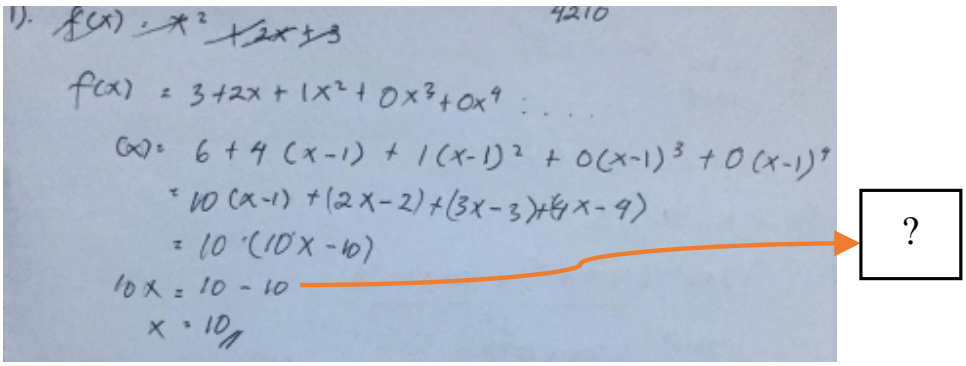

Figure 2: Subject's answer E1 for the first question made..

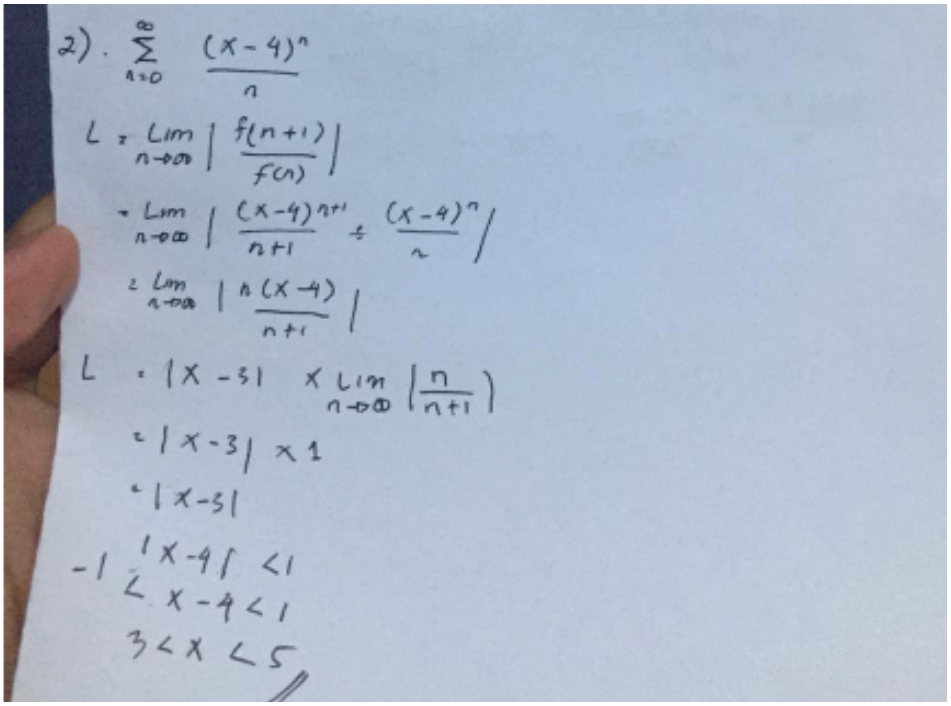

Figure 3: Subject's answer E1 for the second question made.

When interviewed, subject E1 revealed that in working on the first question, the subject was still confused. When asked further about what caused it, E1 explained that during lectures online, the subject felt a lack of awareness causing not participating in online learning followed by focus, lack of interest and doubt about the usefulness of online learning, lack of attendance, lack of personal touch, and lack of interaction due to connectivity issues.

Meanwhile, the subject of E2 gave the correct answer to the first question that was made and was correct in solving it as shown in the following Figure 4.

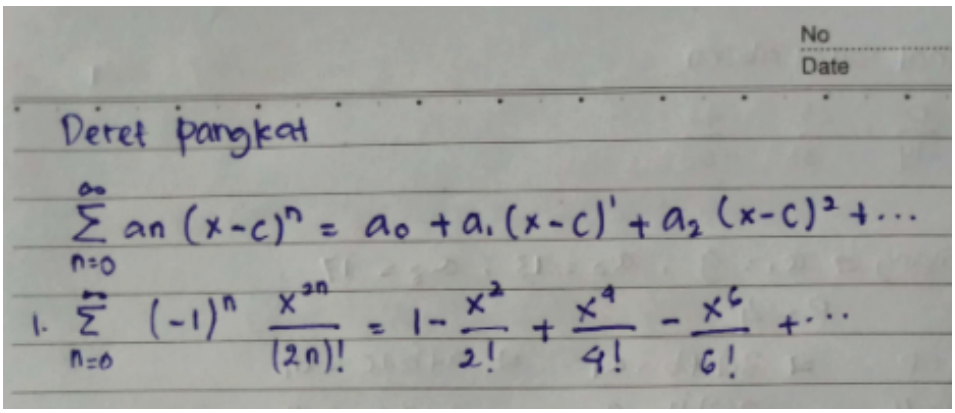

Figure 4: Subject E2's answer to the first question made.

For the second question in fig 5, subject E2 made a mistake when substituting the value of n from n=1 and so on into the numerator of the series formula, resulting in an incorrect solution. As seen in fig 5, if we substitute the value If n=1 then it should be $\frac{x^{2n+1}}{2n+1} = \frac{x^3}{3}$ but what E2′s subject wrote was $x\ \frac{2n+1}{2n+1} = \frac{x^2}{3}$

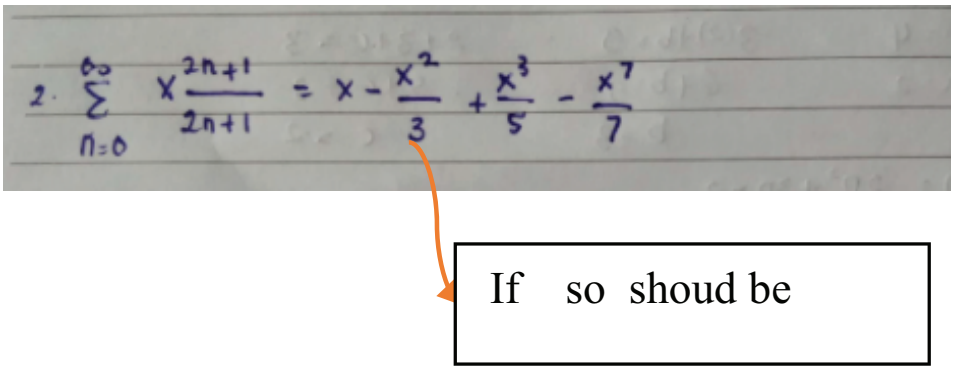

Figure 5: Subject's answer E2 for the second question made.

In addition, the subject of E2 also failed in formula writing. In the interview session, the subject actually wanted to write down the formula:

$$\sum_{n=0}^{\infty} \frac{x^{2n+1}}{2n+1}$$

However E2 writes it with:

$$\sum_{0}^{\infty} x\ \frac{2n+1}{2n+1}$$

When interviewed, subject E2 revealed that during the pandemic students became passive, less creative, and productive; accumulation of information/concepts, so that students feel less useful. This is reinforced by research by [8] which examined the impact of online lectures during the covid-19 pandemic in Indonesia.

This research is based on the definition of cognitive engagement that has been embedded in the introduction where it is stated that students' cognitive involvement is the level or degree of attention, curiosity, optimism, interest, and passion, resulting in the conclusion that students' cognitive involvement during a pandemic includes the following three elements. : supportive learning communities, interesting multimedia (engaging multimedia), an active online discussion forums. This is in line with research conducted by [9-11]. To describe the problem-solving abilities of students on series material during online learning, based on the results of students' written answers and the results of interviews with both subjects, it can be said that subjects E1 and E2 are in the medium category. This is based on the results of research [12] because subjects E1 and E2 meet high criteria for indicators of understanding the problem, sufficient for indicators to design strategies, high criteria for indicators of implementing plans, and high for indicators of checking again.

However, apart from the findings in the field which show more weaknesses in online lectures/learning, there are also positive sides. Online lectures have various impacts on students' abilities which make students' abilities further increase or even decrease, students who prefer independent learning methods will feel more comfortable and easier to understand the online learning system, but on the contrary, students who prefer the learning system by gathering with many people in one room will find it difficult in the process of understanding material, and students who are accustomed to understanding the explanation of the material directly will have difficulty understanding an explanation. In this study, the level of students' cognitive involvement in the series material reached the fourth level, namely extending, at this level students in the class answered questions and showed interest by asking questions. This can be seen in their activities on the task of making questions and solving them with many questions addressed to the lecturer.

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