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MEASURING MATHEMATICAL DISPOSITION IN COLLABORATIVE PROBLEM BASED LEARNING

Ika Ratih Sulistiani
Universitas Islam Malang
e-mail: [1]ika.ratih@unisma.ac.id

Abstract

The purpose of this study is to measure the *ability of students' mathematical disposition* in mathematics learning courses with collaborative problem based learning models in the Online environment. Quantitative approach with descriptive method used by researchers to explain the results of investigation of student math disposition. The subjects of the study were 120 students of Madrasah Ibtidaiyah Fai UnismaTeacher Education. The results showed that the disposition of mathematics students are at a moderate level . Students with a positive disposition towards mathematics learning can understand and express ideas in analyzing mathematical problems. More than 55% of students have a positive attitude towards mathematics learning. There are some faktor that affect the mathematical disposition one of the important is faktor anxiety. The study also suggests that mathematical disposition does not depend on differences in cultural background.

Key words: *Mathematical Disposition, Collaborative Problem Based Learning, Online learning,*

INTRODUCTION

Learning in college is the process of interactive transfer of knowledge and skills between lecturers and students. The process aimstodeliver successful students in work and life through the mastery of various competencies and skills. The competencies and skills required to face the life and world of work in the 21st century include the ability to think critically and problem solving, collaborate, communicate orally and in writing, and innovate (Brandon C. Ledward and Dorothy Hirata, 2011; Trilling & Fadel, 2009). These competencies must be developed integrated with classroom learning and not with individual learning (Boholano, 2017; Saavedra, A and Opfer, 2012).

The problem of quality and achievement of learning outcomes becomes an educational problem today. Trilling & Fadel (2009) reported in his research that college graduates are still incompetent in terms of: (1) oral and written communication, (2) critical thinking and problem solving, (3) working professionally, (4) working collaboratively, (5) using technology, and (7) leadership management. This is similar to Zubaidah (2017) which confirms that problem solving, collaborative, communication and professionalism skills are fundamental problems of college graduates.

Effective learning relates to opportunities to explore, communicate, solve problems, and critical thinking (Asghar et al., 2012; Hmelo-silver et al., 2007). This learning concentrates in many areas that have been integrated with student-based learning approaches including (1) Inquiry learning, (2) project learning, (3) problem-based learning (Alghazo et al., 2013; Asghar et al., 2012; Zubaidah, 2017). Problem-based learning process involves 4C principles namely critical thinking, communication, collaboration and creativity (Reigeluth et al., 1993; Trilling & Fadel, 2009; Zubaidah, 2019). Collaborative problem-based learning is a 21st century learning trend that promotes aspects of problem solving, creativity, group collaboration and communication (Brandon C. Ledward and Dorothy Hirata, 2011; Kwok et al., 2002; Tarmizi & Bayat, 2012; Trilling & Fadel, 2009).

Mathematics is a basic science that contributes greatly and plays an important role in the development of science and technology. To master and create technology, a strong mastery of mathematics is required from an early age. The purpose of mathematics learning is for students to have the ability to appreciate the usefulness of mathematics in life, namely to have curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving (Magliaro et al., 2005). The positive attitude resulting from the study of mathematics is known as mathematical disposition. This is in accordance with the statement *"productive disposition—habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy"* that mathematical disposition is also called productive *disposition*/ productive attitude that considers mathematics reasonable, useful and useful coupled with the belief in perseverance and efficacy itself (Kilpatrick et al., 2001).

Mathematical *disposition* relates to how students view and solve problems; whether confident, diligent, interested, and think flexiblely to explore alternative problem solving strategies. Disposition also relates to the tendency of students to reflect on their own thinking (Forman, 2000). Mathematical disposition assessment is also contained in the affective realm that is the purpose of mathematics education, namely "learners have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving". This shows how important mathematical disposition is in mathematicallearning.

Students' disposition towards mathematics is realized through attitudes and actions in choosing the approach of completing tasks whether done with confidence, curiosity looking for alternatives, perseverance and challenges and the student's space reflects the way of thinking that they do. Reflection is a way of thinking about

what has just been learned or thinking backwards about what has been done in the past. Reflection is a response to a newly received event, activity, or knowledge. Mathematical disposition contains seven components, namely: (1) confident in using mathematics, (2) flexible in doing mathematical work (mathematics), (3) persistent and tenacious in doing mathematical tasks, (4) have curiosity in mathematics, (5) reflect on the way of thinking, (6) appreciate mathematical applications, and (7) appreciate the role of mathematics.

According to Maxwell (2001), disposition consists of (1)*inclination* (tendency), namely how students behave towards tasks; (2 *) sensitivity,* namely how students readiness in facing the task; and (3) *ability* (ability), namely how students focus on completing the task completely; and (4)*enjoyment* (pleasure), namely how students behave in completing the task.

The student's mathematical disposition is said to be good if the student likes the problems that are challenges and involves himself directly in finding / solving problems. In addition, students feel themselves experiencing the learning process when completing the challenge. In the process students feel the emergence of confidence, hope and awareness to look back at the results of thinking. Mathematical Dispositions include: 1) belief in using mathematics to solve problems, to communicate ideas, and to provide reasons; (2) flexibility in investigating mathematical ideas and trying to find alternative methods of solving problems; (3) diligently to do math tasks; (4) have interests, curiosities, and meet-ups in doing mathematical work; (5) tendency to monitor and reflect their own performance and reasoning; (6) assess the application of mathematics to other situations arising in mathematics and daily experience; (7) appreciation of the role of mathematics in culture and values, both mathematics as a tool, and mathematics as a language.

(Kilpatrick et al., 2001) states that students' mathematical dispositions develop as they study other aspects of competence. For example, when students build *strategic competence* in solving non-routine problems, their attitudes and beliefs as a learner become more positive. The more concepts understood by a student, the more convinced that mathematics can be mastered.

Conversely, if students are rarely given challenges in the form of mathematical problems to solve, then they tend to memorize the problem solving that has been learned rather than follow the proper ways of learning mathematics. This causes students to start losing their confidence as learners when they fail to solve new questions given by teachers. When students feel themselves capable or good at learning mathematics and use it in problem solving, they can develop their

skills using adaptive procedures and reasoning. Thus the disposition of student mathematics is a major factor in determining the success of their education.

From the description above, it can be concluded that mathematical disposition is an aspect related to problem solving skills in mathematics learning. The mathematical disposition contains seven components, namely: (1) confidence in using mathematics, (2) flexible in doing mathematical work (mathematics), (3) persistent and tenacious in doing mathematical tasks, (4) having curiosity in mathematics, (5) reflecting on the way of thinking and performance in oneself in learning mathematics, (6) appreciating the application of mathematics, and (7) appreciating the role of mathematics / opinions on mathematics (Kalambouka et al., 2016; NCTM, 2000).

This study measuring the mathematical disposition of prospective teachers during collaborative problem-based mathematics learning lectures with an online environment setting. Considering the immediate and long-term impact of positive advances related to technology integration, the findings will appeal to Educators and teacher training institutions.

METHOD

This study uses quantitative approach in the form of surveys. This study uses cross sectional design to determine the self-regulation of students of level 3 of Madrasah Ibtidaiyah Teacher Education Study Program at The Islamic University of Malang. Cross - sectional design is used to collect data about their attitudes, opinions, beliefs. The research population is all students of madrasah ibtidaiyah teacher education which amounts to 240 students. Then 120 students were taken using random sampling technique which means that all members of the population have the same opportunity to be selected as samples.

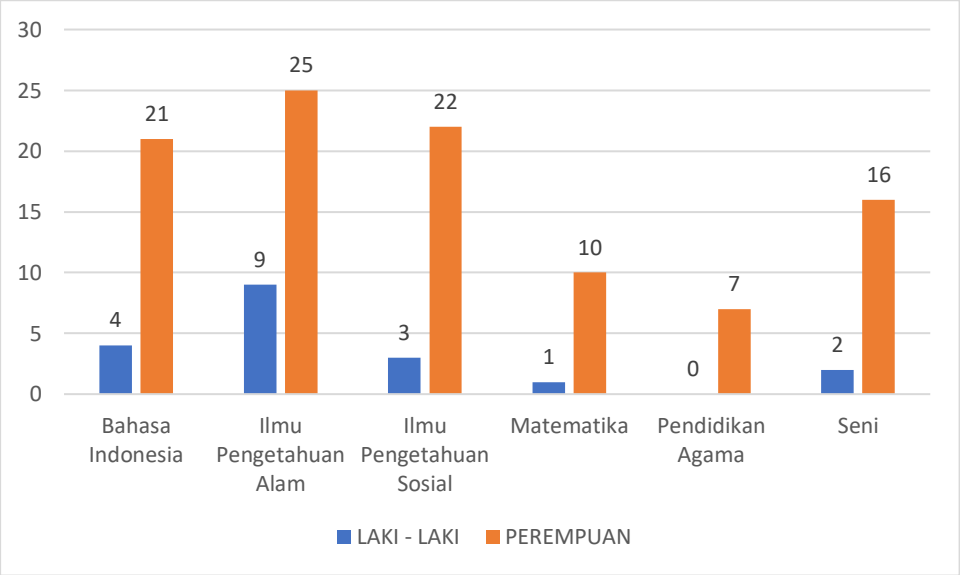
The survey in this study was conducted by collecting information about mathematical disposition using questionnaires. Questionnaires contain a number of questions about students' attitudes and beliefs in looking at and solving math problems in *a collaborative problem based learning*environment. The questionnaire consists of 30 items using a 5-point Likert scale, which consists of strongly agreeing, agreeing, doubting, disagreeing,and strongly disagreeing. Answers never show the lowest points (1), while answers always show the highest points (5). survey in research using The Mathematics Dispositional Functioning Inventory (MDFI) which is specifically designed to measure mathematical dispositions as described by Beyers (2011). There are three categories measured using MDFI, namely, the disposition of Conatif, Cognitive, and Affective to mathematics.

No	answer	POSITIVE SCORE	NEGATIVE SCORE
1	Strongly Agree	5	1
2	Agree	4	2
3	Doubt – Doubt	3	3
4	Disagree	2	4
5	Strongly Disagree	1	5

Table 1. Questionnaire Answer Level Score

RESULT AND DISCUSSION

a. Demographic Description



Graph 1. Demographics of student profiles by Gender and Field of Interest

Based on the results of demographics mathematical disposition shows that the number of male students as many as 19 students with criteria in the field of interest in Bahasa Indonesia as many as 4 students, The Field of Natural Sciences as many as 9 Students, The Field of Social Sciences as many as 3 students, Mathematics as many as 1 student, the field of Religious Education as many as 0 students,and the field of art as many as 2 students. The number of female students as many as 101 students with criteria in the field of interest in Bahasa Indonesia as many as 21 students, the field of Natural Sciences as many as 25

students, the field of Social Sciences as many as 22 students, the field of mathematics as many as 10 students, the field of religious education as many as 7 students,and the field of art as many as 16 students.

b. Student Mathematical Disposition Profile

Confidence

At a time when students are showing high anxiety at the time of cognitive disposition function, most of the other students' responses indicate that they have confidence that they can gain more and become more accomplished in mathematics if they persist and try harder to understand new mathematical concepts that may be needed to solve a math problem. Interestingly, however, the student's response to the item (10) from the questionnaire revealed that they had given up trying to solve or understand some math problems or ideas in their math class.

		Strongly agree (5)	Agree (4)	Doubt – doubt (3)	Disagree (2)	Strongly disagree (1)
1.	I felt I wouldn't understand math, even though I made a lot of effort to learn it.	18%	58%	20%	2%	3%
2.	If I can't solve a math problem quickly, then I may not be able to solve it even if I've tried hard	13%	10%	33%	35%	23%
3.	I'll be able to solve math problems, if I keep trying	7%	49%	23%	13%	8%
4.	I'm sure my math scores remain low even though I study hard	18%	61%	20%	2%	0%
5.	I realized I wasn't talented in math	15%	63%	20%	3%	0%
6.	I'm afraid my weaknesses in maths are known to my friends	17%	63%	18%	3%	0%
7.	I feel ashamed when I get bad math scores	12%	67%	20%	2%	0%

Table 2. Responses to questions related to the disposition of the contingency

Cognitive Disposition

On cognitive disposition, student responses to questionnaires related to dispositional function against mathematics varied. Table 3 shows that students' answers to mathematical disposition questionnaire questions; cognition function assesses its connection and argumentation function. The data revealed that students' responses about making connections were somewhat evenly distributed

on "agree" and "disagree" responses; however, the data showed that students did not engage or participate in mathematical reasoning, justification, or discussion when they were not asked. This is an indication of students' anxiety when solving mathematical problems, as well as the lack of confidence in their mathematical abilities. A more detailed analysis of participants' anxiety about mathematics will be given in the next section (see table 4).

	Strongly agree (5)	Agree (4)	Doubt – doubt (3)	Disagree (2)	Strongly disagree (1)
8. When I'm dealing with math problems, I try to connect how they relate to other problems in math	15%	62%	22%	2%	0
9. I always try to see how the problems / concepts - concepts / ideas - mathematical ideas in different classes are connected to each other	14%	56%	28%	3%	0%
10. I try to see how problems / concepts / concepts / ideas - mathematical ideas have to do with other non-math classes	11%	61%	27%	2%	0%
11. I try to see how problems / concepts - concepts / ideas - mathematical ideas in one class are connected to each other	18%	62%	19%	2%	0%
12. I use mathematical reasoning and proof to explain how I solve problems in maths even though I was not asked	20%	58%	19%	2%	0%
13. I try to develop and evaluate mathematical arguments to explain problem solving in math class even though I am not asked	13%	58%	28%	3%	0%
14. I'm trying to justify a statement I made in math class	15%	64%	18%	3%	0%

Table 3. Responses to questions related to cognitive disposition

Affective Disposition

Students' responses to the questionnaire related to affective disposition revealed that most of the students showed good attitudes towards mathematics; as much as 75 percent gave a response saying that they "like doing math," while the response to a statement related to "I don't like math in lectures is only 25 percent. The next response relates to students who have never liked math lectures by 6%, lectures what is done is boring by 27%, and the last response relates to students

liking solving math problems during their lectures by 73%.(See Table 3) Furthermore, the responses related to the Self-Concept subfunction showed that 50% of students stated "I am very good at math", and 70% of students believed that they were capable of learning mathematics when they were taught step by step problem solving techniques.(See Table 4) On the other hand, most of the students reported that they were not good at math in their secondary school years, which further emphasizes the difficulties they face when ika learns various ways to solve problems, or problems that require a high level of thinking. and cognitive skills.

However, in the anxiety function, based on the results of filling in the data by students, it shows that students will consistently feel frustrated when they face various math problems. more than 53 percent of students are frustrated in math class while 33 percent feel frustrated when dealing with math tests. As many as 43 percent of students feel frustrated when making math tests compared to other tests based on data owned by student respondents who do not experience frustration when doing math by 28 percent. This is because the experience factor during mathematics learning is an important factor that can affect the position of students in mathematics.

	Strongly agree (5)	**Agree (4)**	**Doubt – doubt (3)**	**Disagree (2)**	**Strongly disagree (1)**
15. I love doing math with an environment outside of lectures	13%	63%	23%	3%	0
16. I don't like doing math in lectures	13%	12%	23%	42%	10%
17. I've never liked maths courses	4%	2%	27%	23%	44%
18. The math courses I follow are boring to me	18%	9%	19%	45%	10%
19. I love working on math problems during my studies	15%	58%	19%	5%	2%

Table 4. Responses to questions related to attitude functions

	Strongly agree (5)	**Agree (4)**	**Doubt – doubt (3)**	**Disagree (2)**	**Strongly disagree (1)**
20. I am good at maths	17%	40%	35%	5%%	3%
21. Maths courses are challenging for me to understand them well	15%	65%	15%	2%	3%
22. I have no trouble understanding concepts in mathematics	1%	12%	27%	20%	40%
23. I easily understand The Steps – Steps to work on math problems/ problems	14%	55%	23%	8%	0%

24. There are "mathematical talents" that make some people better at math than others.	25%	48%	21%	2%	1%
25. In the pekuliahan, I am very good at mathematics	18%	50%	12%	15%	3%

Table 5. Responses to questions related to the function of self-concept

	Strongly agree (5)	**Agree (4)**	**Doubt – doubt (3)**	**Disagree (2)**	**Strongly disagree (1)**
26. I'm not stressed when doing maths outside of lectures	17%	11%	29%	25%%	17%
27. I get frustrated when I have to take a maths exam	15%	18%	45%	19%	3%
28. I get frustrated when I have to do any test	20%	23%	37%	15%	5%
29. I would be even more frustrated when I have to take a math test than any other type of test	18%	25%	33%	8%	6%
30. I get frustrated when I have to do math in math class	25%	28%	31%	14%	2%

Table 6. Responses to questions related to Anxiety function

The purpose of this study is to investigate the disposition of students during mathematics learning lectures with collaborative problem based learning models in an online learning environment.

The results showed that the disposition of students during mathematics learning lectures with collaborative problem based learning models in the online learning environment generally falls into the moderate category, and the acquisition of mathematical disposition scores is strongly influenced by the level of student anxiety in dealing with problems in mathematics learning. The findings of this study are in line with research conducted in Saudi Arabia and the United Kingdom by (Alghazo et al., 2013; Hall, 2016) which shows that the results of mathematical disposition are more influenced by previous math learning night and mathematical disposition is not influenced by differences and cultural factors.

Diverse learning and various representations of mathematical ideas are very emphasized concepts in preparing students to become professional teachers. In addition, the Implementing Institute of Teacher Education Program is important to focus on the attitude of teachers and also their influence on their mathematical disposition of mathematics. Recent research has revealed that teachers who have low levels of anxiety in mathematics have a significant influence on students' attitudes towards math learning especially in relation to improving academic

achievement and asking for math learning (Njiku et al., 2020). Epstein &Miller (2011) further reveals the importance of teacher education institutions in developing student-centered learning programs and producing teachers who have knowledge of mathematical concepts and mathematical dispositions so that they can develop math teaching.

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