

Interaction between Students and Mathematical Contents in Learning Mathematics

Interaction in mathematics learning activities is needed. One of them is students' interactions towards math content. This study underlines the importance of teachers to develop interactions in mathematics learning. This study aims to explore students' interactions towards math content that can help students to comprehend mathematics. This research is a qualitative research with a phenomenological approach. This research was conducted to 29 eighth graders of SMPN 2 Tumijajar. The results of this study are the interactions between students and mathematics content in learning that help students understand mathematics, a) student interactions towards mathematics content by taking notes, b) paying attention to mathematics, c) reading mathematics, d) working on math problems. Teachers are expected to pay more attention to interactions between students and math content to improve student understanding. Teachers are expected to pay more attention to interactions between students and math content to improve student understanding. The next researcher must delve deeper into each of the impacts of these interactions

Keywords: Interaction, students, mathematics content

Introduction

The interaction between students and mathematical content involves students and mathematical content. Students are subjects in learning and mathematics content as learning objects. The mathematical content referred to in this study are all stimuli encountered during the learning process. Thus, mathematical content includes knowledge of mathematics subject matter that students must learn, activities with mathematics content and everything about the instruction of existing subject matter knowledge including teaching activities and input from teachers and peers in teaching (McLaughlin et al., 2007).

Student engagement towards content is students' cognitive interaction to challenging subject matter knowledge (material content knowledge) through activities that must construct the mental processing necessary for learning (occasion for processing) and that students are capable (physiological readiness) and willing (motivation) to perform (McLaughlin et al., 2007). The interaction between students and math content involves students and the math content itself. Students are subjects in learning and mathematics content is as learning object. Mathematical content includes knowledge of mathematics subject matter that students must learn, activities with math content and

1 everything about the instruction of existing subject matter knowledge including
2 teaching activities and input from teachers and peers in teaching (Koçak et al.,
3 2009).

4 Content offers knowledge and activities that help students interact to
5 subject matter successfully. It also offers stimuli from teachers, fellow students,
6 instructional activities, and instructional settings that influence students'
7 motivation and other aspects of students' readiness to interact successfully to
8 subject matter knowledge. Engagement, within the framework of student-
9 content engagement, refers to forms of cognitive interaction between students
10 and instructional content (McLaughlin et al., 2007).

11 Participation can be attending school or discussions, comparing new
12 information to previous insights, and practicing a bunch of facts. In this
13 condition, instructional content is a lecture or discussion, new information, or a
14 collection of facts; the engagement describes how students and instructional
15 content interact. Engagement describes the aspects of instructional content with
16 which students interact and how, in cognitive terms, those interactions occur.
17 The term of student-content engagement defines three categories in which all
18 influences on learning can be ranked; Students, instructional content, and two
19 both engagement (McLaughlin et al., 2007).

20 The interaction between students and class content involves each student's
21 implicit or explicit estimation of the relevance of the content to them. In
22 general, the more students perceive class content to be personally relevant to
23 them, the more possibility they engage to it. A study noted that there are three
24 ways classroom content may be relevant to students: relevance to someone's
25 current interests, relevance to someone's future goals, and relevance to
26 someone's identity or sense (Corso et al., 2013).

27 The interaction between students and learning content need to be applied
28 well in learning. Unfortunately, in reality there is still learning that does not pay
29 attention to the form of interaction between students and content. Teachers do
30 not pay much attention to the importance of interaction between student-
31 learning content and tend to focus only on teacher-student and student-student
32 interactions. Even though based on the theory previously explained, the
33 interaction between students and mathematics content also has a lot of
34 relationship to students' understanding about learning material.

35 The interaction between student-learning content has a lot of relevance to
36 students. This relevance has many benefits for students' knowledge
37 development in learning. The interaction between students and learning content
38 needs to be explored, what kind of interactions need to be developed in
39 learning, especially in mathematics learning. Thus, educators can apply these
40 interactions in their learning activities.

41 The interaction between students and mathematics content is an interaction
42 that occurs when they learn mathematics. It occurs in one direction, more in the
43 form of mathematics students' attitudes or actions. The actions are taken by
44 students towards mathematics when they learn. This study seeks to explore

1 interactions between students and mathematics content that help students to
2 comprehend mathematics.

3 4 5 **Method** 6

7 This study aims to explore and investigate the interactions that occur in
8 mathematics learning. Interaction in the learning process is between students
9 and mathematics content in understanding mathematics. Mathematics
10 comprehension in learning process can be seen in students' work results and
11 learning evaluation. Interactions in learning that help students understand
12 mathematics were explored through observation, interviews and
13 documentation. The interaction that occurs as an experience experienced by
14 students was observed in detail and strengthened through interviews and
15 documentation. Furthermore, these experiences were interpreted as forms of
16 interaction in understanding mathematics.

17 This is a qualitative study applying the phenomenological method. The
18 analysis used in this study is used phenomenologi data analysis from
19 (Moustakas, 1994); (Nurdin, Ismail & Hartati, 2019):1) Consider each
20 statement with respect to significance for description of the experience, 2)
21 Record all relevant statements, 3) List each nonrepetitive, nonoverlapping
22 statement, 4) Relate and cluster the invariant meaning units into themes, 5)
23 Synthesize the invariant meaning units and themes into a description of the
24 textures of the experience, 6) Reflect on your own textural description, 7)
25 Construct a textural-structural description of the meanings and essences of your
26 experience.

27 The validity of the data in this study consists of credibility or internal
28 validity with the triangulation method. Data triangulation was done by
29 collecting then combining, cross-checking the data that had been obtained
30 through observation, interview, and documentation techniques. Transferability
31 or external validity, and dependability or reliability, dependability is done by
32 conducting an audit of the entire research process that has been carried out.

33 34 35 **Results and discussion** 36

37 The data of this research were obtained through observation, interviews
38 and documentation. After analyzing data, this study found out the interactions
39 of students towards mathematics content. Those interactions involve students
40 and the math content itself. Students are subjects in learning and mathematics
41 content is as learning object. The mathematics contents in this study are all
42 stimuli encountered during the learning process. The content offers
43 mathematical knowledge and activities that help students interact with subject
44 matter (McLaughlin et al., 2007).

1 Student interaction to math content is students' activities on math material
2 in order to understand mathematics. Those activities were observed by
3 researchers during observations in mathematics class. In this study, the
4 researcher observed, recorded and selected the activities carried out by
5 students. Furthermore, the researchers confirmed the findings to the previous
6 theory or research.

7 8 **Taking Mathematics Notes**

9
10 Based on the results of previous studies, it can be seen that taking notes
11 can help students understand mathematics. Taking notes is important as
12 students' process in learning mathematics. This activity can also improve
13 students' math performance. Although learning prioritizes discussion activities,
14 presentations, and observations, note-taking activities still need to be
15 considered in learning mathematics because of many benefits obtained from
16 these activities. Teachers are expected to always remind students to take notes
17 so that they can be used for learning after learning in class is over. Teachers are
18 also expected to guide students in making notes.

19 Taking notes is the practice of recording information taken from other
20 sources. By taking notes, the writer records the main information. Taking notes
21 plays an important role in learning and cognitive (Mosleh et al., 2013).
22 Recording in a cognitive image, cognitive learning is a learning style that stems
23 from the concept that people learn by paying attention to what others do, learn
24 by using their reason, intuition, and perceptions, learn to acquire knowledge
25 from listening, watching, touching, or experiencing (Mosleh et al., 2013).

26 Research conducted by Haydon (Haydon et al., 2011) shows that using
27 guided notes has a positive effect on student outcomes. Furthermore, another
28 research (Birria, 2010) concluded that taking notes positively affects students'
29 academic achievement, there is a strong bond between note-taking strategies
30 and cognition and / or metacognition, note-taking positively affects students'
31 academic achievement, notes is effective for students' learning.

32 Crawford (Mosleh et al., 2013) said that students who took notes showed a
33 positive impact on their test performance. In addition, other studies such as Di
34 Vesta and Gray, Fisher and Harris, Kenneth A Kiewra, Kiewra (Mosleh et al.,
35 2013) confirm Crawford's findings that taking notes helps students to
36 remember recorded information and to perform well on exams relating to that
37 information. They determined that the notes could be used later for study or for
38 other review tasks as external memory enhancers. Note-taking can serve as an
39 external storage function because it builds a repository of information for later
40 review and additional cognitive processing (Mosleh et al., 2013). In addition,
41 taking notes during reading material requires less cognitive effort than taking
42 notes during learning

43 Note-taking has many benefits, however, in taking notes students need
44 teacher's assistance so it can be well organized and have a positive impact on
45 student performance. Research shows that instructors can help students

1 improve their note-taking skills (Cardetti et al., 2010). Research states that
 2 note-taking with instructions can have a positive effect on learning process
 3 (Wetzels et al., 2011). Good notes are the important goals for students
 4 (Titsworth, 2004), so that students can take advantage of these notes.

5 Taking notes is important to do, the importance of taking notes are as
 6 follow (Mosleh et al., 2013): a) Taking notes helps to record information and
 7 documents, b) Taking notes supports efficient processing and understanding of
 8 information, c) Taking notes makes students more focus and improves
 9 concentration, d) Taking notes helps students think, e) Taking notes organizes
 10 information, f) Taking notes helps students memorize and remember, g) Taking
 11 notes improves learning and students' achievement.

12 Research conducted by (Dündar, 2015) states that making mathematics
 13 notes is important in terms of form and process. In another hand, a study by
 14 Swenson (Swenson, 2018) aims to show how to implement note-taking
 15 strategies to improve students' performance. The results showed that the note-
 16 taking strategy improved students' performance appraisals in mathematics
 17 learning. Many students stated that they liked the way notes were organized.

18 19 **Paying Attention to Mathematics**

20
21 One of the interactions that students make towards math content is paying
 22 attention to math material. In the research class, it was seen that students paid
 23 attention to the material presented by the teacher. Students paid attention to the
 24 material, paying attention to the discussion of examples of math problems and
 25 paying attention to math assignments. But there were also some students who
 26 did not pay attention because they looked around the class

27 Paying attention to mathematics is the first step which students take in
 28 learning mathematics. This is a students' activity when learning mathematics.
 29 Attention is a form of student's interest in something. Starting from an interest,
 30 students began to pay attention and then began to study mathematics. Paying
 31 attention to mathematics needs to be emphasized to students. If students do not
 32 pay attention to mathematics during learning, it will cause difficulties for
 33 students in understanding mathematics

34 When students give their attention on a certain stimulus, they are more
 35 easily aware of the goals to be achieved, and aware of what they are paying
 36 attention to. Attention makes students easier to choose and learn information
 37 (Cicekci & Sadik, 2019). Therefore, attention is emphasized as a mechanism to
 38 initiate learning (Ainley & Luntley, 2007; Chen & Huang, 2014; Cicekci &
 39 Sadik, 2019)

40 The research conducted by (Gunesch, 2015) suggests to study about
 41 attention specifically in mathematics learning. The study concluded that
 42 attention affects students' understanding of mathematics learning. Structured
 43 attention is very important for what can be considered, and what can be
 44 learned. Attention at all times is structured according to the degree and degree

1 to which wholeness, distinction-making, relationships, properties, or properties
2 that define axioms as the focus (Mason, 2003).

3 The effect of attention during learning on student understanding was
4 strong, especially when learning mathematics. The teacher's attention had an
5 important role in learning activities. Based on the theory, it is revealed that it is
6 impossible to learn information processing without attention. Social learning
7 theory states that humans can learn through direct observation and experience.
8 According to Sternberg (2006) conscious attention is processing a small
9 amount of information from a large amount of information available.
10 According to the American Heritage Dictionary, information can be said to be
11 knowledge obtained from learning, experience, or teaching. Information is
12 obtained from sensing, memory and other cognitive processes. The process of
13 paying attention helps to efficiently use limited mental resources which helps to
14 accelerate reactions toward certain stimuli. Humans' limited mental resources
15 to process a stimulus need assistance to get reflexes faster. Directing specific
16 information will accelerate the mental stimulation process (Muksar, 2016).

17 18 **Reading Mathematics**

19
20 Reading is a form of student's interaction to mathematics. Reading is the
21 interaction between the reader and the text. Aquino states that the reader
22 constructs the meaning of the text by guessing and predicting the next text
23 based on the reader's previous knowledge of the text and the world (Imam,
24 2016). Students read material in printed books, in notebooks and presentations
25 written by the teacher on the blackboard. Reading is one of the students' efforts
26 to understand the content being discussed.

27 In the research class, students were seen reading when the teacher asked
28 them to read. The teacher always invited students to read the material to be
29 studied in advance. The teacher asked students to read so that they had an
30 overview of the material to be discussed. Because students' prior knowledge is
31 essential in learning process, the teacher also reminded the students to read
32 again after the discussion was finished.

33 Reading text is a crucial skill in the modern world (reading internet
34 material, literature, textbooks, etc.). However, it is possible that many students
35 cannot read mathematics textbooks to understand (Berger, 2019). Reading is an
36 important skill, unfortunately in reading mathematics, students have many
37 difficulties. This happens because mathematics consists of many symbols and
38 signs that are difficult to understand.

39 Reading skills are needed to understand mathematical texts (Imam, 2016).
40 Reading in mathematics learning can have a more radical impact, as it can
41 contribute to the redefinition of what it is to understand and study mathematics
42 (Borasi & Siegel, 1990). Applying reading and writing mathematics as a task
43 gives students many advantages. Reading and writing in mathematics classes
44 will have more concrete understanding of concepts and be able to study
45 alternative situations (Bosse & Faulconer, 2008).

1 In addition, reading provides opportunities for students to practice
2 extracting mathematical content from a work (Caputo et al., 2015).
3 Mathematics is full of signs and symbols; therefore, students have to read a lot
4 of mathematics to understand them. Research conducted by Osterholm
5 (Österholm, 2006) concluded that there is a need for a more explicit teaching of
6 reading comprehension for texts including symbols. A study also states that
7 students have difficulty understanding mathematics. So, the researcher
8 suggested a special reading strategy that could help students understand
9 mathematics (Shepherd et al., 2009).

10 Mathematics is the language of order, and reading mathematics requires
11 one to pay attention to several principles that guide how reading must be
12 performed if accurate interpretation, understanding, and communication are to
13 be produced (Adams, 2003). In understanding mathematics reading skills are
14 needed by students. Through reading students can understand and interpret
15 mathematics.

16 Students develop goals for communicating mathematically through words,
17 symbols, and numbers. Teaching that helps students see mathematics as a tool
18 for solving problems, participating in recreation and other fun activities, and
19 understanding the world as seen by students is instruction that motivates
20 students to read mathematics (Adams, 2003).

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22 symbols, and numbers. Teaching that helps students see mathematics as a tool
23 for solving problems, participating in recreation and other fun activities, and
24 understanding the world as seen by students is instruction that motivates
25 students to read mathematics (Adams, 2003).

26 Reading mathematics is someone's attempt to apply mathematics. The
27 words, symbols, and numbers that give discipline to attitude, framework, and
28 power are the same as words, symbols, and numbers that students must use to
29 communicate ideas, perform procedures, explain processes, and solve
30 problems. Therefore, someone who knows mathematics is a mathematician,
31 and a mathematician is a math reader (Adams, 2003).

32 Through reading students know the vocabulary in mathematics. Monroe
33 and Orme as quoted by Miller and many educators stated that the key
34 component in understanding Mathematics is learning vocabulary, without
35 understanding the vocabulary that is used routinely in teaching mathematics,
36 textbooks, and word problems, students become disabled in their efforts to
37 learn mathematics (Imam, 2016). Once the importance of reading and
38 understanding mathematics, researchers state that students become disabled,
39 which means that students will have difficulty understanding mathematics. This
40 happens because mathematics consists of many vocabulary symbols if students
41 do not read then they will not understand mathematical symbols and in the end,
42 they will not understand mathematics as a whole.

43 Many studies believe that students learn mathematics through reading
44 mathematics. Students learn mathematics more effectively and deeply when
45 reading and writing is directed towards learning mathematics (Bosse &

1 Faulconer, 2008). Reading and writing are integral activities in the learning
2 process/as well as learning mathematics. When students write, students must
3 first read the material to be written. Reading is a form of basic student activity
4 in understanding mathematics.

5 More deeply, researchers argue that reading is an active process of
6 meaning making in which readers use their knowledge of language and the
7 world to construct and negotiate interpretations of texts (Dewitz & Dewitz,
8 2003; McNamara, 2004). The idea of reading shifted from simply moving the
9 eye across pages of written symbols and translating these symbols into spoken
10 words, to the idea of reading as a way of thinking and learning (Draper, 2002).
11 Seeing the importance of reading, researchers consider reading as a person's
12 way of thinking and learning.

13 Mathematics is the language in which people communicate, solve
14 problems, and create works of art and art tools. It is a language of words,
15 numbers and symbols that are sometimes interrelated and interdependent and
16 sometimes unrelated and autonomous (Adams, 2003). The words, terminology
17 and vocabulary used in mathematics are key factors in the communication
18 process with mathematics. The National Council for Mathematics Teachers
19 argues that knowing mathematics is doing mathematics (1989). In other words,
20 knowing mathematics means being able to apply mathematics. Doing math
21 requires reading math. The words, symbols, and numbers that give discipline to
22 its sub-attitudes, framework, and power are the same words, symbols, and
23 numbers students should use to communicate ideas, perform procedures,
24 explain processes, and solve problems. Therefore, someone who knows
25 mathematics is a mathematician, and a mathematician is a reader (Adams,
26 2003).

27 The interaction of students to math content in the form of reading
28 mathematics is very important. Teachers should invite students to read
29 mathematics such as reading words, numbers, and symbols so they can reveal
30 messages from and about mathematics. Reading is like a trifle, but if it's
31 explored more, it can provide numerous benefits. Teachers are expected to pay
32 more attention to the reading process of students in order to know whether the
33 student is really reading and gaining understanding or just reading without
34 understanding.

35 36 **Working on Problems as Mathematics Task**

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38 The next interaction is working on math problems. In learning
39 mathematics, it cannot be separated from the activity of working on problems.
40 Most of the activities in learning mathematics are working on problems,
41 solving math problems and discussing them. This activity is carried out in order
42 to train students to solve math problems. The more often students work on
43 questions, the more students understand and are familiar with mathematics.
44 The questions were given in the form of individual assignments, group
45 assignments and homework.

1 The results showed that students were often invited to practice doing the
2 questions by the teacher. The teacher gives an example first, then they discuss
3 about the answer, after that teacher asks students to work on the questions in
4 groups. After this session is over and the result has been discussed, the teacher
5 gives individual questions. Then the teacher gave some questions as homework
6 as a students' learning instrument at home. If all materials have been discussed,
7 the teacher would provide a test. Students showed quite satisfying results.
8 Students who diligently work on problems while learning mathematics get
9 satisfactory results.

10 The researcher perceived the interaction between students and mathematics
11 content in the form of working on math problems to be an interaction that helps
12 students understand mathematics. Working on math problems can train and
13 strengthen students' understanding of the material. Research conducted by
14 (Ildikó & Tibor, 2013) discusses the use of interactive math tasks in teaching
15 mathematics. The study concluded that practicing task is beneficial for students
16 and its effectiveness in education. Hiebert & Wearne (Watson & Mason, 2007)
17 said that what students learn is largely determined by the tasks given to them.
18 This statement shows that managing assignments in learning provides great
19 benefits for students to understand the lesson.

20 Mathematics assignments have important benefits in learning. According
21 to research conducted by (Clarke et al., 2014), it is said that mathematics
22 assignments are chosen by teachers to realize learning objectives. Problems and
23 tasks bring many advantages into teaching mathematics, which contribute to
24 increasing student success (Clarke et al., 2014). Research conducted by (Ildikó
25 & Tibor, 2013) states that math assignments provide many advantages in
26 increasing students' achievement. Thus, if students work on math tasks more
27 often, they will gain better understanding of mathematics. Because the more
28 often they do math assignments, the more students understand mathematics.
29 Students will find it easy to solve problems because they are used to doing
30 math problems.

31 Understanding the meaning of math assignments delivered by the National
32 Council of Teachers of Mathematics, mathematics assignments are the core of
33 learning mathematics. Giving mathematics assignments is an exercise to
34 improve students' understanding and abilities in mathematics. The more often
35 students do math assignments, the more skilled their abilities will be and they
36 will be more experienced. Students' interactions toward mathematics are
37 mediated by artifacts, such as math assignments (Rezat & Sträßer, 2012). The
38 function of mathematics assignments as a tool to facilitate students' learning
39 leads us to further recognition that the use of instruments, tasks, fundamentally
40 affect the nature of the activity being facilitated, namely student learning
41 (Clarke et al., 2014). Based on this statement, it is known that mathematics
42 assignments are instruments to facilitate students' learning. Mathematics
43 assignments facilitate students' interaction to mathematics. Providing math
44 assignments has implications for students' activities in learning mathematics.
45 By the existence of mathematics assignments, students are active in learning

1 mathematics. They try to do it, look for the right way to solve problems and
2 convey their ideas.

3 The interaction between students and mathematics content in the form of
4 doing math problems or assignments is an interaction that helps students
5 understand mathematics. This interaction is considered as an interaction that
6 can help students understand mathematics and train students' skills in solving
7 math problems.

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10 Conclusion

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12 This research aims to explore information about interactions in
13 mathematics learning. The interactions that were explored were interactions
14 between students and mathematics content. Research attempts to explore
15 interactions between students and mathematics content that can help students
16 understand mathematics through observation, interviews, and documentation.
17 Based on the results of research and discussion, this study concludes that there
18 are interactions between students and math content that can help them to
19 understand mathematics, namely, a) taking notes on mathematics, b) paying
20 attention to mathematics, c) reading mathematics, d) working on math
21 problems. Those interactions are activities that we often hear about in learning.
22 Researchers hope that mathematics educators will pay more attention to them.
23 Those interactions seem normal, but they are so beneficial for students.
24 Educators can apply appropriate strategies in learning and still pay attention to
25 interactions between students and mathematics content.

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Teachers are expected to pay more attention to interactions between
students and math content to improve student understanding. Teachers are
expected to pay more attention to interactions between students and math
content to improve student understanding. The next researcher must delve
deeper into every impact of the interaction between students and mathematics
content on students' understanding of mathematics.

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