The analysis of mathematics with ATLAS.ti

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Abstract. The teacher is one of the important factors in a good teaching and learning process. A teacher is required to have qualified cognitive and pedagogical abilities, so that he/she is creative in everything, including problem posing. Many studies discussed the problem of students’ ability but not many discussed the problem of teachers’ ability itself. This study used ATLAS.ti software as a tool for data analysis. ATLAS.ti software assisted researchers to manage all various data. The research was conducted on prospective teachers in one private institution. Observations and tests were conducted on 40 respondents, while only 6 respondents were involved at the time of the phase, namely interviews. Through ATLAS.ti software, the result showed that the problem posing skill of prospective teachers was still far from enough. What is needed is the right action to overcome the problem.

1. Introduction

It is essential that we know the development of mathematics in our country. This can be seen from the development of students at the elementary, middle, and high school levels. Students’ development cannot be separated from the role of a teacher in their school. A teacher has an important role in the way of school teaching and learning process. The teacher acts as an organizer of the learning environment and at the same time as a facilitator [1–3] which includes: models, planners, forecasters, leaders, guides, and mentors.

The various roles of the teacher in the learning process create a system of activities involving teachers and students. Students certainly have the responsibility to learn, while the teacher is responsible for starting the selection and sorting of material, the application and use of methods, the delivery of material, guidance to evaluating students’ learning outcomes. The learning process will take place well if it is carried out by teachers with good academic competencies quality and high professionalism [4]. Therefore, enhancing the quality of education should be sought by prioritizing improving the quality of teacher quality. As complete or sophisticated as any educational facilities and infrastructure, without being supported by good quality, will not have a significant meaning in improving the quality of education.

Improving the quality of education caused by improving the quality of teachers is accompanied by an increase in the competencies of a teacher in fulfilling his duties in providing a good quality of teaching. Various enhancements of good teacher competencies are an increase in pedagogic competence, professional competence, personality competence, and social competence [5]. Through various enhancements to this competency, the impact on teachers is the increasing learning process and competency of fellow teachers in schools.
The enhancing competence of mathematics teachers has a linear impact on the achievement of students' mathematical ability competencies [6]. In the Revised Edition Curriculum of 2013, the development of students' mathematical ability competencies is directed at improving life skills, especially in building creativity, the ability to think critically, collaborate or cooperate, and communication skills. For this reason, it is necessary to have problem posing skills from a teacher [7], as scaffolding students to develop students' mathematical competency skills by following the curriculum.

Through scaffolding, teachers’ problem posing provides an opportunity for students to be able to master more flexible and diverse thinking, facilitate students’ problem-solving abilities, expand and enrich students' perceptions of mathematics, and embed basic concepts [8]. This problem posing is defined in formulating questions from a given mathematical situation, reformulating the questions that have been resolved from the given situation, and modifying questions based on the mathematical situation given [9].

The importance of problem posing abilities in the learning process of mathematics has been stated in various previous studies, especially for teachers or prospective teachers. Problem posing is an important component in mathematics learning [10]. The importance of mathematics learning that facilitates students to interact actively, construct knowledge, problem posing and mathematical problem-solving in various ways [11], and use technology [9]. Problem posing skills are needed in the investigation of course material at the university level [12]. The need for problem posing skills of a teacher or prospective teacher is the basis for developing students 'mathematical abilities, especially students' problem-solving abilities [13].

The fact of this study needs to be followed up by providing appropriate learning environments so that prospective teacher students are accustomed to doing mathematical problem posing and interacting actively during learning. In this study also presented the process of using one of the qualitative software, namely ATLAS.ti, as a data management process in this study.

Therefore, researchers are interested in further analyzing the problem posing abilities of prospective teacher students on certain material. Based on the background of the problem, the problem in this study is the low ability of mathematical problem-posing for prospective teacher students. This research has an aim to describe the student's completion strategy to answer the question before and after the realistic approach begins; to see the process of managing research data using ATLAS.ti.

2. Method
The research method used is a qualitative research method, with a type of design research. Design research has three phases, namely the initial preparation and design phases, experimental teaching phases, and retrospective analyze phases [14]. The three stages are carried out according to research needs in the form of a repetitive cycle until the results are needed.

This design research was the subject of discussion by previous researchers. Through the words design and research, each researcher has the characteristics of each of the terms of design research that they adopt. Starting from developmental research [15], research that emphasizes the process of the development cycle of research activities naturally without the intervention of researchers. Furthermore, this type of research changes terms along with differences in understanding the term the researcher becomes a design experiment [16-17]. The essence of this research is the interrelationship between the development of learning situations and the development of relevant theories. The term changes again when it has a different focus, such as focusing on the perspective of learning activities [18] and focusing on curriculum perspectives [19], becoming educational design research. Small differences from these characteristics do not change the basic concept of design research, namely the three phases of the research itself.

Some points are the reasons why design research should be used [14], that is: (1) Design mathematical problems to facilitate student learning; (2) Determine the assumptions/expectations of student learning; (3) Determine the conjecture as a teacher to facilitate and guide the learning process of students; (4) Provide open questions and follow-up questions as a step in problem posing; (5)
Observing what students do and say closely; (6) Analyze and interpret what students do and say; and (7) Redesign mathematical problems and assumptions/conjectures about student learning according to data that has been obtained. The seven points are in line with the implementation of this research because design research aims to understand the process of student mathematics learning activities.

The research was conducted at an institution in the city of Garut, namely the Indonesian Education Institute. The research subjects were 69 levels 1 mathematics education study students who were divided into 2 classes. All students are given a test file and some student answers are taken for further research.

This time, researchers had the opportunity to discuss one test question and several diverse student answers. The selection of students used as core research subjects is based on the results of the answers of different students, for the same answer, only one answer will be taken as the representative. Each different answer is analyzed according to the results of the question and answer with each student concerned.

3. Results

3.1. Student completion strategies before realistic approaches

3.1.1. Preparation and design. At this stage several steps need to be done, namely: Literature review, formulating research objectives and research questions in general and creating a Hypothetical Learning Trajectory. After the material is determined, the researcher examines relevant theories related to the material chosen, namely fractions. The following is a situation of mathematical problems about fractions with the context of rainbow cake (figure 1).

![Figure 1. Rainbow cake’s question.](image)

3.1.2. Teaching experiment. Collecting data at this stage needs to be determined in advance and prepared by the instrument. Data that can be collected are data on teacher and student observation, teacher and student interview data, and student work results. Doing different data collection methods convinced the reader that the researcher was triangulating data.

3.1.3. Retrospective analyses. All types of data obtained are analyzed at this stage. This time, the researcher will display some of the student's work related to the rainbow cake problem (figure 2 & 3).

| Nurdianti | Nurdianti gave an incomplete answer, but her mind was almost right. Nurdianti answered the question by focusing on simplifying the shape of the rainbow cake. Nurdianti's aimed to cut the entire shape of the rainbow cake into the simplest form of 8 pieces. When it was only halfway through, Nurdianti realized that later on simplifying the shape of the fourth rainbow cake, the simple shape of the 8 pieces would not be the same as the others, so the answer was stopped because of Nurdianti's doubts. |

![Figure 2. Nurdianti’s solution.](image)
Siti answered briefly, clearly, and densely without using any image media. Siti said that any object divided by 4 of the same size, must be the same value, i.e. $\frac{1}{4}$. However, the problem here is how to cut this rainbow cake, the four are different, and it becomes a question that needs to be explained, whether the cutting method gives the same shape or not. While Siti directly stated that it was the same.

**Figure 3. Siti’s solution.**

### 3.2. Student completion strategies after a realistic approach

#### 3.2.1. Preparation and design.

At this stage there several of steps that need to be taken, that is: back to the review literature to complete the lack of theory, formulate the research objectives and final research questions, and revise the Hypothetical Learning Trajectory. The mathematical problem situation discussed, namely the issue of rainbow cake, has no change (figure 1).

#### 3.2.2. Teaching experiment.

The type of data collected shall be the same or there are additions compared to the previous cycle.

#### 3.2.3. Retrospective analyses.

Re-analyze the data that has been obtained. Here are some student answers about the rainbow cake problem (figures 4, 5, & 6).

Fajar had a solution to the problem by linking the shape of the cutting of the four-rainbow cake with numbers $\frac{4}{4} = 1$ through a repeated addition strategy of $\frac{1}{4}$. This Fajar solution is rare because, among other friends, there is only one other student who has the same idea as Fajar.

**Figure 4. Fajar’s solution.**

Nadini’s solution above was a type of solution provided by almost all other students. The idea of this solution was to cut back every form of $\frac{1}{4}$ piece of rainbow cake type 1 into $\frac{1}{8}$ pieces of other types of rainbow cake. Each form of cutting was drawn one by one clearly and completely.

**Figure 5. Nadini’s solution.**
Amalia had a unique solution, an idea of the solution, which is a material wide area. In this case, Amalia had made connections between materials that have been studied before (intertwinement) with fraction material, and it could be said that Amalia's solutions were original. None of his friends answered with an idea like this, only found in Amalia's answer.

Figure 6. Amalia’s solution.

From some of the results of this student answer, we know that students who can think are only 1-2 people, the rest do not have the mathematical abilities that are appropriate as prospective teachers. The results are by following the statement of even skilled adults do not always have direct access to a fraction's magnitude [20]. On this fraction topic, there are often problems with misconception in the learning process, evidence that understanding students' concepts of fractions are still low [21–23] also in this study.

Misconceptions that arise in this study are obtained from one geometry-fraction problem. Students do fraction misconceptions on the prevalence of misconception errors based on response patterns [24] and do geometric misconceptions on a lack of background knowledge and reasoning [25]. We need to develop case-focused learning [26] as a follow-up in improving students' mathematical abilities.

3.3. The process of research data management uses ATLAS.ti?
The research data management process uses ATLAS.ti [27], that is: (1) Creating HU (Heurumeunistic Unit), create a new document in HU; (2) Input data, create several PD (Primary Document) and submit various types of data into PD; (3) Selecting data, create some essential quotations of data; (4) Providing coding, create a code that matches the marked data; (5) Doing analysis, create a network image; (6) Searching data, use a query tool; (7) Creating memo, give a comment on each data analysed; and (8) Producing an output.

4. Conclusion
The mathematics skill of prospective teachers was still far from enough. A prospective teacher should have a diverse perspective; it is not enough to have only one perspective. The low ability of mathematical problem posing for prospective teacher students is a problem here. What is needed is the right action to overcome the problem.

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