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Preservice mathematics teachers' conceptions of and approaches to learning: A phenomenographic study

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Abstract

Knowing the preservice mathematics teachers' conceptions of learning is one of the key factors of taking significant educational measures regarding the future. The purpose of this study was to investigate preservice mathematics teachers' conceptions of and approaches to learning. The phenomenographic qualitative research method was used to determine preservice mathematics teachers' conceptions of and approaches to learning. The data obtained from written materials were collected from 150 participating students using an open-ended question and analyzed through content analysis techniques. Then the participants' conceptions of and approaches to learning were categorized into six and two groups, respectively. The results show that approximately one-third of preservice mathematics teachers focus on learning as applying. Additionally, it is found that two-third of preservice mathematics teachers use surface approaches. and one-third of them use deep approaches.

Keywords: Preservice mathematics teachers; Learning conceptions; Phenomenography

1. Introduction

Recently, many researchers have been carried out on how the individuals think about and interpret learning [1-8]. The first important study about the concept of learning was carried out by Saljo [6]. In this study, adults with different education levels were interviewed and the question "what do you mean by learning" was addressed to them. Saljo [6] developed five categories for learning concept depending on the analysis of the answers of this question. Similar researches about the learning concept [9, 10] put forward similar results, instead of different expressions, about the variety of learning concepts of the students [11]. Based on these studies, the five learning concepts are as following: (a) Learning as memorizing, (b)

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learning as acquiring knowledge, (c) learning as application of knowledge, (d) learning as making connections between parts of a subject, and (e) learning as interpreting and understanding reality.

Through phenomenograhpy, Marton et al. [4], identified the sixth learning concept by reformulating and extending the forth and the fifth learning concepts above. In this sixth concept, learning is evaluated as learner's change as an individual through developing new ways of seeing the events on the world. After reconstruction, the six concepts of learning are stated as following: (a) increasing one's knowledge, (b) memorizing and reproducing, (c) applying, (d) understanding, (e) seeing something in a different way, and (f) changing as a person [4].

While the first three of these concepts are quantitative, the other three ones are qualitative. That is, the first three concepts focus on acquiring an increasing quantity of information while the other three concepts focus on understanding and integrating information [12]. This difference shows parallism with distinction -surface/deep- between learning approaches [13, 14]. "Deep learning" means comprehending the concept and keeping it in the memory for longer by analyzing the new concepts and relating them with the existing concepts and principles. On the other hand, "surface learning" means memorizing and accepting the information without relating it with the reality. Ramsden states the features of the individuals having deep and surface learning approaches as below [15].

Table 1. Deep and surface approach to learning

Deep approach	Surface approach
• Focus on what is "signified" (e.g. the author's argument or the concepts applicable to solving the problem)	• Focus on the "signs" (e.g. the words and sentences of the text or unthinkingly on the formula needed to solve the problem)
• Relate previous knowledge to new knowledge	• Focus on unrelated parts of the task
• Relate knowledge from different courses	• Memorize information for assessments
• Relate theoretical ideas to everyday experience	• Associate facts and concepts unreflectively
• Relate and distinguish evidence and argument	• Fail to distinguish principles from examples
• Organize and structure content into a coherent whole	• Treat the task as an axternal imposition

Bryne and Flood [16] state that students having lower levels of concepts use surface approaches, thus they reach just surface comprehension levels. However, the ones having sophisticated learning concepts use deep learning approaches and they gain deep levels of comprehension as a result.

Learning concept of a student affects his/her learning approach in terms of the quality of the learning outcomes [17,18], hence learning concept is a significant factor. Students organize their learning processes themselves and that has a considerable effect on learning outcomes. It is known that there is a close relationship between students' approaches to learning and learning outcomes; and this relation can be explained with learning concepts. According to Trigwell et al. [19], students' approaches to learning are related to teachers' approaches to teaching. Teachers' approaches to teaching cover their teaching practises and strategies. In this concept, it is important to put forward mathematics student teachers' learning concepts and teaching approaches in terms of teaching mathematics. Moreover, it is thought that this study will contribute to required educational precautions for the future and the field of mathematics education when the fact that today's student teachers will be tomorrow's teachers and educational politicians is taken into consideration.

In order to investigate student teachers' learning concepts and their approaches to teaching, the following two questions are focused on in this study:
1. How mathematics student teachers do conceptualize the "learning" concept?
2. How do mathematics student teachers approach to learning?

2. Method

2. 1. Participants

A total of 150 mathematics student teacher, who were studying to become elementary mathematics teachers at the Education Faculty of a University in Turkey, participated in this study. The average age of the participants was 21.4 years (range 18–25). The majority of the participants were female (102 of 150). The participants had taken the basic educational pedagogical courses, such as development and learning; that is they had the required pre-information. The study was conducted in April, 2010.

2. 2. Procedure

In order to establish the preservice mathematics teachers' conceptions of learning, each one was asked to respond to the following open question: "In your opinion, what is learning? Please explain." The participants were given approximately 15-20 minutes to write down their ideas. As the intent was to benefit from the first ideas to come to the minds of the participating students, this time was considered sufficient [7, 20]. The open question given above is the basic data source for this study. Phenomenographic qualitative research method was used to determine and classify student teachers' learning concepts according to Marton et al.'s [4] six subcategories of learning concepts. This method, combining interview, protocol and discourse analyses, is mostly used to classify student qualitatively different, hierarchically related, conceptions of learning [21].

2. 3. Data analysis

First, the written responses of the participants were read and collected in three main categories: memorization/increase knowledge, practice, and comprehension. After two or three days, the responses rereviewed and tried to be classified according to six categories of Marton et al. [4]. After two weeks, the responses were read for the third and the last time and the categories were definitely shaped. Results obtained from the last revision were different from the previous ones since categories of some responses changed after a deeper reading. Change in the categories stemmed from the fact that the given responses did not belong to a certain category. In the last classification, the responses were mostly collected under the categories of *applying* and *increasing one's knowledge*. The last classification was verrified by an expert professor. This independent verification provided %90 of scorer reliability. In many studies, such a data analysis technique has provided reliable results [4, 6, 7, 22, 23].

3. Findings

While 145 of the participants gave proper responses to the deternined categories, 5 participants gave responses about the common definition of education or the required qualifications of a good teacher. Thus, responses of those 5 participants were not taken into

consideration. Learning concepts of 145 participants were classified according to six categories of Marton et al. [4] as shown in Table 2.

While some 66% of mathematics student teachers conceptualize learning in A, B, and C categories, about 33% of them conceptualize it in D, E, and F categories. Depending on that, while two-third of the mathematics student teachers approaches to learning "surfacely", one-third of them approach it "deeply".

Table 2. Categories of conceptions of learning and numbers of students at each categories

Categories	N	%
A. Learning as increasing one's knowledge	26	17.9
B. Learning as memorizing and reproducing	24	16.6
C. Learning as applying	45	31
D. Learning as understanding	21	14.5
E. Learning as seeing something in a different way	6	4.1
F. Learning as changing as a person	23	15.9
Total	145	100

The descriptions of six learning conceptions and some of the prototypical quotes examples belonging to these six conceptions from our data were given as follows.

A. Learning as increasing one's knowledge

In this category, learning is conceptualized as *increasing one's knowledge*. Learning shows an augmentation of previous knowledge. This category which covers the views of look of the all other categories is a conceptualization which is common, covering and not specific. Selected example responses from this category are as follows.

(a) "Learning is accumulating new information on the existing knowledge… We always learn new things throughout our life. We learn addition, subtraction, multiplation, and division at primary school. At high school, we learn trigonometry, complicated numbers, etc.. At university, we teach some other subjects that we do not know. Up to now, we have learned much more things with the information we accumulated at each level." (Student 35).

(b) "Learning is permanent knowledge aggregation in the brain which is gained through cognitive, affective and pschomotor behaviors." (Student 69).

(c) "Learning means individual's comprehension of new facts or adding new facts on the existing facts." (Student 7).

(d) "We can liken each of information we learn to the bricks of a house. In time, these bricks come together and constitute a house, our knowledge store." (Student 58).

B. Learning as memorizing and reproducing

In this category, learning is conceptualized as memorizing and being able to remember some information. A regular storage of knowledge is the key for learning. Examples of responses classified in this category are as follows.

(a) "A student willing to learn and a teacher able to understand his/her student's needs are required for learning. After these conditions are provided, information should be transferred

to the learner regularly and systematically. Information tranfer, which is the base for learning according to me, should be proper and controlled." (Student 130)

(b) "While studying for the exams, I should solve the examples one by one (without looking the resourse) in order to say -Yes, I'm ready for the exam, I learned, I memorized. When I feel that I learned, I can solve many questions about the related subject." (Student 131).

(c) "Learning is a mental process. The brain stores the information obtained from the environment and uses it when necessary.... If the information has been transferred to long-term memory from the short-term memory and can be recalled to short-term memory, that means the information is learned, that is memorized." (Student 126).

(d) "There are many ways of learning. Though I'm against the memorizing as a mathematics teacher candidate, it is the best way of learning for oral courses." (Student 112)

(e) Learning is relating the new information to the existing one and internalizing and saving the required quantity of it that can be used later. I think, if the individual make use of short ways, codes, and key words according to him/herself while relation the new information to the existing knowledge, he/she learns almost perfectly. Because the quicker we can recall 100% of the information when needed, the better we learn it." (Student 105).

C. Learning as applying

In this category, learning is conceptualized as applying the gained knowledge in the real life. This category is different from the "A" category because it emphasizes application, and "B" since application is not a must for measurement. Examples of responses for this category are shown below:

(a) "If a person can make use of the information he/she has learned in the real life, that is learning is really realized. This can be a rule in mathematics and it is used in solving problems, or a task to do at home and used in daily life. Real learning is realized only by transferring the learned information to the real life. Otherwise, it is just memorization." (Student 127).

(b) "Learning is comprehending a certain information and applying it in real life. If application exists, learning is realized; if not, learning is not realized. For instance, if a child learns addition theoretically but cannot sum cost of the the products he/she buys in a shop, that is he/she has not learned addition yet. Being able to use information in life means learning." (Student 140).

(c) "Learning is being able to synthesize and make use of information in life. For example; in mathematics we taught addition, subtraction, multiplation, and division, four basic calculation, to a student using the relation between conceptual information and operational information. Then, did the student learn? That is, was learning realized? No. Then, why? Because the student has not synthesized and used this information in daily life yet. Learning will occur only after the student go to a market and calculate the cost of the things he/she buy and the change." (Student 41).

(d) "When learning is mentioned, positive behavior changes these are useful for the individual and applicable in daily life should come into mind. Learning is not just to attend the courses and keep the information in mind till passing the exams, it is being able to use information actively. For instance, operations, such as addition, subtraction, and numbers are not forgotten in mathematics, this is because this information is activated when you go to a market. Humans do not forget the information they use. However, advanced mathematics

subjects like derivative and integration are forgetten if you are not within mathematics since there is not a large area in life to use them. Nobody mentions them in daily life. In short, the information that cannot be transferred to daily life is not learned." (Student 84).

D. Learning as understanding

In this category, learning is conceptualized as improving the right comprehension of information. "Meaning" is the border line between this category and the first three ones as a way of realizing, searching, exploring, and relating something and gaining a new way of looking. Example responses classified under this heading are shown below:

(a) "Comprehension of the concept is required for entire learning." (Student 28).

(b) "Learning can be described as understanding or comprehending a new event or fact by relating it to the existing knowledge." (Student 102).

(c) "In my opinion, learning is understanding something new and making effort to obtain information about it." (Student 141).

E. Seeing something in a different way

In this category, learning is conceptualized as interpreting the phenomena in different ways. Here, "seeing something in a different way," is not limited just with study cases, it is dealt with the whole life. Three example from six responses related this category are as follows:

(a) "Learning should not be labeled just as gaining something, sometimes it should be seen in a way of holding a pencil. I think, learning is a point of view." (Student 45).

(b) "Different learning may occur depending on different ways of thinking, a graduate of elementary school cannot be expected to see an event like a graduate of university." (Student 56).

(c) "Each individual has different ways of learning. For instance, a curious apartment resident is much more sensitive than the others to the events happening in the apartment complex. Or, a tradesman, planning to enlarge his job, thinks to use the ideas he heards from the others in the future. That is, actually learning is our acpects to environment and the events." (Student 142).

F. Changing as a person

This concept is set upon the E and D concepts and it contributes an existentialist aspects to the learning. This concept is based on the view that seeing something in a different way occurs as a result of learning. As a result of learning individual sees the world differently and changes as a person. This concept is different from the others since it attributes changing as an individual to learning and information. Example responses of this category are shown below:

(a) "Human being learns something new every day from the first day he/she was born. This learning process causes positive or negative behavioral changes. Thus, individual gains a certain attitude towards life and personality." (Student 65).

(b) "Throughout our life we come across with different situations and unknown cases; these new cases merge with the existing knowledge. As a result positive or negative personality and behavioral changes are observed. Thus, human being always changes." (Student 32).

(c) “The most broad meaning of learning is that it is the permanent changes occuring as a result of our contact with the environment.” (Student 53).

(d) “Learning is human being’s improving oneself with the knowledge he/she gains using his mind.” (Student 38).

(e) “Mainly, learning is one’s change occuring as a result of motivation, the more a person learns, the more he/she changes.” (Student 83).

4. Discussion and Conclusions

Findings of this study show that mathematics student teacher’s learning concepts cover all variations of six learning categories developed by Marton et al. [4]. The other variation or learning concept was not put forward. This study reveals the fact that mathematics teacher candidates do not have the same idea about learning. The findings of this study obtained from content analysis, differentiates from the previous findings, obtained from phenomenografic studies, in terms of the focus rates of candidates’ on categories. The number of the studies conceptualizing learning mostly as “increasing one’s knowledge”, “memorization,” and “understanding” is quite high [12,20,24]. However, in this study, the rate of the candidates’ considering learning as “increasing one’s knowledge,” “memorization,” “understanding,” and “chainging as a person” is close to each other and changes between 15% and 18%. The fact that the ones sees learning as “changing as a person” describe learning in a short and one sentence like “learning is the changes occurring in one’s ownself” is significant. The rate of the ones seeing learning as “seeing something in a different way” is quite low (4%). On the other hand, about one-third (31%) of the mathematics teacher candidates conceptualize learning as “applying”.

Two-third of the mathematics teacher candidates see learnig as “increasing one’s knowledge,” “memorizing and reproducing,” and “applying”. This reveals that they have surface approach towards learning. The students having surface approach see the tasks as something imposed outside, try to cope with the requirements of the courses and focus on routine facts [25]. When this case is taken into consideration, it is seen that mathematics teacher candidates tend to memorize formulas and theories of the subjects, not to understand the theoretical structure of the subjects deeply. This is an undesired result. However, well-educated mathematics student teachers are expected to understand and interpret the reality, do generalizations for new conditions and have the abstract thinking skill; these are the features of ones’ having “deep” approach to learning [25, 26-55].

Based on those findings, it is found out that mathematics teaching curriculums are required to be revised and reorganized in a way that traditional teaching approaches will be omitted and deep teaching approaches will be included. It will be useful to carry out similar studies on teacher candidates using phenomenographic methods. This will enable us to understand how teacher candidates from other branches conceptualize learning and approach to it. Depending on that, we can evaluate the existing teacher training curriculum as a whole.

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