

The Examination of High School Math Teachers' Belief in Examples on Their Use in Teaching Process

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Abstract

Math examples are the inseparable and consistent part of math though as well as its teaching and learning methods. If we accept that the way of math teachers' performance is affected by their beliefs and conceptions, the identification of these beliefs and conceptions contributes to the better evaluation of teaching and its improvement. In this research, through phenomenological method in the field of qualitative researches, data collection and analysis were conducted. The statistical population of this research includes all the high school math teachers of Zahedan. The results show that most of teachers consider math example as an aid for the better understanding of subjects and objectifying abstract math concepts that interferes directly in teaching. Furthermore, the kind of belief and conception of teachers in examples affects the way of presenting the examples and their quality.

Keywords: Belief, Teacher, Example, Math Teaching

1. Introduction

Educational system of each country plays an important role in the individuals' personal and social behavior. In fact, educational activities of each country can be considered as an investment of a generation for another generation that its objective is human development. In other words, the objective of educational activities is developing awareness, and potential abilities of human. In respect to the broadness and widespread cover of the activities of educational system, it is necessary that in designing and implementing relevant activities to it, the most optimum methods should be used to promote educational quality [10].

Mathematics is one of the tools of training thought. The role of mathematics in identifying the nature and training of thought is one of the importance backgrounds of math that necessitates its teaching and learning. Psychologist interested in teaching math, try to understand that how different factors affect learners' math behavior [1]. Math examples are the inseparable and consistent part of math though as well as its teaching and learning methods particularly are extremely important in relation to conceptual understanding, generalization, and argument and analogical thought and so on. Example is used as a sample, instance, image, case or component of a mathematical idea, process or a category of concepts [16], but meanwhile, what is the role of teachers' belief in using example? In a simple and clear definition, "beliefs or opinions are thoughts that an individual believe in their veracity and truthfulness" [9]. In a wider concept, beliefs include knowledge or known ones, opinions or doctrine [12]. According to the most of researchers, one of the most fundamental contributing factors in educational programs of math teachers and development of their professional skills is the effect of their beliefs, conceptions and knowledge on the math teaching [4]. If we accept that the way of math teachers' performance is affected by their beliefs and conceptions, the identification of these beliefs and conceptions contributes to the better evaluation of teaching and its

improvement [6]. Researches have shown that teachers' performance is the reflection of their views towards math. Thus, it is necessary that teachers should be aware not only of their students' potential beliefs and the way of their development, but also of their beliefs. Teachers' belief concerning teaching and learning math affects the nature of the math class environment and the teaching kind that students receive [5].

2. Data Collection and Analysis

In this research, through phenomenological method in the field of qualitative researches, data collection and analysis were conducted. The statistical population of this research includes all the high school math teachers of Zahedan who were 200 persons. Among this statistical population, a sample of 50 high school math teachers was selected by simple random sampling method among.

To determine sample size in this research, saturation method was used. Data saturation or theoretical saturation is an approach, which is used in qualitative researches to determine sampling sufficiency. Using data saturation method is considered as the golden standard of sampling end in qualitative researches [8].

The research data were collected using questionnaire. In this research, first, the teachers' answers were studied accurately and common matters in the answers were codified. Since the answer of some teachers included several codes, the below formula was used to calculate the teachers' answering percentage to each question:

$$\frac{\text{Number of Common Answers to One Code}}{\text{Total Number of Common Answers to the Codes}} \times 100$$

Answering percentage =

The questionnaire that was presented to the teachers was as follows:

Dear Teacher

This questionnaire is prepared in order to find out regarding "high school math teachers' conception of examples", (beliefs or opinions are thoughts that an individual believe in their veracity and truthfulness). Your accuracy in answering will guide us in better and clearer inference of results and findings of this research. Please for each question, explain your reason completely. Your answers will be kept completely confidential, but owing to conducting other phases of the research, please mention requested qualifications completely.

Academic degree and relevant subfield:

Teaching record:

City for your teaching:

Teaching level and taught courses until now:

If you like, please write your first and last name and phone number to call you:

Thank you for your cooperation

1. What is your conception of example?
2. In your view, which of following cases can be considered as an example? Regarding each reason, mention your answer and if your answer is positive, mention evidence for it.
 - Definitions
 - Theorems and problems
 - Proofs and arguments
 - Figures and diagrams
 - Solved exercises
3. How you use examples in your daily class? Write the advantages of this method.
4. Are you familiar with other methods for using examples? If your answer is positive, explain your methods and write why you do not use these methods in your daily teaching and classroom.

3. Data Analysis

Having examined the questionnaires and presented answers by teachers, we will present collected information concerning the objectives of the research in its field section.

In this section, teachers' statements are distinguished with a small circle at the beginning of each paragraph. In some cases, inappropriate or contradictory answers are seen among their views owing to preserving what teachers have expressed.

3.1. Teachers' Answer to the First Question

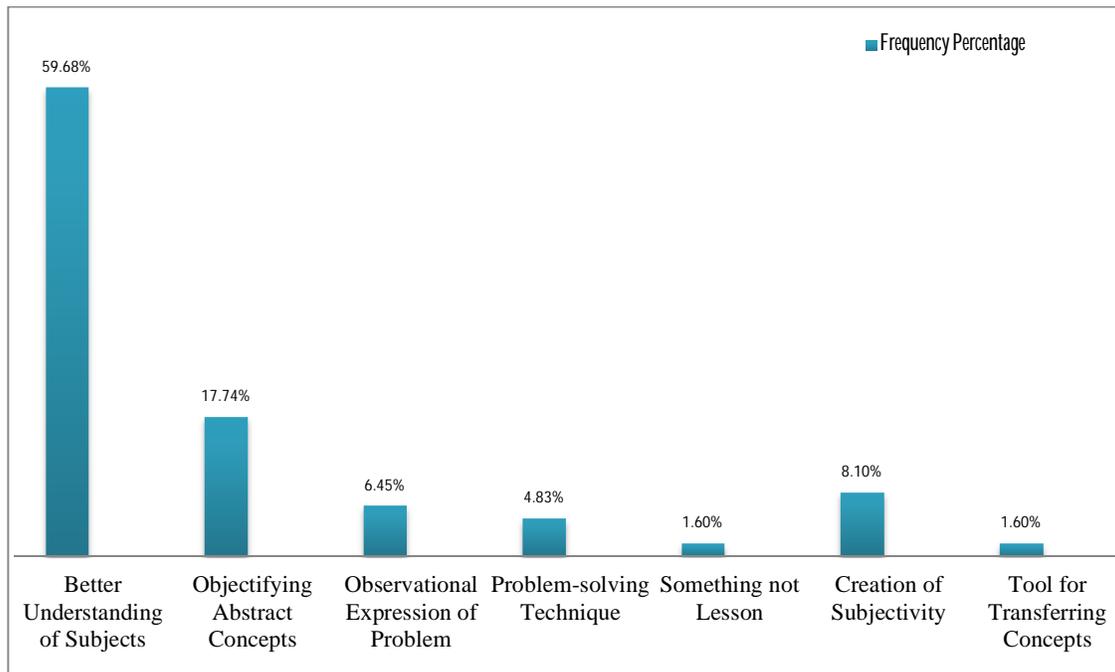
- If example would be suitable and to the point, it could be useful in comprehending definition and theorems for the student.
- Objectifying abstract math concepts
- Something which students do not consider it as a lesson and easily answer our question regarding that issue and could be led to the lesson.
- In math, a problem, which the subject of the taught lesson is observed in it.
- Examples are for better understanding of lesson-related subjects including definitions and theorems.
- Definition is an observation for problem and a way expressing the problem and simplifying the subject.
- Mentioning an issue in accordance with the subject of lesson in order to create the subjectivity of the subject in student as well as stabilizing the learning of the issue.
- When a math subject is presented abstractly to the students, example is necessary to be mentioned for a better and profound understanding (minimally a numeral example).
- Example is quite constructive for beginning the lesson and preparing students' mind in mathematics.
- Examples play a crucial and major role in teaching math concepts and developing mathematics, have had a particular place in most of math teaching theories, and have played a key role in different methods of math learning.
- Making teaching subject similar to what is objectively apparent and understandable.
- The purpose of example is solving the problem relevant to the lesson after teaching concepts relevant to the better learning of concepts and making them tangible for students.
- Example is the observational expression of problems for explaining or preparing the background for the beginning of teaching.
- Example is part of my teaching method that I use in explaining lesson-related subjects. I improve students' perceptive cognition through example.
- It is a particular and simple situation used to show that total order is correct and teacher presents it in the classroom in order to prepare students' mind to understand the total situation. Furthermore, it stabilizes the intended subject in students' mind.
- Example can be used to transfer anew concept and relating several concepts with each other. In fact, example is a tool for transferring concepts.

3.2. Analysis of the First Question

All 50 participated persons answered the first question. The researchers examined the mentioned cases by the teachers and the teachers' general understanding consider example as a help for better understanding of the subjects that can help them in different grounds. The results are observed in Table 1 and Figure 1.

Table 1: Number and Percentage of Answers Regarding Types of Conception of Example

Conception Type	Number of Answers	Percentage of Answers
Better Understanding of Subjects	37	%59.68
Objectifying Abstract Concepts	11	%17.74
Observational Expression of Problem	4	%6.45
Problem-solving Technique	3	%4.83
Something not Lesson	1	%1.6
Creation of Subjectivity	5	%8.1
Tool for Transferring Concepts	1	%1.6

**Figure 1: Presented Answers to the First Question**

3.3. Teachers' Answer to the Second Question

A) Definitions

- Definitions as examples are not usable, but for each definition, an appropriate example should be presented.
- Slight familiarity with the subject and guiding towards problem-solving method
- It is the only initial introduction of the subject.
- In different definitions, example can be cited to express that definition easily such as the definition of set or the definition of error in measuring.
- A definition is not an example, but a good example can include definition.
- Definition is the first stage of teaching and because the most observational problems can be expressed in the frame of definition, citing example in a definition is usually an easy and impossible work such as train rails for two parallel lines.
- Definitions can be used in the frame of example, but are not example.

B) Theorems and Problems

- Theorems are not example, but many of examples can be concluded using theorems.
- Theorems and problems can be used as example, because they contribute to the better understanding of lesson text and they express the application of lesson.
- Problems can be example, because they may contain some cases of the student's daily life.

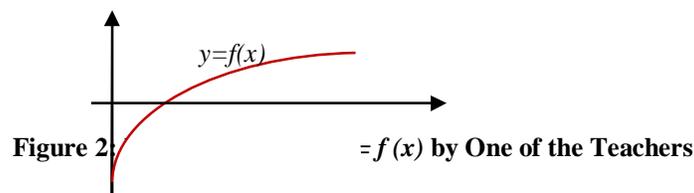
- Theorems are not example, but sometimes problems can be considered as example owing to the variety of its solutions.
- Before expressing the statement of theorem, a problem can be cite as an example and the application of that theorem can be specified in the example such as the theorem of triangle similarity in Geometry 1.
- Problems and the application of theorems can be considered as an example, because they create more proficiency and understanding in learner and using theorems, other problems and examples can be generalized and more examples can be expressed.
- After definitions and cognition, definitions are mentioned, because we use definitions for proving theorems and solving problems and example has no position here.
- Problems can be considered as example, for example, in the first grade of high school, the problem of scale and weights of bodies can be a good example for the entrance of the subject of unequal ones that student considers each unequal side as the pan of a scale.
- Theorems and problems better can be incorporated in the frame of an example, for example, for expressing definitions between deductive reasoning and inductive reasoning, theorems can be used.
- Theorem is a sentence that we have accepted its correctness, therefore, it can be a good sample of example, but regarding problems, it is not example, because it needs proving.
- Theorems and problems are recorded under a particular law, but can be used in the frame of example.
- Problems are used after teaching the subject. Posing different problems can be used to understand whether student has learned the lesson or not.

C) Proofs and Arguments

- Example is not mentioned, but it is used to prove lesson-related laws for the better understanding of lesson.
- Argument is a kind of example, because sometimes the way of reasoning is important for solving the problems.
- Proofs can be use as example in order to express sets and their characteristics.
- The description and explanation method as well as verity and untruth of a problem through example are not acceptable.
- Proof and argument as well as reasoning and example are inconsistent with each other, because no example is proof and no proof is compatible with example.

D) Figures and diagrams

- Figures and diagrams can be even objective as an observational perception or example and greatly contribute to the comprehension in respect to the intangibility of math.
- Figure and diagram are used to teach some functions, amplitude and range of functions, to examine the equality, ascension and descension as well as to solve inequalities.
- Figures and diagrams can be used as appropriate examples such as the example of diagram for displaying functions, understanding consistent functions, graphs and so forth.
- We use thermometer to teach integral numbers and to see marked numbers.
- Figures and diagrams can be good examples to explain for example congruent triangles, ascension and descension of a function is expressible with the help of figure and diagram (Figure 2).



- Figures and diagrams can be considered as a useful tool in transferring concepts according to their observational view that they give to students.

Example: if figure is as follows (Figure 2), which one is function range of $y=\sqrt{xf(x)}$?

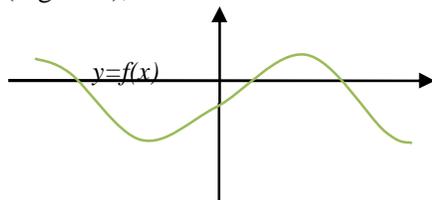


Figure 3: Drawing Function $y = f(x)$ by One of the Teachers

E) Solved Exercises

- Solved exercises can be used as appropriate and opportune examples.
- This is a good case to citing as example, because it is designed according to the lesson-related subjects.
- In all parts of polynomials or signs and son on, most of subjects of the new book needs solved exercises for students in the form of a pamphlet.
- Sometimes, owing to the great variety of exercises and their solutions, reference to different solved exercises can be considered as example and a help to solve more exercises for students.
- Solved exercises are not used as example, because in the student-assigned exercises, student's performance is evaluated.
- The student will be familiar with the solution method through seeing solved exercises.
- Solved exercises are as chewed morsel and because student sees solution, his/her mind will not be involved with the subject; therefore, they are not example.
- Solved exercises are effective as practical and applicable examples showing problem-solving method or strategy and reinforcing scientific or mental faculties.
- Maybe in solving an exercise, definitions, theorems, proofs, arguments, figures and diagrams are used, therefore, through solving a textbook example, important information can be achieved.

3.4. Analysis of the Second Question

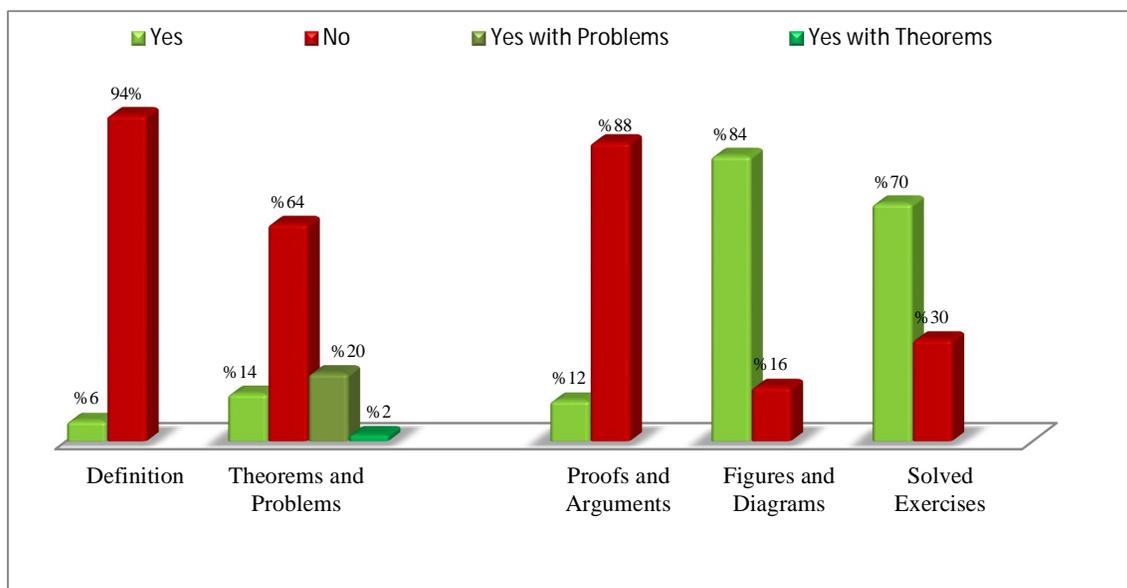
All 50 participated persons answered the second question. Three persons answered that definitions are also pedagogical example or can be used as pedagogical example in some cases and forty and seven persons have not considered definitions as pedagogical examples.

Seven persons have stated that theorems and problems can be suggested as example in some cases. Thirty-two persons do not consider theorems and problems as example. Ten persons have stated that problems can be example, but theorems are not example and one person considered theorem as example and did not accepted it as example. Six persons have expressed that proofs and arguments are examples or can be example in some cases and forty-four persons have not considered proof and argument as example, but separate from example.

Forty-two persons have considered figures and diagrams as example and have expressed that these cases can be among the best types of pedagogical examples. Eight persons also have not considered figures and diagrams as example. Fifteen persons have not considered solved exercises as example and thirty-five persons have considered them as example. The results are observed in Table 2 and Figure 4.

Table 2: Number and Percentage of Presented Answers to the Second Question

Number of Answers	Number of Yes Answers	Number of No Answers	Percentage of Yes Answers	Percentage of No Answers
Definitions	3	47	%6	%94
Theorems and Problems	7	32	14% Yes and 64% No, 20% (10 Persons) Yes Only with Problems and 2% (1 Person) Yes Only with Theorems	
Proofs and Arguments	6	44	%12	%88
Figure and diagram	42	8	%84	%16
Solved Exercises	35	15	%70	%30

**Figure 4: Presented Answers to the Second Question**

3.5. Teachers' Answer to the Third Question

- After each definition, appropriate examples can be used. After theorems, example can be used for better understanding of theorem. Students can be asked to eliminate some conditions from the theorem and use example to reject theorem using reverse example for better understanding of theorem.
- I try to explain the lesson better to students by solving several appropriate examples by myself and volunteering students after complete teaching of subjects.
- Some examples are used during teaching as a teaching method and some other ones are assigned to the students as an exercise to be solved as the final lesson conclusion.
- Firstly, I try to express example for students to their understanding limit. Next, I express the intended subject for them and then I broach the intended details for them with mentioning examples concerning that subject and finally after the taught subject, I ask students regarding similar problems and more complex samples in order to explain the subject again in problem-arising places or to perceive the subject themselves.
- Relating it to the daily life and encountering way to it in life, because most of mathematical problems are in complete conformity with the society and industry.
- Citing example is the best method for starting the work. If the cited example is in relation to the issues of students, it is extremely more effective.
- I try to present the intended issue in an example frame out of lesson and field or in an observation frame and then create conformity between the intended subject and the suggested example.

- In a lesson like one-to-one function, we examine individuals' relation with their national identity code so that student can understand the concept of function better. After that, we want the student to present an objective example.
- Example, owing to its observational aspect, is extremely helpful in better explaining problems as much as possible. Generally, initiating each subject with an example (often non-mathematical) is important in laying the suitable ground for teaching.
- It is recommended to student that first attempt to solve the examples of the book. Examples are written by the student in the class and sufficient explanations are given by the teacher not to make problem for the student for solving chapter-end exercises.
- Before initiating my teaching, I use practical examples in order to create motivation in students, then I express definitions and lesson subjects and finally I solve solved exercises or diagrams and figures as example by the help of students. The advantage of this method is better understanding of lesson and its application in different cases.
- Whenever that one or several different concepts are expressed, using various examples during teaching and transferring information, students can be helped. Certainly, the type and selection of the example, which contain different points is of great importance.

3.6. Analysis of the Third Question

Two persons (3.57%) have not answered the third question and among forty-eight persons who have answered this question, twenty-seven persons use example as a teaching method, other twenty-four persons use example after teaching subjects and three students wanted to cite example.

The researcher examined expressed methods by the teachers and found that that most of teachers use example in their daily teaching as their teaching method or after their teaching. Most of teachers believed that their selection method could help students to understand lesson-related subjects. The results are observed in Table 3 and Figure 5.

Table 3: Number and Percentage of Teachers' Answers to the Using Method Type of Example in the Daily Teaching

Using Method Type of Example	As Teaching Method	After Teaching Subjects	Example Production by Student
Number of Answers	27	24	3
Percentage of Answers	%48.21	%42.86	%5.36

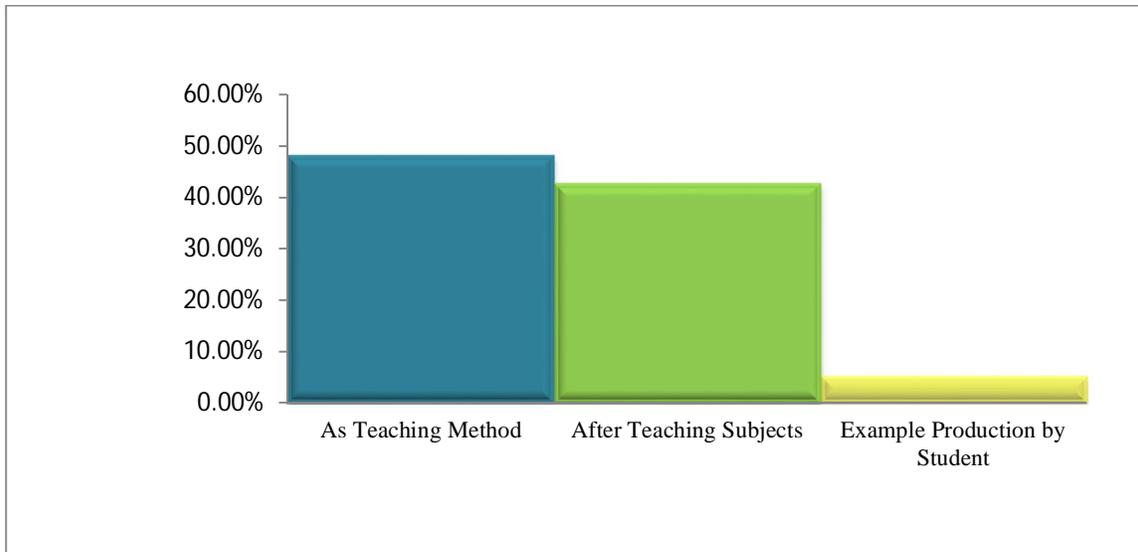


Figure 5: Using Methods of Example in the Teachers’ Daily Teaching

Twelve persons (21.05%) have not answered the advantage part of the third question (totally two persons have not answered the third question and ten persons have not answered the advantage part of this question). Twenty-three persons have considered their teaching advantage in better understanding of the subjects. Four persons believed that their method creates subjectivity. Two persons believed that their method transfers information to the student. Six persons have considered their advantage of their method in learning the use of subjects by student. Four persons believed that their method increases student’s activity in the class. Certainly, it should be noted that most of participants in this research indirectly have expressed the advantage of their selected method in the type of method and the researcher have obtained the above-mentioned cases from the generality of what has been written in the questionnaires. The results are observed in Table 4 and Figure 6.

Table 4: Number and Percentage of Teachers’ Answers to the Advantage of Using Way of Example in the Daily Teaching

Advantage	Number of Answers	Percentage of Answers
Better Understanding of Subjects	23	%40.35
Creating Subjectivity	4	%7.02
Making Subjects More Tangible	6	%10.53
Transferring Information	2	%3.50
Learning How to Use Subjects	6	%10.53
Student’s Activity	4	%7.02

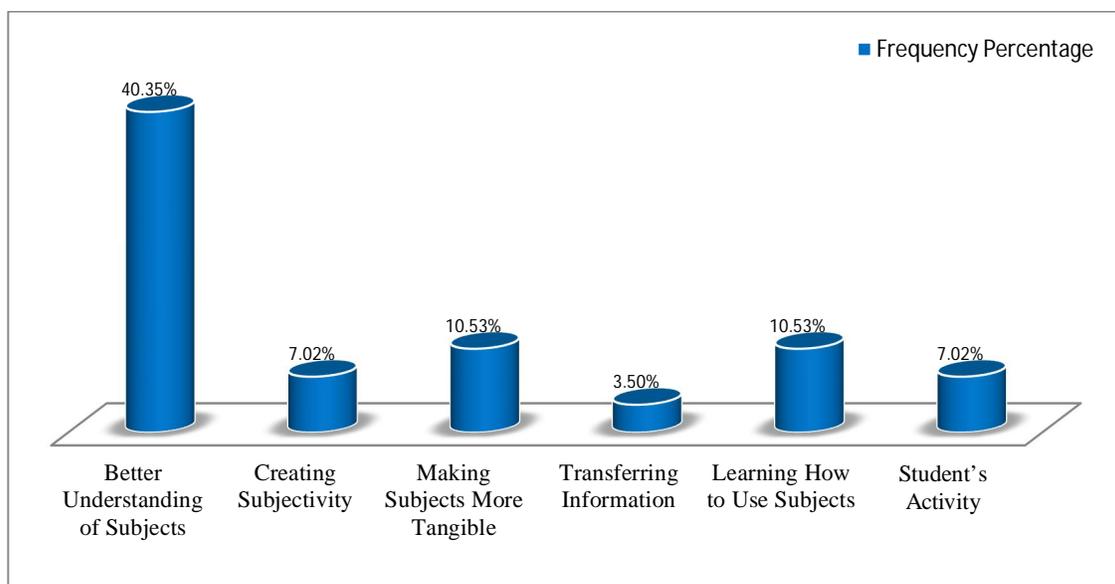


Figure 6: Advantage of Using Way of Example in the Teachers' Daily Teaching

3.7. Teachers' Answers to the Fourth Question

- Using living pictures or visual media is extremely helpful, but unfortunately, its facilities are not available in all schools.
- Objective examples, which exist in the daily life or in the classroom or surrounding environment of students, can be used particularly in geometry lesson. I do not use figures and problems of the daily life in most cases as examples, because I have not detailed information in this regard.
- I am not interested in using empirical method that requires measurement and calculation as well as tool and means due to that fact that it is time-consuming and costly and so forth.
- An example that student himself/herself reaches lesson-related subject not examples, which facilitate learning and examples should be used that are mentioned in the history of mathematics and perception and finding method (the history of the subject).
- Using scientific and practical examples, which are used for high school and guidance school levels and because math workshop is needed, in every school, the facilities of workshop are not provided therefore, this method cannot be used.
- Example is the dramatic method of using work tool (for example using a made cube for showing diameter and mode and so on) using CD and Computer software that nonuse of it is due to time pressing and the lack of computer facilities.
- Sometimes if examples are mentioned at first, then the subject is taught, student understand the lesson better.
- Doing textbook activities can be a kind of example. After proving a theorem such as unequal triangle, solving a textbook exercise or problem can be a help as an example in recording the subject in the student's mind.

3.8. Analysis of the Fourth Question

Nineteen persons have not answered the fourth question and fifteen persons answered no to this question. Four persons, one person, two persons, four persons, two persons, one person and four persons have mentioned visual media, textbook activities, as teaching method, model and modeling, empirical method, the history of mathematics and objective examples respectively.

This question was analyzed like the first and the third questions. Most of teachers answered no to this question and most of the teachers who answered positively to this question have mentioned visual media, objective examples, model and modeling. The results are observed in Table 5 and Figure 7.

Table 5: Number and Percentage of Teachers' Answers to the Familiarity with Other Using Methods of Examples in the Daily Teaching

Answers	Number of Answers	Percentage of Answers
No or No Answer	34	%65.38
Visual Media	4	%7.70
Doing Textbook Activities	1	%1.92
Objective Examples, Daily Problems	4	%7.70
As Teaching Method	2	%3.84
Model and Modeling	4	%7.70
Empirical Method	2	%3.84
Using the history of Mathematics	1	%1.92

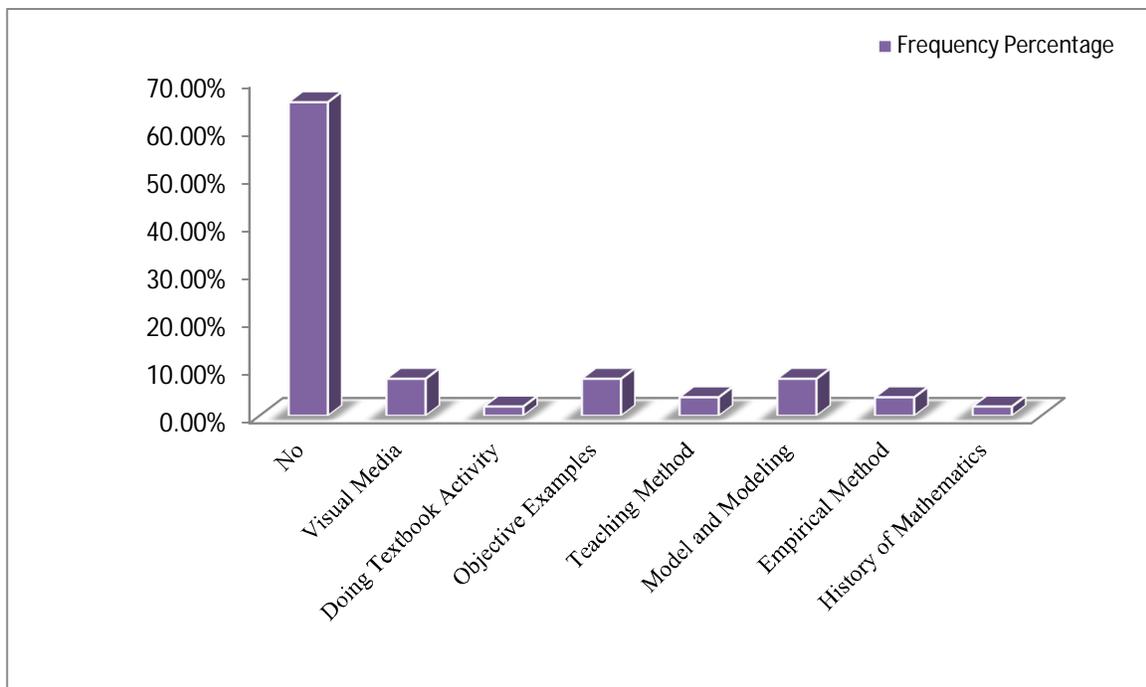


Figure 7: Teachers' Familiarity with Other Using Methods of Examples in the Daily Teaching

Sixteen persons have mentioned some familiar methods for the fourth question, but ten persons (19.24%) of them have not mentioned the faults of the method. The results are observed in Table 6 and Figure 8.

Table 6: Number and Percentage of Teachers' Answers to the Faults of Other Using Methods of Examples in the Daily Teaching

Faults	Costliness	Being Time-consuming	Shortage of Facilities	Not Having Sufficient Information
Number of Answers	1	2	4	1
Percentage of Answers	%1.92	%3.84	%7.70	%1.92

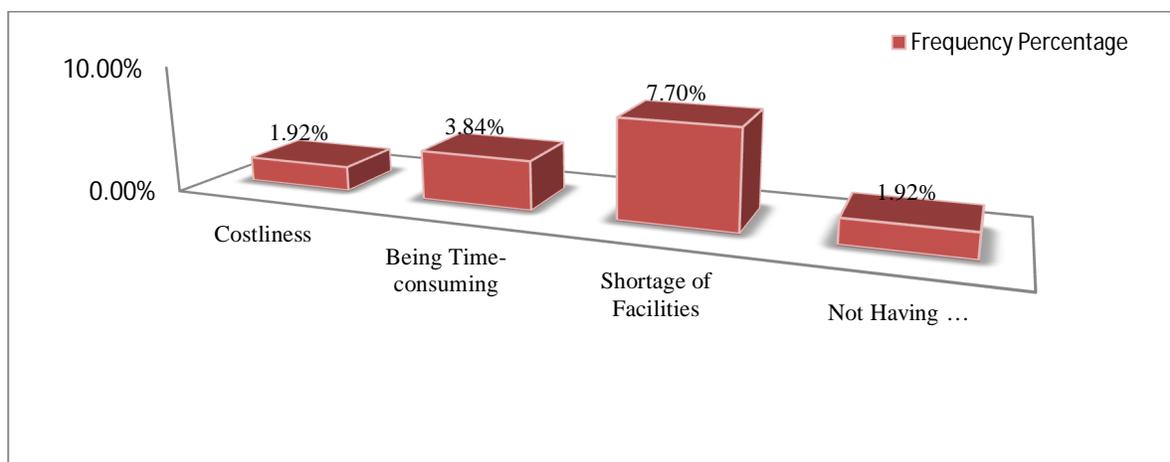


Figure 8: Faults of Other Using Methods of Examples in the Daily Teaching

4. Conclusion

The result of examining presented answers by the teachers show that most of teachers consider math example as a help for the better understanding of subjects and objectifying abstract math concepts that has a direct interference in teaching. Thus, it can be mentioned that teachers consider examples as an important, effective, necessary and integral part of teaching and do not consider using example as a marginal, unnecessary, tasteful or even ineffective. This conception is consistent with the researchers' view including "teachers consider pedagogical math example as a useful and necessary tool or a common and understandable language for the learner that has a direct interference in the teaching [14]" and "examples can be as an accurate and as a magnifier evaluating learners' understanding of concepts or showing their participation way in making concepts [11]". Obtained statistical results from conducted codified works also indicate that most of participated teachers in this research, used examples as a teaching method for explaining the subject after teaching the new subject that this method is consistent with researchers' view such as "in the pedagogical perspective, examples are suggested as a teaching or learning tool in teaching math concepts. This perspective is a common and traditional one and most of math teachers use examples in their teaching. Almost all math books and references use examples for the better explanation of concepts along with definitions and theorems [7]" or "understanding through familiar examples objectifies math abstractness. Meanings and concepts generally are perceived through working with examples and definitions are a reference. In other words, definitions are general or abstract, while profound meanings are extracted through dexterity with familiar examples and learners construct concepts of generalization, abstractness and inference through familiar examples [3]". Few teachers have mentioned example production by the student that this issue is not consistent in the view of researchers such as Watson and Mason who "have laid their pedagogical strategy as the foundation of learners' productive examples and have presented a pedagogical framework on the basis of example and have considered example as an important tool for making connection with abstract math ideas as well as a tool for making connection of an individual with himself/herself and other and interchanging math knowledge [15]", or Dahlberg and Hausman that have stated that "example production can result in a powerful learning so that learners have a real development and progress in learning [2]". Most of the teachers have considered the advantage of using method of example in their daily teaching in the better understanding of subjects. This issue in respect their conception of example that most of them believed that examples contribute to the better understanding of subjects is consistent or is in consistent with "an individual's beliefs determine a ground that in which the individual chooses among accessible sources. In addition, the circumstance of the individual's use of sources is also determined his/her beliefs. It is

impossible that an individual follows particular strategies if he/she does not believe that using them make him/her successful [13]”.

According to the research’s findings, the kind of belief and conception of teachers in examples affects the way of presenting the examples and their quality, because teachers who had a wider view towards the examples and considered definitions, theorems, problems and arguments as a type of examples, were more successful in exemplifying.

It is recommended that pedagogical planners and designers emphasize example-production-based teaching in the math textbooks through the process of example-production by the learner. We need to teach teachers to achieve this issue and success in teaching math using examples, because real design or selection of examples is conducted through different types of considerations, teachers’ attention, personal characteristics, their tendency as well as their judgment. Thus, academic planners should prioritize teaching teachers in their programs to acquire necessary preparations in this regard.

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