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Students' difficulties and attitudes facing contextualized mathematical problems: A teacher perspective

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This research is carried after the implementation of the Mathematics Study Programs in Costa Rica, where one of the main curricular strands is contextualized problem solving. The aim is to find out the perceptions of teachers regarding the difficulties and attitudes of students when faced with mathematical problems in contexts close to everyday life. The survey of 67 teachers collected teachers' opinions on various statements. The results show that teachers mainly agree that students are actively involved and motivated in working with contextualized problems; but do not show a clear position about difficulty and complexity of contextualized problems as it is currently indicated in the literature. There are no significant differences between groups according to level of education, work experience or dedication to planning.

Introduction

The history of mathematics shows how knowledge has been constructed and reconstructed responding to the needs and demands of the social environment (Schwantes et al., 2019). Consequently, problem solving has accompanied the daily and academic work of humanity, and since the 1980s it has gained strength as a vitalizing strand in mathematics curricula (Blanco, 2015).

In the last thirty years, the presence of problems contextualized in the reality of the students in the curricula of several countries has increased (Puig, 2008), so as research in the contextualization (Albanese et al., 2017). In the case of Costa Rica, since the implementation of the "Mathematics Study Programs" (Ministerio de Educación Pública [MEP], 2012), the teacher has had to choose, create and adapt mathematical problems to increase the cognitive and motivational action of students. According to Baltodano (2018), this has been a very demanding task for the teachers, who have not had previous preparation for that. In the curricular documents available to teachers examples of problems provided are not always consistent with the stated theoretical references about contextualization, as we analysed in another publication (Chavarría & Albanese, 2021).

Moreover, as indicated by Mayela and Ballestero (2008), the teachers must not only select and adapt mathematical problems, but also be a guide and motivator of their students in the

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process of problem solving. Therefore, among others, it is essential that they know the difficulties their students face when solving these contextualized problems.

Despite it being a decade since the implementation of the mathematics study programs, we do not know the teachers' perceptions of students' difficulties and attitudes in solving mathematical problems contextualized in their sociocultural environment. This is precisely the objective of this paper.

Contextualized mathematical problems and attitudes

The Ministry of Public Education of Costa Rica indicates that working with contextualized problem solving not only allows activating higher order cognitive skills, but also promotes student motivation, as they perceive mathematics as being closer to their reality (MEP, 2012).

In this same line, a study by Chavarría (2014) indicated that contextualized problems (as compared to abstract mathematical problems) were better received by students, generating a feeling of being challenged and motivated to solve them. Similarly, Gómez-Chacón (2002) highlights that contextualized problems that emerge from real life can become motivating elements for students as they allow interaction with their experiences and close environments.

Difficulties in solving mathematical problems

Several studies have inquired about the difficulties that students face when solving problems and this includes, of course, those problems that are contextualized. In this regard, Chavarría (2014) explains that there are affective factors (lack of motivation, fear and doubts), poor relationships between mathematical concepts and previous knowledge, insecurity when facing new mathematical situations, poor relational comprehension and difficulties in reading comprehension. Regarding this last aspect, Blanco and Caballero (2015) reaffirm that among the most observed difficulties in their research, the following stand out:

> the lack of reading comprehension or lack of attention when reading the statement, the tendency to literally translate the problem statement into a mathematical expression, and the lack of knowledge of analysis elements of the situation posed and of specific heuristics. (p. 114, own translation)

Sánchez (2001) adds that the difficulty in solving mathematical problems lies not only in the student, but also in factors such as teaching methodology and teacher motivation. Buschiazzo et al. (1997) indicate that a problem has a difficulty in itself since it presents a novel situation for the student.

Methodology

This study is exploratory and descriptive, with a mixed quantitative and qualitative approach.

Participants were 67 in-service mathematics teachers from Costa Rica, selected through virtual sampling (González et al., 2018). The sample was characterized according to:

- Education: 43 teachers (64%) have studies beyond a Bachelor's degree in mathematics education, it means a Master or a PhD, while the remaining 24 (36%) have only a Bachelor's degree or a lower level diploma.
- Teaching experience: 29 teachers (43%) have less than 10 years of teaching experience, while 38 (57%) teachers have 10 or more years of teaching experience.
- Dedication to planning: 32 teachers (48%) report spending 3 or more hours per week choosing or developing problems, while 35 teachers (52%) spend two or less hours on this task.

A questionnaire was developed as data collection instrument, previously validated by the judgment of nine experts, specialists in different areas of research.

The data analysed in this communication correspond to items constructed in such a way that participants must provide a degree of agreement or disagreement according to a Likert Scale (from 1 to 5) with respect to statements elaborated by the researchers on various aspects related to the perception of students' difficulties and attitudes when solving mathematical problems. In each item of the Likert Scale, teachers were asked to indicate how much they agreed with certain statements, where 1 means strongly disagree and 5 means strongly agree.

Nonparametric hypothesis testing was performed due to the limited sample size.

Results

The contextualization proposed by the MEP (2012) in the Mathematics Programs of Study seeks to promote the active participation of students. In this regard, almost half of the teachers surveyed agree with this statement. In fact, 49% of them expressed they agree or strongly agree (score 4 and 5), while 39% express neither agreement nor disagreement (score 3) and only 12% express a disagreement (score 1 and 2). The box diagram in Figure 1 summarizes the information collected.

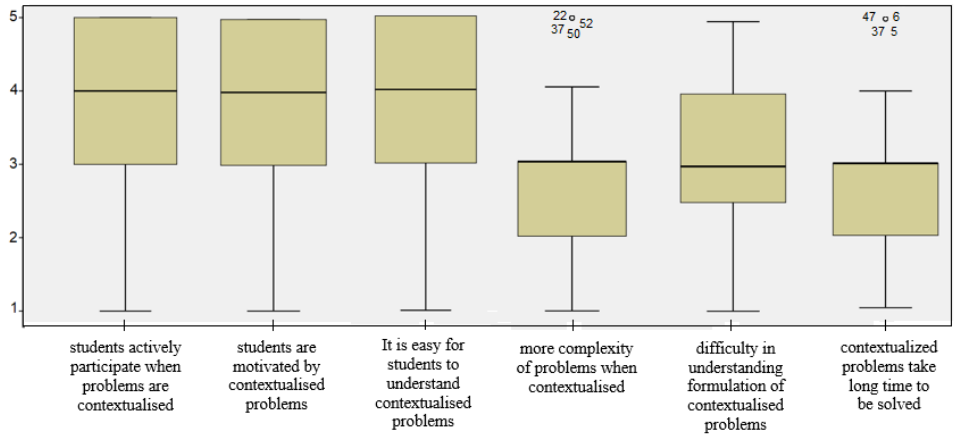

Figure 1: Box diagrams of teachers' level of agreement on the statements proposed.

In relation to a more emotional aspect, more than half of the teachers surveyed (58%) agree or totally agree that their students are motivated when mathematics problems contextualized in their reality are proposed to them, which is in line with what Gómez-Chacón (2002) stated. Only 11% of the teachers indicated that they disagreed or totally disagreed and the remaining 31% express neither agreement nor disagreement (score 3).

On the other hand, when teachers were asked whether they agree that it is easy for students to understand problems involving everyday situations, only 15% of them considered that they disagreed or strongly disagreed (score 1 or 2) with this statement, in contrast to 52% who agreed or strongly agreed (score 4 or 5). Teachers who neither agreed nor disagreed (score 3) were 33% (Figure 1).

On the same topic, teachers provided their opinion on whether a mathematical problem becomes more complex for the student when it is presented in a contextualized situation. In this regard, 48% indicated a degree of disagreement, 30% showed neither agreeing nor disagreeing, and the remaining 22% showed agreeing or strongly agreeing with this proposition (Figure 1).

Now, in order to deepen the teachers' perception of their students' reading comprehension, they were asked if, when they propose a mathematics problem with active contextualization, they consider that the student show difficulty in understanding the formulation. In this regard, the opinions were varied, 33% indicated agreeing or strongly agreeing, 42% neither agreeing nor disagreeing and the remaining 25% showed a degree of disagreement (Figure 1).

Statements	Mean	Median	Mode	Standard deviation
Students are actively involved in working with contextualized problems.	3,79	4	3	1,03
Students are motivated by contextualized problems.	3,82	4	5	1,07
It is easy for students to understand contextualized problems	3,36	4	3	1,11
Problems are more complex if they are contextualized	2,63	3	3	1,17
Student has difficulty understanding the formulation of a contextualized problem.	3,1	3	3	0,97
Contextualized problems take a long time to be solved.	2,87	3	3	1,04

Table 1: Descriptive statistics about the level of agreement on the statements proposed.

In addition, when the teachers were asked if the resolution of these problems requires a lot of time to be solved in class, 31% indicated disagreement or strong disagreement (score 1

and 2) and 24% showed a degree of agreement (score 4 and 5), while almost half of them indicated neither agreed nor disagreed (score 3). Figure 1 summarizes the information obtained on this aspect.

Finally, according to Blanco and Pino (2015), a mathematical problem presents a greater complexity in its resolution, compared to a traditional exercise, which implies a greater effort on the part of the students. Precisely, 58% of the participating teachers express to agree or totally agree in this aspect, 34% neither agree nor disagree and 75% are in disagreement.

In addition, when performing the nonparametric Mann Whitney test on the opinions of teachers regarding the items analysed, no statistically significant differences were identified between the degree of agreement and disagreement in all the statement according to the teachers' education. Nor were there statistically significant differences between the groups of teachers according to years of experience or the time they dedicate to planning problems per week. Table 1 summarizes the information with the respective statistical and significance values.

Conclusions

Teaching mathematics through contextualized problem solving is currently a very important curricular strand in countries such as Costa Rica. Its implementation and scope in terms of learning, motivation and skills achieved should be the subject of research.

This paper, addressing the teachers' perspective on this topic, showed that almost half of the participants agree or strongly agree that contextualized mathematical problems increase active participation in their students, while indicating that these problems allow the student to more easily understand the mathematical knowledge involved.

On the other hand, more than half of the respondents agree that the implementation of contextualized problems promotes students' motivation.

Regarding the teachers' perception of the complexity level and the difficulties that students may face, as well as the need for more time when solving contextualized problems, the data have shown a not so clear position. In fact, in the corresponding items the sample has been more evenly distributed, indicating that teachers do not clearly position themselves either in agreement or in disagreement of such statements. This has been surprising since contextualized problems are usually perceived as more demanding for the students, as previously highlighted in the literature (Sánchez, 2001; Buschiazzo et al., 1997; Blanco & Caballero, 2015).

Finally, it should be noted that no statistically significant differences were found in the opinion of the teachers about the statements described with respect to the groups of teachers divided according to education, teaching experience or dedication to planning.

We are aware of the limitations of studies based on a closed-items questionnaire. But this study is part of a broader research in which we propose to establish a more fruitful and dynamic dialogue with teachers to give answers to the some of the questions envisioned here.

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