# Mathematics Learning Challenges and Difficulties: A Students' Perspective


**David Wafula Waswa and Mowafaq Muhammed Al-kassab**

**Abstract** Mathematics is considered one of the core subjects that all students should learn to a certain level, and a lot of emphasize and importance is bestowed on it by almost all governments. However, students consider it a challenging subject that is difficult to understand. This research therefore seeks to establish what could be the major causes of difficulty in learning mathematics by students in the region. A questionnaire was distributed to 120 university students from five departments of the faculty of Education, and data collected and analyzed using one-sample t-test, two-samples t-test, and analysis of variance through the Minitab software. Results point to three major groups of sources of difficulties encountered by students in learning mathematics: learners' innate cognitive abilities, mathematics problem-solving processes and procedures, and external factors that include overcrowded classes, fear and anxiety, weak foundation, and instructors and instructional materials. Recommendations particular to the Kurdistan region were discussed and they include decongesting classrooms, investing in instructors by offering incentives and providing professional development opportunities, and adequately equipping students with the necessary learning tools and materials.

**Keywords** Descriptive statistics · t-test · Analysis of variance · Learning challenges · Mathematics competitiveness

## 1 Introduction

Mathematics has since been viewed as a "difficult" subject, and stereotypes characterizing this label abound. Such stereotypes eventually lead to fear that develops into mathematics phobia among students. The fear and/or phobia negatively impacts on

D. W. Waswa (✉) · M. M. Al-kassab
Department of Mathematics Education, Faculty of Education, Tishk International University-Erbil, Kurdistan Region, Iraq
e-mail: david.wafula@tiu.edu.iq

M. M. Al-kassab
e-mail: mowafaq.mohammed@tiu.edu.iq



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the students' learning of mathematics leading to poor performance in the subject. The various branches of mathematics present different and sometimes unique challenges to students. In Algebra, for instance, students encounter challenges in converting word problems into mathematical sentences represented by symbols [9], incorrectly substituting and misunderstanding the signs [2] is another common difficulty for students in tackling algebra. Kelanang and Zakaria [3] on the other hand, viewed the origins of the problems that students encounter in learning geometry from 3 perspectives: cognitive and developmental theories, orientation, concept formation, and operative comprehension. In calculus, a course that teachers agree by consensus to be difficult for students [8], students experience challenges with the rate of change concept [6]. In general, [7], generalized sources of difficulties in learning mathematics are categorized in 5 ways; self-factors, teachers, parents, friends, and what they termed as "other" factors. The "other" factors include issues like assessment pressure and the general nature of mathematics. They conceded that other factors like self-esteem, teachers' behaviour, parental cognitive abilities [13], and friends, greatly influence students' disposition towards mathematics learning. Acharya [1] while mostly concurring with the other researchers, he added 2 dimensions, students' prior knowledge and lack of students' labor as possible other sources of difficulty in studying mathematics. Indeed, students find it difficult to understand higher mathematics concepts if their foundation in the subject was weak [4]. It's not enough to just recall previously studied concepts, students must be able to apply them in higher-order mathematics and that is why prior knowledge is key to understanding mathematics. By 'students' labor', Acharya implied students' commitment to the subject. It is obvious mathematics students are required to put in extra hours of study and be committed to "doing" mathematics as opposed to "reading" mathematics, which many students do. But [10] summed the mathematics learning difficulties by putting them in 4 categories: mathematical objects and thinking processes, mathematics teaching processes, students' cognitive processes, and lack of rational attitude towards mathematics. In Kurdistan region of Iraq and in general the larger Iraq and Arab countries, the difficulties talked above are much more general. The general standards of education in the region are relatively low compared to many other places in the world. There are various theories explaining these poor standards of education, perennial unrest in the region and around it, and cultural beliefs that are rooted in family values, such that families would easily sacrifice education on the altar of marriage. For instance, it is common practice for students to repeat grade levels if the teachers deem the performance of the student to be below par. Such practice only serves to discourage students from pursuing learning because it demonstrates to the students that they are not good enough. Mathematics is considered all over the world as an important subject and is made compulsory in many countries for students up to the high school level. Kurdistan region is not an exception to this world trend. It is considered a core subject that all students must take in their early years through high school. Given the importance associated with the subject, many parents, and indeed students themselves also, struggle to continue with it despite the poor outcomes in many instances. This research therefore seeks to establish what could be the major causes of difficulty in learning mathematics by students in the region.

## 2 Methodology and Research Design

This study is quantitative research with data collected through a questionnaire. The study sample is from a private university in the Kurdistan region of Iraq. Respondents were randomly sampled from the 5 departments in the faculty of education at the university. The questionnaires were handed to respondents by selected responsible students and taken back after they were filled out. Even with this careful handling of the process, out of the 120 questionnaires distributed, 7 were found to be defective and therefore rejected. The remaining 113 were analyzed using the Minitab mathematics software and the results are presented below.

## 3 Results

Study results from the 5 departments of the faculty of Education as analyzed by the Minitab statistics data analysis software are presented below. First, descriptive statistics for each department were analyzed, Table 1.

**Table 1** Descriptive statistics analysis for each department

| Departments | Grade level | n | Mean | Median | SE Mean |
|---|---|---|---|---|---|
| ELT | 1 | 8 | 57.13 | 56.00 | 3.57 |
| | 2 | 11 | 52.73 | 46.00 | 5.57 |
| | 3 | 16 | 53.13 | 54.00 | 4.15 |
| | 4 | 12 | 69.42 | 66.00 | 7.01 |
| Biology | 1 | 7 | 56.71 | 57.00 | 5.51 |
| | 2 | 7 | 65.43 | 61.00 | 3.77 |
| | 3 | 5 | 68.20 | 69.00 | 3.12 |
| | 4 | 13 | 58.69 | 55.00 | 4.95 |
| Mathematics | 1 | 4 | 63.50 | 65.50 | 3.80 |
| | 2 | 3 | 66.67 | 66.00 | 1.20 |
| | 3 | 4 | 63.50 | 63.00 | 3.38 |
| | 4 | 2 | 100.00 | 100.00 | 1.00 |
| Physics | 1 | 3 | 53.67 | 46.00 | 7.67 |
| | 2 | 3 | 52.30 | 62.00 | 10.70 |
| | 3 | 3 | 59.33 | 60.00 | 3.48 |
| | 4 | 5 | 62.20 | 74.00 | 9.61 |
| Computer | 1 | 4 | 59.75 | 61.00 | 3.57 |
| | 2 | 3 | 55.30 | 65.00 | 11.70 |

From Table 1, it can clearly be seen that the sampled students from each of the five departments agree with the questionnaire, except for 4th grade mathematics students whose mean was way above 72.

**One-Sample t-Test Analysis**

After the descriptive statistics, the researchers also carried out a one-sample t-test for individual grade levels in each department. The t-test was based on the hypothesis that the average for individual grade levels in each department is 72 against the alternative hypothesis that the average is not equal to 72.

$$\text{i.e. } H_0 : \mu = 72$$

$$H_1 : \mu \neq 72$$

the results are shown in Table 2.

Table 2 indicates that slightly more than half of the grade levels in the 5 departments had no statistically significant differences in the answering of the questionnaire as can be seen from the P-Values that are greater than 0.05. Therefore, in each the null hypotheses were rejected at the mean $\mu = 72$. The exceptions are grade levels

**Table 2** One-sample t-Test analysis for grade levels in each department

| Department | Grade level | T-Value | P-Value |
|---|---|---|---|
| ELT | 1 | −4.17[a] | 0.004 |
| | 2 | −3.46[a] | 0.006 |
| | 3 | −4.54[a] | 0.000 |
| | 4 | −0.37 | 0.720 |
| Biology | 1 | −2.78[a] | 0.032 |
| | 2 | −1.74 | 0.132 |
| | 3 | −1.22 | 0.290 |
| | 4 | −2.69[a] | 0.020 |
| Mathematics | 1 | −2.24 | 0.111 |
| | 2 | −4.44[a] | 0.047 |
| | 3 | −2.52 | 0.087 |
| | 4 | 28.00[a] | 0.023 |
| Physics | 1 | −2.39 | 0.139 |
| | 2 | −1.84 | 0.207 |
| | 3 | −3.64 | 0.068 |
| | 4 | −1.02 | 0.365 |
| Computer | 1 | −3.43[a] | 0.041 |
| | 2 | −1.42 | 0.291 |

[a] Means significant at 5%

**Table 3** Analysis of variance within departments

| Department | F-value | P-value |
|---|---|---|
| ELT | 2.19 | 0.103 |
| Biology | 0.94 | 0.434 |
| Mathematics | 20.31[a] | 0.000 |
| Physics | 0.28 | 0.842 |

[a]Means highly significant at 5%

as can be seen in the table, including 4th grade ELT, 2nd and 3rd grade biology, 1st and 3rd grade mathematics, all grade levels in Physics, and 2nd grade computer.

One-way analysis of variance (ANOVA) was performed for each department to ascertain if there exist any differences in the grade levels within each department. This analysis was performed on 4 departments since the 5th department, Computer Education Department, had only 2-grade levels at the time of this research. Therefore, a Two-Sample t-Test was conducted instead.

Table 3 shows there was a statistically significant difference among the grade levels of mathematics department at $P = 0.000$. This significance is due to grade 4 which has a mean of 100 (see Table 1). The rest of the departments showed no significant differences among the grade levels. The two-sample t-test performed on the computer education department also returned a no statistically significant difference verdict as indicated in Table 4.

A separate descriptive statistics analysis for all departments was performed followed by a One-Sample t-Test and an analysis of variance to check for differences between and among the departments. The results are displayed below (Table 5).

It can be ascertained from the table that since all the means $\mu < 72$, students acting together as departments generally agreed or completely agreed with the questionnaires. On the other hand, the one-sample t-test shown in Table 6 indicates that

**Table 4** Two-Sample t-Test for computer education department

| Grade level | Means | T-value | P-value |
|---|---|---|---|
| 1 | 59.75 | 0.41 | 0.695 |
| 2 | 55.300 | | |

**Table 5** Descriptive statistics analysis for departments

| Department | n | Mean | Median | SE mean |
|---|---|---|---|---|
| ELT | 47 | 57.87 | 54.00 | 2.81 |
| Biology | 32 | 61.22 | 60.50 | 2.56 |
| Mathematics | 13 | 69.85 | 66.00 | 4.00 |
| Physics | 14 | 57.64 | 61.00 | 4.19 |
| Computer | 7 | 57.86 | 62.00 | 4.91 |

**Table 6** One-sample t-Test for departments

| Department | n | T-Value | P-Value |
|---|---|---|---|
| ELT | 47 | −5.04[a] | 0.000 |
| Biology | 32 | −4.22[a] | 0.000 |
| Mathematics | 13 | −0.54 | 0.600 |
| Physics | 14 | −3.42[a] | 0.005 |
| Computer | 7 | −2.88[a] | 0.028 |

[a]Means significant at 5%

**Table 7** One-way analysis of variance for departments

| Source of variation | Degree of freedom | Sum of squares | Mean sum of squares | F-value | P-value |
|---|---|---|---|---|---|
| Between departments | 4 | 1627 | 407<br>280 | 1.45 | 0.221 |
| Error | 108 | 30,200 | | | |
| Total | 112 | 31,828 | | | |

all departments except the mathematics department reject the null hypothesis. The one-sample t-test analysis for departments is shown in the table below.

The One-way analysis of variance for all departments is shown in the Table 7.

The one-way analysis of variance for the departments resulted in no rejection of the null hypothesis indicating that there was no statistically significant difference among the departments.

The last analysis performed was the descriptive analysis for each scale item on the questionnaire, and the results are depicted in the table below.

The descriptive data in Table 8 can be analyzed in three broad ways; there are items associated with the students' own inability to grasp the concepts. As can be seen from the table, 71% of the respondents agree that mathematics is difficult to understand. These agree with more than half, 56%, who accepted that they had difficulties in interpreting mathematics questions. It's obvious that if a student is not able to interpret a question, then such a student will consider the question to be difficult because interpreting is the very beginning of the problem-solving process. Clearly, it's not the mathematics vocabulary that makes it difficult to interpret, and therefore, understand the question. This is evident in the table that more than half of the respondents disagreed with the notion that mathematics vocabulary was difficult to read. This, therefore, leaves us to conclude that it is the mathematics content and or context that is difficult for students to interpret and understand, indeed almost 70% of them expressly said that they are not able to understand the meanings of mathematical expressions. To reinforce this, almost 60% of the respondents confirmed that they do not have the requisite critical thinking abilities for mathematical problem-solving. Critical thinking is necessary for students to recognize quantitative facts and relationships in a mathematical problem in order to solve it, therefore it's not surprising that more

than 50% of the are not able to recognize these facts and relationships. Which is not surprising that three quarters of them are not even able to relate lessons to previous ones in order to make sense of the mathematical content. If students are not able to relate two or three lessons, then it would be very difficult for them to relate concepts, hence the difficulties in understanding the subject.

Besides the students' own inability to grasp concepts, the scale items also brought to the fore the difficulties students encounter in understanding the procedural aspect of mathematical problem-solving. As clearly depicted in Table 8, almost 80% of the respondents had difficulties understanding rules and/or methods of problem-solving in mathematics, and almost the same number, 78%, had difficulties in choosing appropriate methods for solving mathematics problems. Indeed, it follows with certainty that such students would find it almost impossible to follow the steps involved in solving mathematical problems, as is seen in the table that about 72% were not able to or find it difficult to do so, and almost 80% find it difficult to understand the rules of mathematical order of operations. As a clear indication, data also shows that over 70% of the respondents confess that they get confused by too many mathematical formulas. It is therefore clear that most students experience some form of difficulties in understanding mathematical procedures and algorithms.

The last aspect of this descriptive data is the external interferences. The data reveals other factors like technology, fear, attitude, teaching materials, and instructors. Table 8 shows that almost 80% of the respondents had a weak foundation in mathematics, and this is clearly displayed by the 75% who accepted that they were unable to continue with mathematics lessons, and the 70% who become uncomfortable or shy away from asking questions in class. The weak foundation may be attributed to the instructors or perhaps instructional materials like textbooks and classroom technology. For instance, 76% of the respondents agree that the textbooks used are not appropriate, and 73% suggest overdependence on technology to solve mathematics problems. This could also have been caused by overcrowded classrooms, 78%, or negative attitude towards the subject as shown by 72% of the respondents. Teachers take a fair share of the cake, 74% agree that teachers are not able to deliver the lesson to students effectively, and 77% think that teachers are unable to use mathematical language that students understand in formulating problems.

## 4 Discussion and Conclusion

It is evident that mathematics subject presents challenges to learners in various ways and causes of which vary as well.

**Table 8** Descriptive statistics analysis for all items

| Scale item | Completely agree | Agree | Not sure | Disagree | Completely disagree |
|---|---|---|---|---|---|
| Mathematics is difficult to understand | 38 | 33 | 12 | 12 | 5 |
| Difficult to understand rules/methods of problem solving | 21 | 38 | 18 | 14 | 7 |
| Weak foundation in mathematics | 23 | 38 | 23 | 12 | 4 |
| Difficult to interpret mathematics questions | 20 | 36 | 22 | 18 | 4 |
| Too many students in a class affects understanding | 32 | 38 | 8 | 16 | 6 |
| Difficult to read mathematics vocabulary | 13 | 35 | 16 | 23 | 13 |
| Difficult choosing appropriate methods for solving problems | 27 | 28 | 23 | 19 | 3 |
| Difficult to follow all steps in solving a mathematics problem | 30 | 27 | 15 | 20 | 8 |
| Difficult to understand rules of mathematical order of operations | 26 | 34 | 18 | 15 | 7 |
| Dependency on technology to solve mathematical problems | 20 | 27 | 26 | 19 | 8 |
| Lack of critical thinking in solving mathematical problems | 20 | 39 | 19 | 16 | 5 |
| Inability to recognize quantitative facts and relationships in a mathematical problem | 22 | 33 | 16 | 23 | 6 |

(continued)

**Table 8** (continued)

| Scale item | Completely agree | Agree | Not sure | Disagree | Completely disagree |
|---|---|---|---|---|---|
| Inability to understand the meanings of mathematical expressions | 28 | 40 | 14 | 12 | 6 |
| Fear of failing to solve a mathematical problem | 29 | 23 | 27 | 14 | 7 |
| The teacher is unable to deliver the lesson to the students effectively | 25 | 28 | 21 | 22 | 4 |
| Negative attitude towards mathematics | 26 | 21 | 25 | 20 | 8 |
| The teacher is unable to use mathematical language that the students understand in formulating problems | 22 | 31 | 23 | 17 | 7 |
| Fear of failing to solve a mathematical problem | 29 | 23 | 27 | 14 | 7 |
| Students' inability to relate the lesson to the previous one | 19 | 34 | 22 | 22 | 3 |
| Inability to continue with the lesson | 19 | 34 | 22 | 20 | 4 |
| Feeling uncomfortable when solving a problem | 27 | 24 | 16 | 16 | 15 |
| Feeling shy to ask questions in class | 26 | 28 | 16 | 13 | 17 |
| Repeated absences that lead to lack of understanding of the subject | 21 | 34 | 23 | 19 | 3 |
| The course book is not appropriate for students | 26 | 26 | 20 | 19 | 9 |
| Confused by too many mathematical formulas | 31 | 26 | 17 | 13 | 13 |

## 4.1 External Factors

In this research, it was found that students in the Kurdistan region exhibited are affected by external factors that affect their understanding of mathematics concepts.

***Weak Foundation***

It is evident in some of the results such as a weak foundation in mathematics from the early years in school contributes immensely to the difficulties experienced in later years. This result was also found by the rand group [11] which established that more than two-thirds of Kurdish students have been retained at least one year by the time they reach grade 9, and that in about two-thirds of urban schools, more than 50% of students failed the school's assessment in 2007–2008. This paints a grim situation for educators, more specifically, mathematics educators in the region. One possible explanation for this would be the unrest that has bedeviled the region. After the Iraq war, which lasted for a long time and disrupted all aspects of human development including education, the semi-autonomous Kurdistan region became relatively stable in terms of peace, and this attracted rapid development in terms of education and even physical infrastructure. That's until the ISIS crises that brought uncertainty in the region again. All these cause immense negative consequences on the education sector in the region.

***Overcrowded Classes***

Overcrowded classes are another reason for poor performance in mathematics. This result is also shared by [11] through the Rand organization found that school infrastructure in the Kurdistan region is not in tandem with the growth pace. They affirmed that all schools at all levels are overcrowded, in poor conditions such that they don't keep up with the rapid growth of student enrollment, leaving no room but double shifts. The lack of sustainable peace in the larger Iraq and war in the neighboring Syria saw an influx of people in the relatively peaceful Kurdistan region [12]. Indeed, many expatriates especially dealing with peace in the larger Iraq and Syria set up office in Erbil, Kurdistan. These large numbers of people exert pressure on the limited resources in the region, and this includes education facilities.

***Fear and Anxiety***

Fear of and negative attitude towards mathematics creates anxiety in students contributing heavily to lowering standards of mathematics. This research confirmed [5] who found out that mathematics anxiety negatively affects many students' understanding of mathematical concepts. In the Kurdistan region, this anxiety may be attributed to stereotypes that the larger Middle East is good in mathematics and therefore students in Kurdistan should automatically be good in the subject. This puts too much pressure on the students which serve to inhibit creativity in the mathematics classroom.

***Instructors and Instructional materials***

The researchers also established that instructors and instructional materials are other factors affecting students' understanding of mathematics. In the Kurdistan region, as was established by [11], there is an insufficient number of teachers, and the number is not increasing at a matching pace with the rapidly increasing number of students. This imbalance puts too much pressure on teachers and thereby impacting negatively their delivery of lessons. Compounding the problem is the fact that the few available teachers are ill-trained and ill-equipped to do their job, as concluded by the Rand group. The lack of standard textual materials and classroom technology in many schools exacerbates the problem for teachers, leading to poor performance by students due to a lack of understanding of basic concepts.

## *4.2 Mathematical Procedures in Problem-Solving*

This research established that many students experience difficulties in following and/or understanding the procedures involved in mathematical problem-solving.

***Understanding Rules***

Many students seem to get confused with mathematics formulas. In the research, participants acknowledged finding it difficult to follow the rules of mathematics such as the order of operation, or even understanding formulas like the quadratic formula. In this case, the possible logical explanation would be a poor foundation in the subject as described above. It is also possible that poor instructions are given by instructors who are not fully equipped or supported appropriately through training and the provision of classroom materials like textbooks.

***Choosing Appropriate Methods***

This may come as a surprise to many mathematicians, but this research found out that many students are at a loss as to what methods they should use for what problems. Many of them acknowledged being confused by "too many" mathematical formulas. This observation may be attributed to poor instructional strategies by teachers, lack of interest in the subject by students, and the external factors discussed above.

## *4.3 The Learners Cognitive Abilities*

In the research, most respondents acknowledged that they just cannot understand mathematics, saying that they experience difficulties right from the problem interpreting stage. They reinforced this notion by confirming that they were unable to recognize quantitative facts and relationships in a mathematical problem, and even understand the meanings of mathematical expressions. Many agreed that they find

it difficult to relate lessons and therefore could not see any flow in concepts. This phenomenon may also be due to poor instructional strategies that lead to disinterest among learners.

## 5 Recommendations

Based on this study, education stakeholders in the region need to incentivize the teaching profession in order to attract more people. The classrooms need to be decongested and be adequately provided for in terms of classroom materials such as physical manipulatives, classroom technology, and textual materials. More professional development courses, seminars, and/or workshops for instructors to better their instructional strategies and keep up with the latest developments in the industry.

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