Social Science and Humanities Journal
Everant Journal
ISSN: 2456-2653
https://sshjournal.com/
Impact Factor: 2024: 6.576
2023: 5.731
Volume 09 Issue 05 May 2025
DOI: https://doi.org/10.18535/sshj.v9i05.1829

The Current Status Of Context-Based Teaching in Mathematics at High School of Lao People's Democratic Republic

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Received 02-04-2025
Revised 03-04-2025
Accepted 05-05-2025
Published 07-05-2025

Abstract:

The article presents the current staus of teaching algebra 10 in connection with the real context in the Lao People's Democratic Republic (Lao PDR). The authors used investigative methods, practical surveys and expert methods in data collection. The data are analyzed using descriptive statistics with the purpose of assessing the current status of context-based teaching in high-school mathematics. The research results show that Laos' curriculum and textbooks are still limited in connecting school mathematical knowledge with practical problems. In addition, the survey results also showed that the majority of math teachers do not have the ability to teach mathematics in a real context, and students' ability to solve problems related to real contexts is still limited. As a results, the authors propose pedagogical measures to teach algebra in connection with real contexts in high schools of the Lao PDR.

Keywords: Practical problem, real context, context-based teaching, teaching algebra, problem-solving competence.

1. Introduction:

Context-based teaching provides an alternative teaching method to traditional teaching methods that focus on knowledge transfer activities. This concept was originated in Canada in the 1960s and the origin of this educational method is social constructivist theory (Hang, 2014). Context-based education is an approach that has been focused on in many developed countries such as England, Germany, the United States of America, the Netherlands and attracts the participation and research of many leading scientists, educators. Those studies mainly focus on using real contexts connected to lesson knowledge in text books during the teaching process. The first contextualized education project was started in the

Netherlands in the 1970s for students aged from 6 to 12 years old. In the United Kingdom, context-based learning was first designed by the Salters project in 1983 for students aged from 17 to 18. In

the United States, in the 1980s, efforts began to encourage educational reforms that would facilitate the "transition" of students from school to the world of work and real life (Hang, 2014).

Regarding mathematics, one of the central themes of mathematics education during the past three decades has been teaching mathematics in real contexts and applying mathematics in real life. More generally, that is the relationship between mathematics and practice (the world outside mathematics). Real mathematics in formal mathematics education first appeared at the Freudenthal Conference in 1968 (Blum, 2007). Teaching mathematics in a real context was first mentioned by the National Council of Teachers of Mathematics (NCTM) in 1989 in the United States and then teaching mathematics in a real context was interested, researched and applied by countries around the world (Romberg, 2001). Real-world context or real context involves simplifying a complex real-life situation, creating a mathematical model, solving mathematical problems on that model, and responding to the real-world situation. A number of studies have also confirmed the importance of real context in teaching mathematics to help students learn, discover and solve situations arising from practice, from which they see the connection between mathematics and practice (Nguyen et al, 2019; Trinh & Chu, 2021). Boaler (1993) suggests that moving away from abstract mathematics and toward mathematics in real context is seen as illuminating the demands of real life problems and to prepare students for the mathematical demands they will face in everyday life.

According to the ideas and development of mathematics in context by Romberg (2001), the foundation of mathematics in context is actually a combination of three things: NCTM curriculum and assessment standards, a research base based on a problem-oriented approach to mathematics teaching, and the Dutch practical mathematics education method. Some research showed that students' ability to apply mathematics in different contexts in everyday life is considered a core goal of mathematics education (Fauzan, 2002; Boaler, 1993). According to Romberg (2001), mathematics in context is a comprehensive mathematics program for middle school. It was developed by the Wisconsin Center for Educational Research, School of Education, University of Wisconsin-Madison, and the Freudenthal Institute at Utrecht University, the Netherlands. Curry (2012) argue that mathematics in context is a comprehensive mathematics program for students of all ages. In particular, it promotes the development of problem-solving abilities linked to real contexts, enhancing the ability to explore mathematical concepts for middle school to university students. Wijaya et al (2015) argue that one of the main goals of mathematics education is to enable students to apply mathematics to real-life situations; context-based learning theory focuses on many different aspects of a learning environment, encouraging educators to select and design learning environments that incorporate different activities to attract learners' senses, thereby enhancing students' interest in learning. According to Bitterlich (2020), in mathematics education, real-life contexts are often used to attract students' attention and promote their understanding of learning content. Through the use of real-world contexts, mathematical tasks become more subjective and personal for easier access to mathematics.

Tran (2018) has shown that for every student in high school, having good mathematical thinking is closely related to the ability to analyze, solve problems, and express ideas effectively in real-life situations, often beyond common problems in school. Regarding teaching methods associated with real contexts, Nguyen et al (2019) introduced the concept of teaching mathematics based on context and by context, meaning that students' learning activities need to be placed in context. Tran & Nguyen (2020) said that to organize teaching in a way that is tied to the practical context, teachers need to base on the given orientation, and at the same time flexibly apply appropriate teaching techniques and forms to bring high efficiency. The author has proposed

three measures for teaching algebra and calculus grade 11 in a way that is linked to the practical context in high schools. Nguyen (2020) confirmed that teaching mathematics in real context is an educational process that helps learners understand the meaning of learning by connecting specific math content with the context of daily life; focus on learners' emotions, knowledge and experiences.

Pham (2021) has affirmed that using 'practical situations with real contexts' in teaching mathematics for elementary school students will create many values in students' mathematics learning, so that students can see that studying mathematics is not just to learn 'pure mathematics' knowledge and skills. The author has proposed four steps to design practical situations with real contexts. Thanh & Nguyen (2021) clearly stated that in order to design geometry problems with practical content associated with mountainous areas, first of all, teachers must firmly grasp the curriculum, textbooks, the requirements to be met for each content and the level of students as a basis for designing the problems. Besides, teachers need to have certain knowledge about the locality, about living conditions, about regional culture. In other words, teachers must learn about local reality, learn about the reality of students' lives to have appropriate, close connections with students' daily lives. Trinh & Chu (2021) said that teaching mathematics associated with real contexts is understood as using context to carry out teaching activities to achieve the goals of knowledge, skills and attitudes for students; thereby forming and developing students with necessary abilities and perfecting their personality. Ho & Nguyen (2022) said that context-based teaching is a teaching approach that involves students actively participating in the learning process, playing a central role in this process, proactively acquiring and applying knowledge in many diverse contexts by teachers. At the same time, contextual teaching is an educational process that helps students see the meaning of the knowledge they learn by connecting that knowledge to the cultural, social and everyday context. The author has proposed context-based teaching stages that promote students' problem-solving competence. Nguyen & Huynh (2024) affirmed that situations with real contexts in teaching mathematics are teaching situations in which teachers play the role of transforming those situations into learning tasks and practical problems, thereby helping students apply mathematical knowledge to solve problems. The study has introduced the criteria for a contextual situation in teaching and the process of designing situations with real context in teaching mathematics.

In Lao PDR, there have been a number of research projects on mathematics education, mainly researching on active student activities, some other research focuses on issues such as exploiting teaching methods, developing teaching capacity for pedagogical students, designing and using modular materials in teaching. Ammone (2022) clarified theoretical issues about modeling capacity, components of modeling capacity, proposed a modeling process in teaching algebra 10 in high schools of the Lao PDR, researched the current status of teaching modeling in high schools of the Lao PDR and proposed pedagogical measures for teaching algebra 10 towards developing modeling capacity for students. Her (2021) has shown an overview of teaching practices in high school mathematics teacher education in the Lao PDR. The study has evaluated the current situation of organizing teaching practice in teacher education and proposed measures to organize learning practice in training high school mathematics teachers at pedagogical schools in Lao PDR. Vonglathsamy (2022) has proposed feasible and effective measures for teaching probability and statistics in high schools of the Lao PDR.

The practical applications of mathematics in the curriculum and textbooks, as well as in the actual teaching of mathematics, have not been paid attention in the Lao PDR. Situations and exercises in math textbooks in general and in algebra 10 in particular often only focus on exercises that require students to only apply mathematical

knowledge, or make practical assumptions, with very few interdisciplinary exercises or exercises related to real life practice. Furthermore, in the reality of teaching mathematics, teachers do not often or have difficulty using teaching methods linked to real situations, so the practical relevance in teaching is not high. The survey shows that teaching in high schools of the Lao PDR still focuses heavily on presentations and explanations of pure mathematical knowledge; students mainly passively absorb abstract theoretical knowledge, rarely practice relating knowledge to reality, and rarely apply theory to life. Thus, it can be seen that research on teaching mathematics associated with practice in high schools is still limited, there is no research on teaching mathematics associated with real contexts. Therefore, in order to have in-depth research on teaching mathematics in connection with real contexts in teaching mathematics, it is necessary to have research to understand the current situation of teaching mathematics in connection with real contexts in high schools of Lao PDR.

2. Research Methodology:

The article uses secondary document research and practical research methods. The data in the article were collected through the process of investigation and survey at seven high schools belonging to two high schools in the capital Vientiane: Vientiane - Ho Chi Minh Friendship High School, Lao - Vietnam Friendship Secondary School and five high schools in other provinces of Laos: Luangnamtha Secondary School, Luangnamtha Province; Phou Khoun Secondary School, Luang Prabang Province; Napa Secondary School, Xieng Khouang Province; Boarding School, Sa Van Na Khet Province (Savannakhet Province) and Champa Sac - Lam Dong Friendship Gifted High School (Phonesavan high school), Champasak Province. These are high schools representing different areas in terms of infrastructure conditions in the capital, central cities, rural areas, and mountainous areas, in terms of students' cognitive level and economic conditions of students' families. The above diverse selection of schools helps ensure objectivity and reliability of research results. Investigation and survey methods are used to evaluate the current situation of applying context-based teaching approach of high school students in Lao PDR, thereby pointing out shortcomings and limitations and proposing solutions. Survey tools are surveys using questionnaires described on a 4-level Likert scale. The questionnaire survey results were analyzed using Microsoft Excel statistical data processing software. The survey subjects were randomly selected including 70 mathematics teachers and 245 students from the above high schools. In-depth interviews with math teachers were also used for the research team to analyze the causes of shortcomings and limitations in learning associated with real contexts. The system of semi-structured interview assessment questions for teachers was recorded and analyzed based on consultation with a number of educational experts. In addition, the research team analyzed the 10th grade math curriculum and textbooks, and used expert methods to clarify perspectives in reforming the general education curriculum of the Lao PDR. Perspectives on educational program innovation are recorded, analyzed and presented in the current situation section of the article. Mathematical statistical methods were also used to evaluate the real context-related competencies of teachers and students of high schools participating in the survey.

3. Research Results:

Content of algebra in grade 10 mathematics curriculum

Real-life contexts help connect mathematics content in schools with real life, especially knowledge of algebra in the curriculum. Therefore, this study focuses on analyzing the content of Laos' 10th grade algebra curriculum and textbooks. The results show that the problems, examples, and exercises that are related to practice are very few. Exercises and examples in high school math textbooks are divided into two basic types: "pure mathematics" problems and problems with practical situations, in which problems with practical situations are mainly hypothetical

situations. Statistics show that the number of exercises and examples in the Laotian high school grade 10 math textbook under the current program has 271 exercises, including 37 exercises describing hypothetical situations (accounting for about 13.65%) (see Table 1), the content of the algebra section (algebra and trigonometry) in the Laotian high school grade 10 math textbook has only 8 exercises describing real-life situations (accounting for about 2.95%) and have not seen practical problems associated with real contexts in the Laotian high school grade 10 math textbook (see Table 2).

Table 1. Number of exercises and examples in the Laotian high school grade 10 mathematics textbook

Grade 10	Quantity	Total	Quantity in mathematics textbook	
			Pure mathematics	Practical mathematics
Exercises	Number	271	234	37
	Ratio	100%	86.34%	13.65%
Examples	Number	251	211	40
	Ratio	100%	84.06%	15.93%

Table 2. Number of exercises and examples (pure mathematics, practical mathematics, real-life mathematics) in the algebra section of the Laotian high school grade 10 mathematics textbook

Grade 10	Quantity	Total	Quantity in algebra section		
			Pure mathematics	Practical mathematics	Real-life mathematics
Exercises	Number	90	82	8	0
	Ratio	100%	91.11%	8.88%	0%
Examples	Number	95	89	6	0
	Ratio	100%	93.68%	6.31%	0%

In addition, some problems related to practice are hypothetical situations that require students to apply mathematical properties and calculation methods to solve problems. There are very few problems that require students to apply mathematical knowledge to solve problems in real-life situations. There are a number of questions asked students to solve practical problems in the content of lessons such as: calculations in sets, constant functions and first-order functions, quadratic, quadratic inequality, counting rules.

Example 1. (Grade 12 math textbook, page 176) The relationship between the costs of advertising the goods and the income derived from the sale of the goods is given by the table below (in thousands of kip). Calculate the income from selling goods if you invest in advertising costs in the amount of 550,000 kip.

Table 3. Statistics on advertising costs and sales revenue

Advertising costs (x)	Revenue from sales (y)
610	7825
502	4758
790	8100
350	3900
189	2125

Based on the data in Table 3, teachers guide students to find the equation describing the above relationship, thereby making predictions about income from commodity trading. The calculation results give a functional model representing a linear relationship: $\hat{y} = 142{,}79 + 10{,}66x$, where $\hat{y}$ is the proceeds from sales, x is advertising costs (in thousands of kip). From this model, students can calculate the income from selling goods if they invest advertising costs with the amount of 550,000 kip: $\hat{y} = 142{,}79 + 10{,}66(550) = 6005{,}79 \approx 6.005.790$ kip.

Example 2. (Grade 11 mathematics textbook, page 115) Knowing that in 2013, the population of Lao PDR was p_0 = 6,695,000 people and the population growth rate that year was r=2%. How many people will the population of Lao PDR be after 2030 if the population growth rate remains unchanged?

Example 3. (Grade 10 mathematics textbook, page 93) Kham drove from the center of Vientiane capital at a speed of 60 km/h to Tha Lat village, a distance of 85 km. Meanwhile, Sy drove from Tha Lat village at a speed of 40 km/h towards the capital Vientiane using the same route as Kham. How many kilometers from the center of Vientiane capital will these two people meet?

Example 4. (Grade 10 mathematics textbook, page 47) An exam has 120 students participating, knowing that each person must register for at least one subject. After registration, the organizers saw that there were 60 students registered to take the math test, 50 students registered to take the physics test and 72 students registered to take the chemistry test. The number of students who registered for the math and chemistry exam was 27, chemistry and physics was 30. There are 20 students who register to take all three subjects. Ask how many students only take math, knowing that there are 15 who only take physics?

Thus, it can be said that in 10th grade algebra content, there are only 6 examples and 8 exercises related to real-life situations. The analysis also shows that in the 10th grade algebra section, there are a number of practical problems with content that can build situations related to real contexts such as: math operations on sets (2 examples and 4 exercises), quadratic functions (2 examples and 3 exercises), quadratic equation (2 examples), cubic function (1 exercise). In addition, the content on 'trigonometry', 'applying derivatives' has (2 examples and 3 exercises) and 'applying integration' has a number of examples and exercises that can be developed into problems with real-life contexts.

Teaching mathematics in high school is aimed at helping students develop thinking and understanding of basic mathematical skills at the high school level, develop and use mathematical knowledge and skills in real life, in other subjects and continue studying at higher levels or professionally at home and abroad. Algebra content in Laotian textbooks includes main contents such as: solving equations, systems of equations, inequalities and systems of inequalities, trigonometric equations and inequalities, survey graphs of quadratic and cubic functions, rational functions, logarithmic functions, exponential functions, trigonometric functions and quadratic

functions, calculate the area limited by graphs of functions, calculate the volume of rotating circular objects created by rotating graphs of functions around coordinate axes, know how to predict problem models using graphs, solve basic problems of plane geometry and spatial geometry, solve statistical problems, know how to use mathematical knowledge to solve problems of other sciences, know how to apply mathematics to solve practical problems. Therefore, teachers have many opportunities to develop examples, problems, and exercises related to practice in teaching these contents, in order to contribute to the development of problem-solving competence for students and strengthen the connection of mathematical knowledge in school with students' real-life problems.

The current situation of teaching algebra 10 in connection with the real context in high schools in the Lao PDR

Teachers' Opinion

To find out the current situation of teaching algebra 10 in real contexts in high schools in the Lao PDR, we surveyed 70 high school mathematics teachers. Surveying teachers' awareness of teaching mathematics linked to practice, the results are shown that only 5.71% of teachers knowing how to teach mathematics in connection with practice. The survey results show that the majority of teachers know about teaching mathematics in connection with practice, but there are very few teachers who have taught in connection with practice, very few teachers have heard of context-based teaching mathematics, and there are no teachers who have taught in connection with real contexts. Teaching linked to practice and real contexts have a close relationship, teaching linked to practice is an important premise for implementing teaching linked to real contexts or context-based teaching. With the above survey results and from the relationship between teaching linked to practice and context-based teaching, we will not survey teachers about teaching experiences linked to real contexts in teaching mathematics, but instead we will survey teachers about the premises of context-based teaching - teaching linked to practice.

The survey shows that mathematics teachers in Laotian high schools are interested in teaching in a way that strengthens the connection between mathematics and practice. The level of interest of teachers in teaching related to practice is as follows: low level (71.42%), good level (7.28%). Evaluating the students, according to the teachers, there is no student who shows no interest or little interest in practical math lessons. Teachers rarely learn about practical applications of mathematics in life (62.42%). In particular, a number of teachers (5.71%) quite often do this. Only a few teachers (10%) have used issues around daily life that have a direct impact on learners (i.e. teaching in a real context) to form mathematical knowledge for students nad 70% of teachers rarely use this well.

To learn more, we interviewed in-depth a number of teachers interested in teaching in the direction of strengthening the relationship between mathematics and practice. We found that some teachers said they were interested because context-based teaching is a trend in the world to develop students' abilities, and the students have good cognitive abilities, and favorable teaching conditions. Some other teachers said that they did not pay attention to context-based teaching because their students were very poor. Problems related to reality that were not close to students often made it difficult for them to understand. Real-life situations that are close to students and attached to activities in life and learning will make students find it easier to understand. Likewise, when asked about how often teaching is related to real-life contexts, most of the interviewed teachers said that it is not often because they have not been approached and are not clear on how to do it. Thus, the interview results are quite similar to the questionnaire survey results. Furthermore, the results obtained from the interviews help us better understand the reasons why teachers do not care about teaching in the real context. In fact, interviews and questionnaire surveys have also

shown that if teachers care, they often do it, but if teachers do not care, they rarely do it. The main cause of this problem is that the content of the algebra curriculum is too heavy, while the number of teaching periods is small, teachers do not understand and have not reinforced examples, exercises associated with real contexts for students. The main teaching technique is presentation and especially students have hardly participated in experiential activities, especially experiential and application activities related to their real life practices.

The level of teachers' use of practical situations in teaching algebra 10 content such as sets, quadratic functions, trigonometry and integral functions: 50% of teachers occasionally, 10% of teachers regularly, 2.85% of teachers very often and 49.14% teachers never used practical situations. The research also found that teachers use practical situations in teaching activities such as in introductory activities (identifying problems), activities to form new knowledge, practice activities, application activities. The results are shown in Figure 1 that 10% of teachers use introductory activities, 17.14% of teachers use activities to form new knowledge, 10% of teachers use practice and reinforcement activities and 17.14% of teachers use application activities.

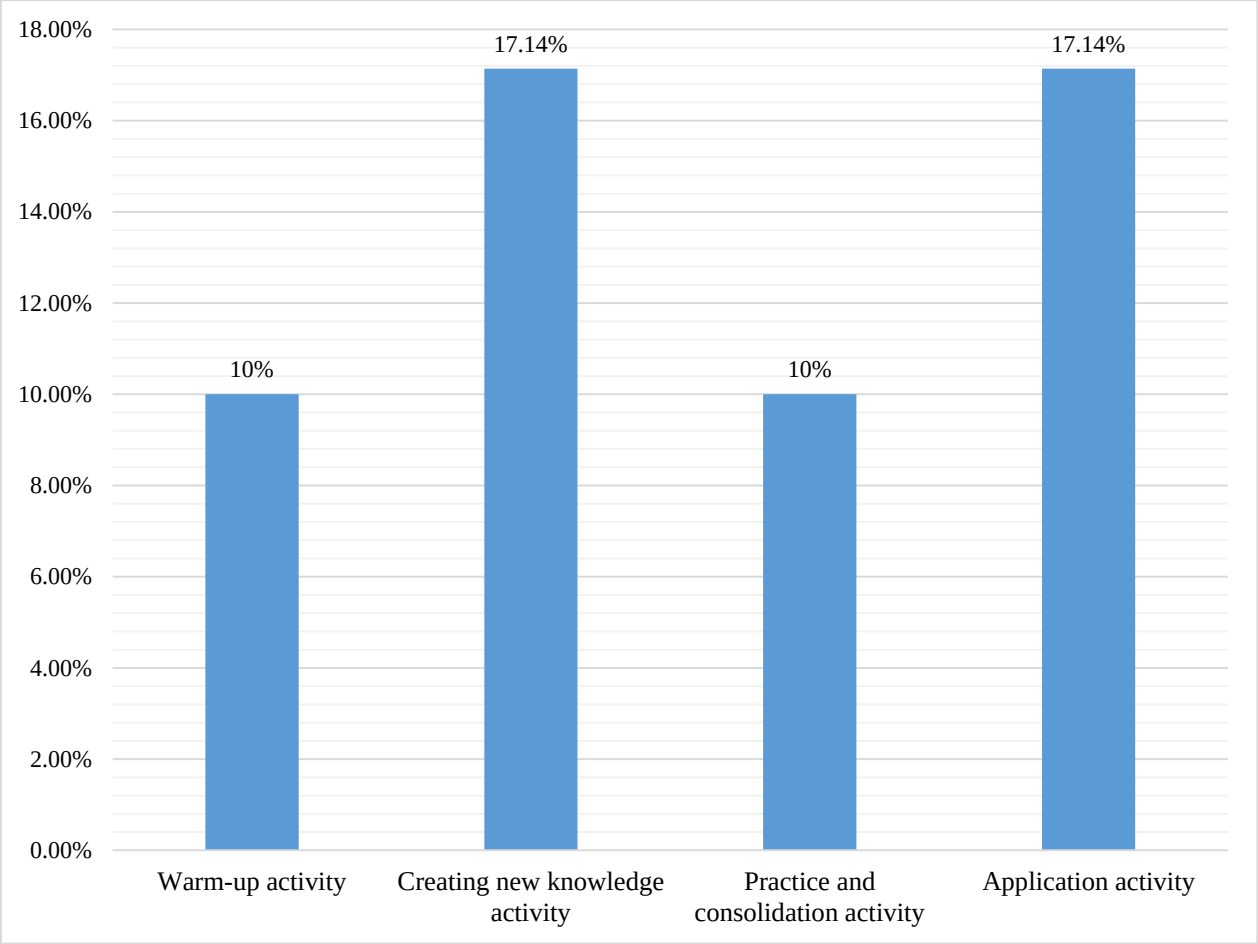

Figure 1. Teaching activities use practical situations

Through in-depth interviews, teachers said that the above results is due to the habits and psychology of teachers who are too dependent on textbooks, do not dare to change and are afraid to change teaching content other than textbooks, thereby leading to teachers' teaching style only focusing on knowledge of mathematical sciences, paying little attention to problems associated with real contexts. To verify the reliability of the survey results, we interviewed some more teachers about when to use real-life situations in teaching algebra 10. The interview results showed some teachers thought that only doing introductory activities to create learning excitement for students, some

teachers only use practice in knowledge application activities. Through interviews, it was also found that the time to use context-based situations depends on the teacher's pedagogical purposes, the teaching subjects and the difficulty of the situations, depending on the pedagogical competencies of the teachers and the students.

Regarding the use of practical situations in testing and assessment in teaching mathematics, survey results show that most teachers do not use practical questions or exercises, only 1% of students think that teachers do. Difficulties in implementing practical situations in teaching mathematics, most of the surveyed teachers encountered many difficulties when implementing context-based in teaching mathematics such as: students' skills in solving practical problems are limited, not enough time for teaching or students are not interested in learning, textbooks have very few practical situations, and limited learning resources for teaching, context-based situations of students in different regions have not been designed so that students can see the meaning of mathematics in life, insufficient teaching facilities, practical problems associated with the topic are few, and teachers' skills in designing practical situations for teaching are still limited (see Figure 2).

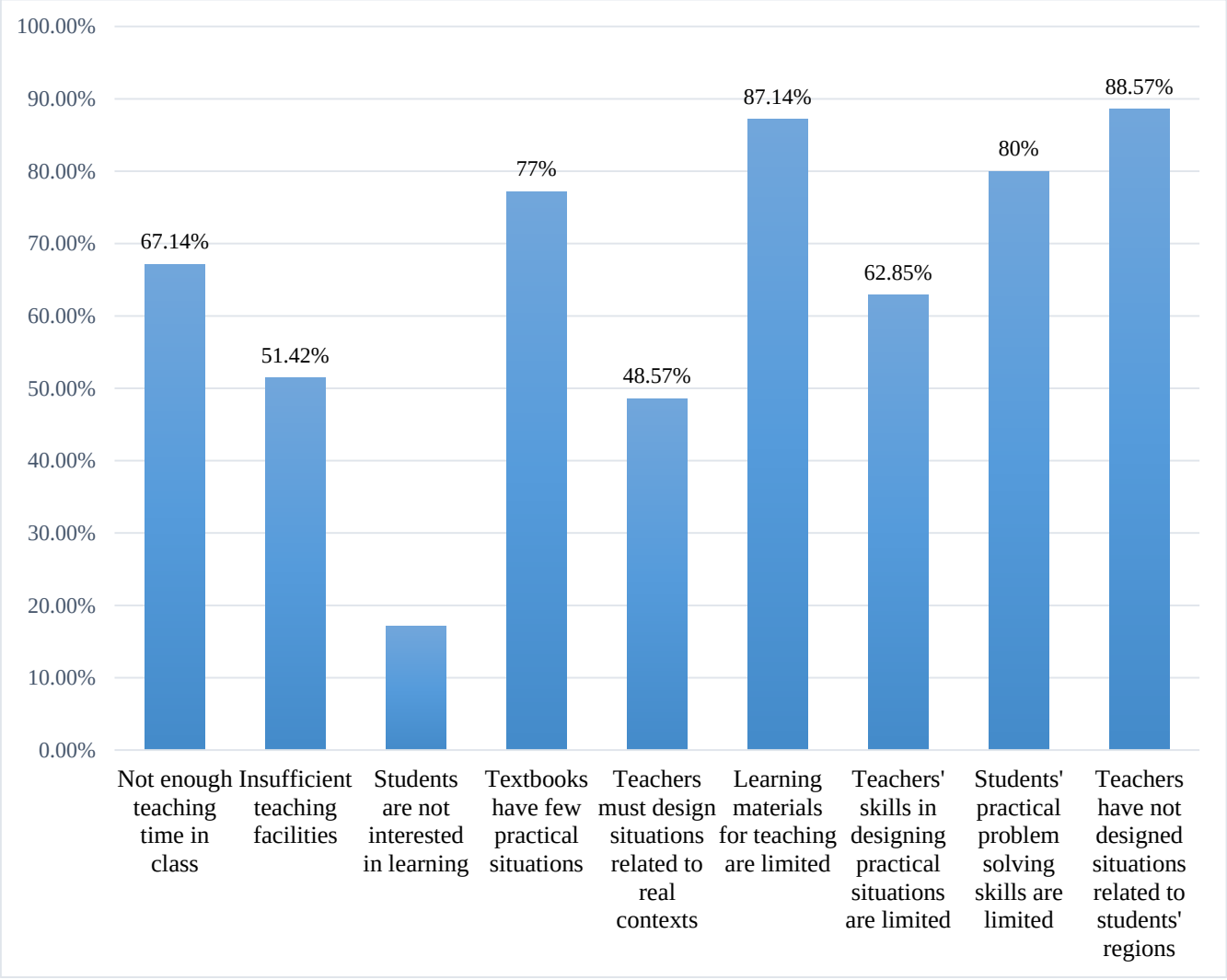

Figure 2. The difficulties teachers face when teaching math related to practice

The research results showed that 67.14% of teachers have not enough teaching time in class, 51.42% of teachers are insufficient teaching facilities, 17.14% of students are not interested in learning, 77.14% of teachers claimed that textbooks have few practical situations, 48.57% of teachers must design situations related to real contexts, 87.14% of teachers realized that learning materials for teaching are limited, 62.85% of teachers' skills in designing practical situations are limited, 80% of students' practical problem solving skills are limited and 88.5% of teachers

have not designed situations related to students' living regions.

We interviewed a number of teachers in depth about this. The difficulties pointed out by the teachers were that the majority of students were not good at mathematics, practical situations are difficult because they do not contain many issues related to their real-life and many scientific fields, so not all teachers can master the situations (especially economic, financial situations, and interdisciplinary situations). Teachers do not have experience to implement and have never heard of context-based teaching. Classroom time is short and classes are large (see Figure 3). Through chart analysis, it shows that the proportion of teachers using active teaching methods is not high and the teaching methods which the teachers used: question and answer method (18.57%), presentation method (20%), problem solving teaching method (14.28%), project-based teaching method (24.28%), collaborative teaching method (14.28%), modeling teaching method (7.28%), and experiential teaching method (10 %).

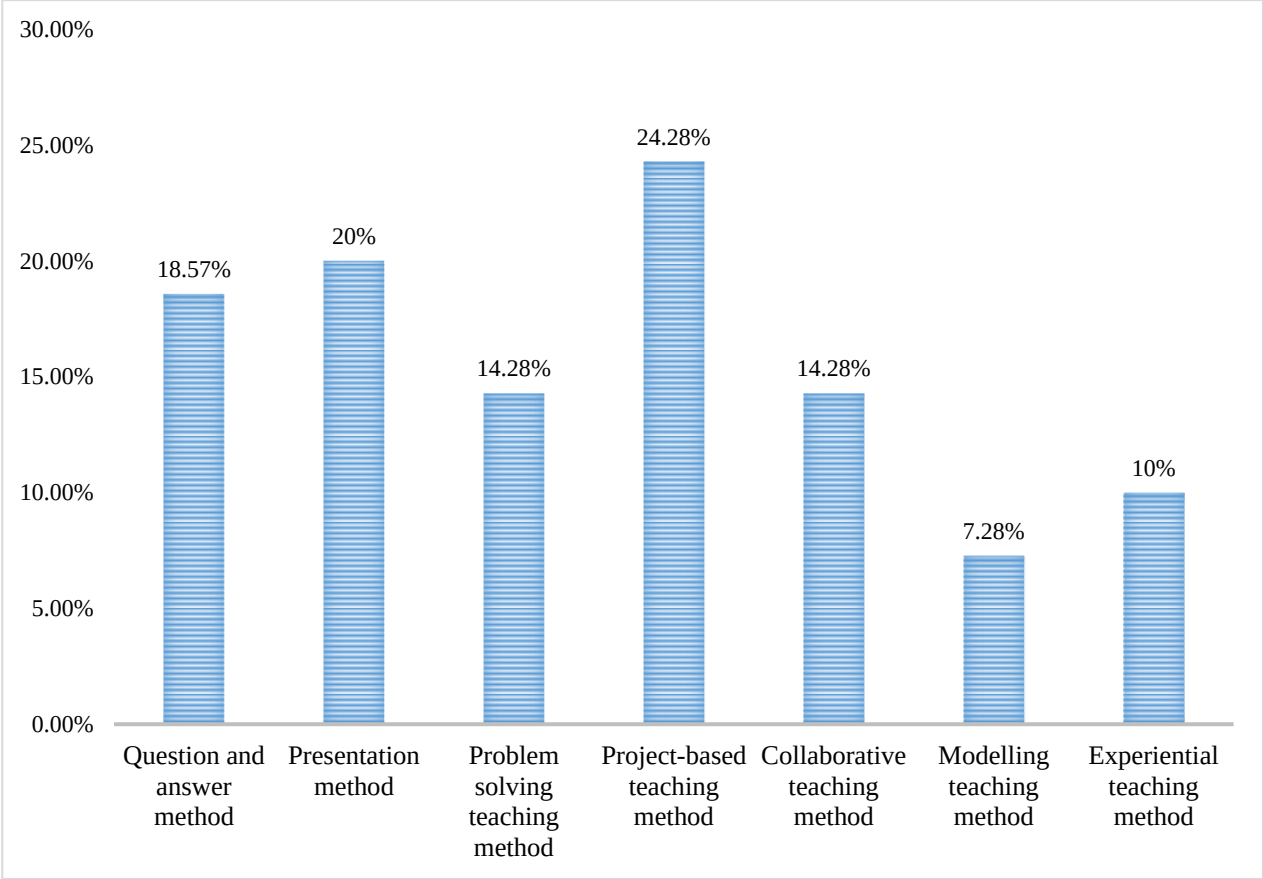

Figure 3. The methods teachers often use when teaching mathematics are related to practice

In teaching mathematics related to practice, because textbooks have very few situations, designing or collecting practical situations is extremely important and necessary. To find out this skill of teachers, we conducted a survey, the survey results are in Figure 4. The survey shows that teachers often design or collect practical situations in the following ways: switch from mathematical problems to problems associated with real contexts (20%); consider which problems can be applied to real life, thereby building practical situations suitable to the life context of students (15.71%); exploit available situations from different sources (such as internet, reference books, other teachers) (8.57%); collaborate with teachers in professional groups to build situations appropriate to the lessons and students (11.2%); ask students to propose their own situations (10%). However, in general, the proportion of teachers who know how to create practical situations is not high. Therefore, to teach mathematics in real contexts, it is necessary to develop the ability to design practical situations for teachers.

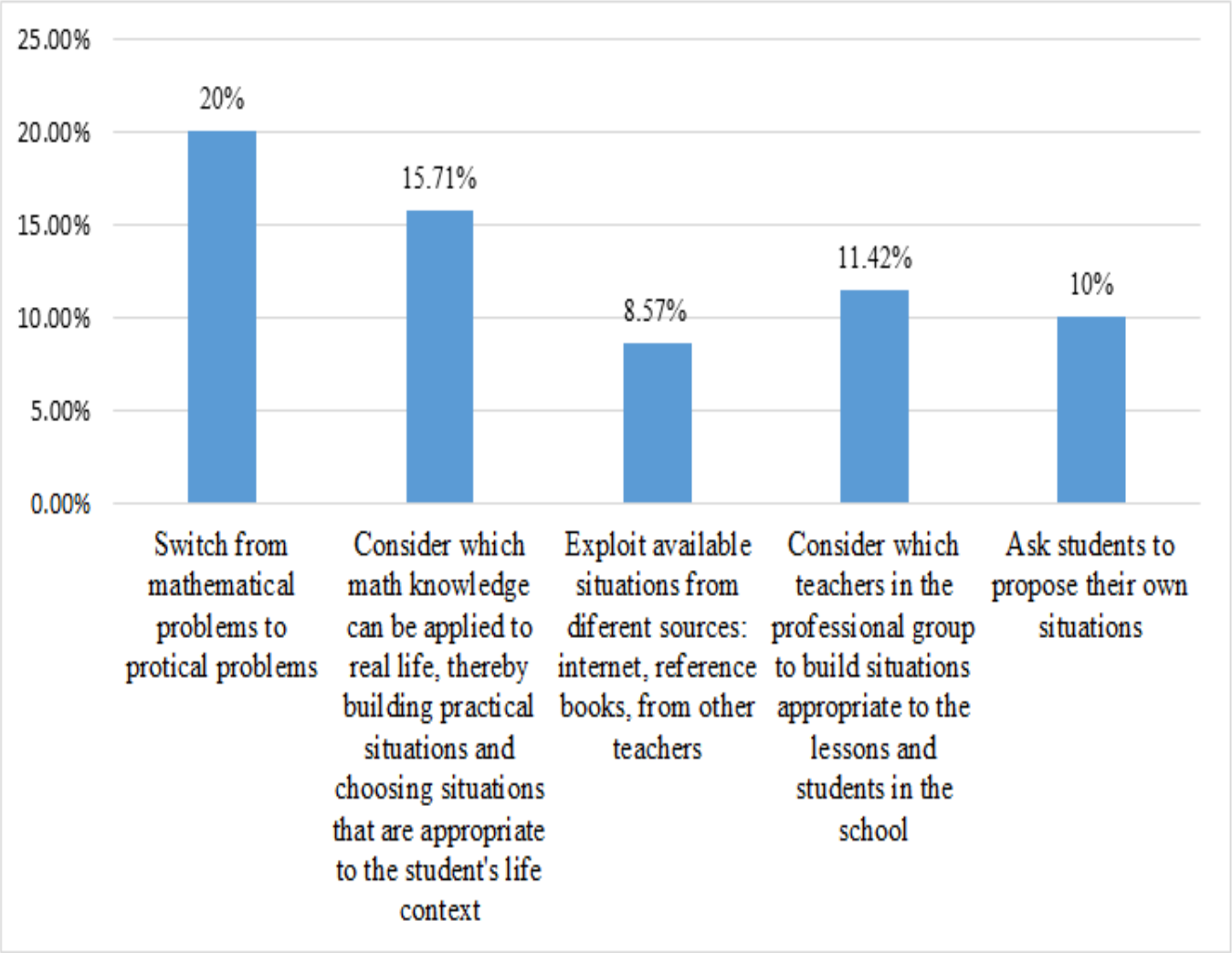

Figure 4. How teachers create practical situations in teaching?

Through the opinions of teachers, it can be seen that there are very few teachers who clearly understand and are able to teach mathematics in real contexts. The reason may be due to lack of accessibility, weak student target group, textbook materials that are not favorable for teaching in a direction linked to real contexts, and limited competence to design teaching activities in this approach.

Students' Opinion

To fully understand the current situation of context-based teaching mathematics algebra 10 in Lao PDR, in addition to surveying teachers about their knowledge, experience, and teaching premises associated with real contexts, we surveyed 245 students using questionnaires, interviews, and tests to assess practical problem-solving ability. Students' ability to solve practical problems not only reflects the teaching situation of teachers, but also reflects the premise of context-based teaching mathematics. This survey is carried out in two forms: students self-assess their knowledge and skills in some algebraic topics, and ability in applying mathematics to solve practical situations through questionnaires, and evaluating students' capacity through tests with the content of practical situations. Through student self-assessment with questionnaires, it is shown that 43.76% of students have level 2 mathematical knowledge. Students know but are not sure, only understand some easy knowledge, can imitate and solve situations as instructed by the teacher and 47.34% of students cannot apply mathematical content to solve practical problems at level 1 (see Table 4 and Figure 5).

Table 4. Students' levels of self-assessment

No.	Content	Levels of self-assessment				
		1	**2**	**3**	**4**	**5**
1	Basic knowledge of quadratic functions	36.12%	43.67%	14.48%	4.08%	1.63%
2	Applying quadratic functions in practice	46.32%	39.18%	10.40%	4.08%	3.26%
3	Basic knowledge of trigonometry	36.32%	40.81%	14.69%	4.89%	1.63%
4	Applying trigonometric functions in practice	39.59%	40.40%	15.51%	2.85%	3.67%
5	Basic knowledge of derivatives and integrals	45.30%	34.28%	12.24%	4.48%	2.44%
6	Applying primitives and integrals in practice	47.34%	40%	8.97%	1.22%	4.89%
7	Recognize mathematical knowledge in practical situations	33.16%	33.06%	19.59%	9.38%	2.85%
8	Move from practical situations to mathematical situations	33.46%	40.40%	20.81%	2.44%	3.26%
9	Solve mathematical problems	26.12%	23.67%	33.06%	13.87%	4.08%
10	Respond to practical situations	33.87%	31.42%	24.08%	6.53%	0.40%

During the process of learning mathematics, 57.55% of students think that teachers rarely let them apply mathematical knowledge to solve practical problems, mainly teachers teach according to the content of textbooks. Students also said that when studying the topics quadratic functions, trigonometry, antiderivatives - integrals, teachers rarely guide students to use the knowledge of those topics to solve problems in real-life. To learn more deeply about the practical situations teachers use in teaching, we interviewed some students. The interview results showed that teachers only let students solve practical situations in books, so sometimes the situations are not really 'close' to all students. Rarely do teachers add practical situations during teaching as well as situations that are close to the students. Some students think they like learning mathematics but they could not solve practical problems.

The results also showed that more than 90% of students feel excited when teachers guide them in applying mathematics to solve real-life problems and all students believe that mathematics is necessary in daily life (only 1.63% of students said it was not necessary). Regarding students' excitement about lessons with practical situations, most students are excited about learning and only 1.04% of students are not excited. Regarding the use of practical situations in testing and assessment in teaching mathematics, students believe that many teachers have not exploited life problems to integrate them into questions or exercises in tests and only 6.93% of students questioned said that students have used them. Furthermore, 70% of the students surveyed said they had never been to factories, companies, workshops, farms, tourist areas, etc. so that they could have more knowledge to support the use of

mathematical knowledge to solve practical situations, so sometimes situations associated with factories, farms, etc. cause difficulties for students.

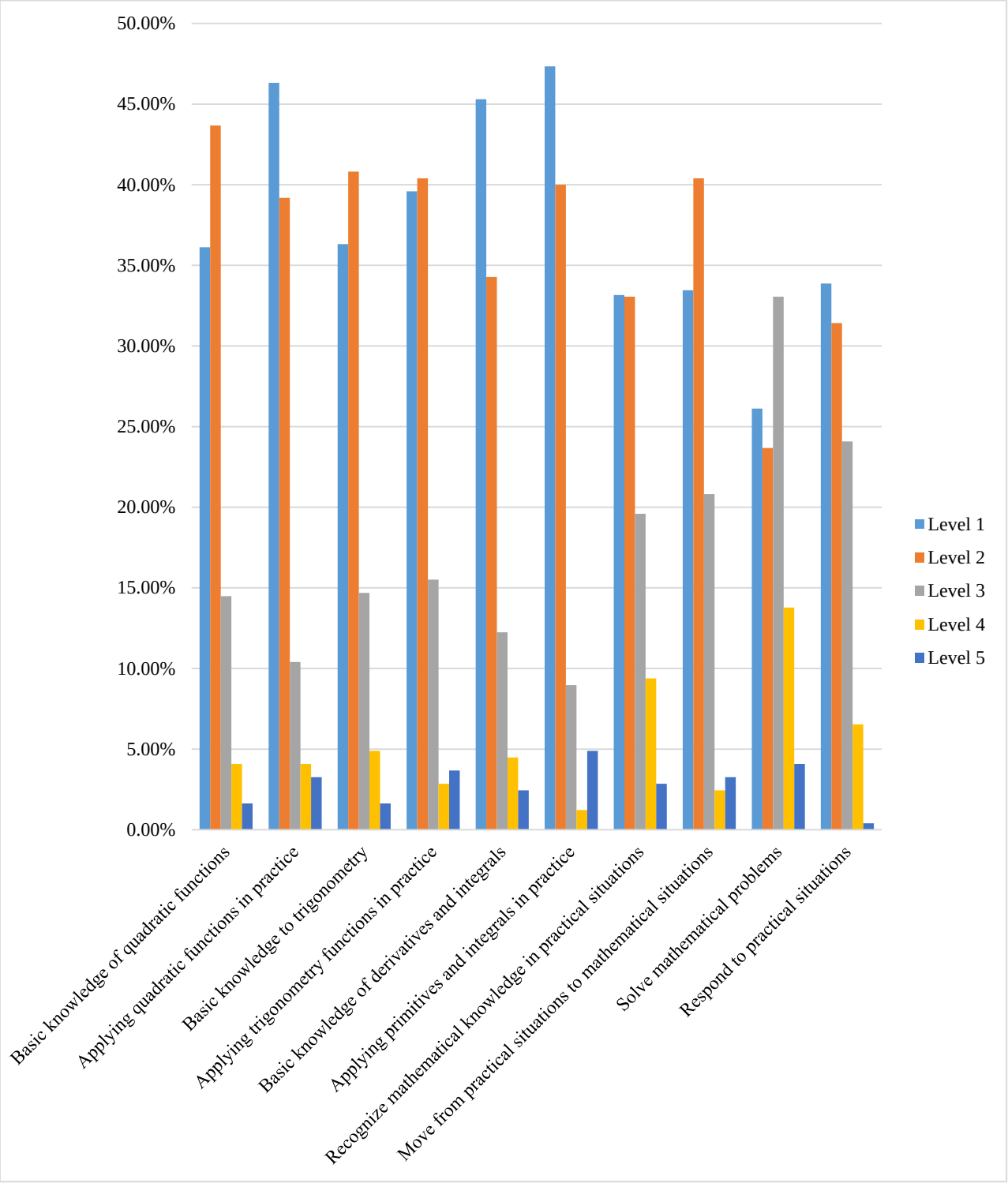

Figure 5. Students self-assess their mathematical knowledge and skills in algebra topics and mathematical application skills to solve practical situations

Find out students' opinions about the role and effectiveness of teaching related to practice, the results obtained are as shown in Figure 6. Most students think that this teaching method helps students remember knowledge well, understand the contents of the lessons quickly and be able to apply mathematics to life, understand the relationship of mathematics with real world and be more interested in learning mathematics, interested in learning how to apply mathematics to real-world situations. This awareness of stuents is a good condition for teaching mathematics in a real context.

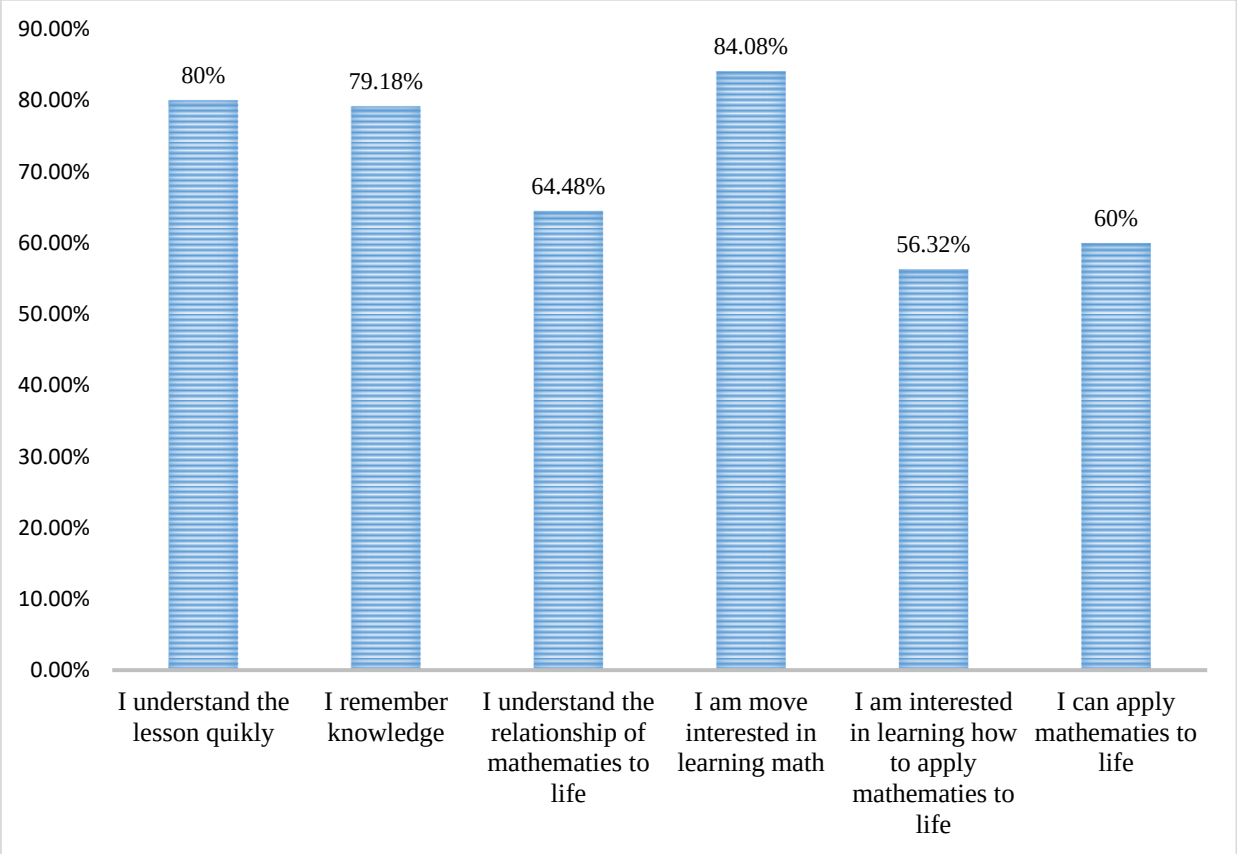

Figure 6. The effectiveness of teachers using practical problems close to students in teaching

In in-depth interviews, some students said that learning mathematics related to practice is very necessary and effective. They really hope teachers teach math problems so that they can be applied in study and daily life. Most of them think that mathematics is a very important and necessary subject, a subject that is both difficult and interesting. Some of students were not good at math but they really like studying math. Mathematics is a very difficult subject for many students because most students think it is rarely used in practice. Based on research on assessing practical problem-solving competence by author Nguyen Thi Lan Phuong (2015), to assess students' problem-solving competence, we have built a tool to assess problem-solving competence of high school students of 143 students in the Lao PDR. The following problems in the test and the results are presented in Table 6.

Table 5. Test of students' problem-solving ability

Problem 1. POPULATION

Population growth is estimated according to the formula $P(t) = p_0(1 + r)^t$, *where* p_0 *is the population of the year used as a benchmark, P(t) is the population after year t years, r is the annual population growth rate. Knowing that in 2013, the population of Lao PDR was* p_0 *= 6,695,000 people and the population growth rate that year was r=2%. How many people will our country have after 2030 if the population growth rate remains unchanged?*

Students answer the questions below according to the suggestions:

1) Proposing situations related to real contexts: In the above problem, there are situations related to life and the problem is ……
2) Find out the content of the situation, mathematize the situation:
   ……

Suggestion: Students need to identify some information such as population formula, understand population issues, population growth rate.

3) Find solutions to established mathematical situations: The teacher and students set

up the problem:……..……

4) Present the solution:……..…..……
Suggestion: Students present solutions to established mathematical problems.
5) Answer questions from situations and correct knowledge:

……..……

Problem 2. DRIVING CAR

Ammone drove a car from the center of Vientiane capital at a speed of 100 km/h to Pac Se city (Cham Pa Sac province), a distance of 800 km. Meanwhile, Ammone's younger brother drove from Pac Se city at a speed of 80 km/h towards the capital Vientiane using the same route as Ammone. How many kilometers from the center of Vientiane capital will Ammone and Ammone's younger brother meet?

Students answer the questions below according to the suggestions:

1) Proposing situations related to real contexts: In the above problem, there are situations related to life and the problem is ……..…..…
2) Find out the content of the situation, mathematize the situation: …….……

Suggestion: Students can ask students questions. How many minutes will you two meet? How many minutes will it take you to reach Pac Se city? How many minutes will the youngest brother get to the center of Vientiane?

3) Find solutions to established mathematical situations: The teacher and students set up the problem:……..……

Suggestion: Students need to return to the problem: let t represent time (unit h); Let $f(t)$ represent Ammone's distance from the center of Vientiane capital and $g(t)$ represent Ammone's younger brother's distance from the center of Vientiane capital.

4) Present the solution:……..…….
Suggestion: Students present solutions to established mathematical problems. The two people will meet when $f(t) = g(t)$.
5) Answer questions from situations and correct knowledge:……..…..

Problem 3. HONGSA LIGNITE ELECTRICAL PLANT

When I arrived at the Hongsa Lignite Electrical plant area, Sayyabouly, Lao PDR, I observed a very high column of dust and smoke. If you stand at position A, the viewing direction from where you stand to the top of the column creates an angle of 30° with the ground and point B is 500m, can you calculate the height of the smoke column?

Students answer the questions below according to the suggestions:

1) Proposing situations related to real contexts: In the above problem, there are

situations related to life and the problem is ……..…….……

2) Find out the content of the situation, mathematize the situation: ……..…

Suggestion: Students need to determine the trigonometry system, the Pythagorean formula, to calculate height that cannot be measured directly.

3) Find solutions to established mathematical situations: The teacher and students set up math problems:……..…

4) Present the solution:…….……..……

Suggestion: Students present their solutions to the established mathematical problem.

5) Answer questions from situations and correct knowledge:……..….

Table 6. Test results of students' competence to solve practical problems

Level	Total score	Frequency	Ratio (%)	Score range	Frequency	Ratio (%)
1 (Weak)	0 1 2 3 4	0 2 13 20 32	0 1.39 9.09 13.98 23.37	0-4	67	46.85
2 (Medium)	5 6	38 24	26.57 16.78	5-6	62	43.35
3 (Good)	7 8	11 3	7.69 2.09	7-8	14	9.79
4 (Excellent)	9 10	0 0	0 0	9-10	0	0
	Total	**143**	**100**		**143**	**100**

The test shows that students' competence to solve problems, especially practical problems, is still limited. The statistical results in Table 7 show that the proportion of students with 'weak' problem-solving competence is 46.85%. The percentage of students achieving the 'average' level or higher is 53.14%, focusing on the 'good' level with 9.79% and no student has achieved the excellent level.

Table 7. Evaluate students' competence to solve practical problems

Components of problem solving competence	Criteria	Level 1	Level 2	Level 3	Level 4
Proposing situations/ determining situations	Students discover practical situations or problems that need to be solved	39.86%	41.95%	13.98%	4.19%
Understand the content of the situation/problem, mathematize the situation	Students can present the characteristics and manifestations of situations/problems and move from practical problems to mathematical problems	39.86%	44.05%	12.58%	3.49%

Components of problem solving competence	**Criteria**	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Find a solution to the established situation	Students collect information, make plans and propose solutions to solve problems	42.65%	44.05%	10.48%	2.79%
Present the solution	Students collect, organize information, assign tasks, implement solutions and draw solution results	35.66%	45.45%	16.08%	2.79%
Answer the questions posed from the situation, accurate knowledge	Students can transfer from the results of solving mathematical models to the results of problems containing situations and precise knowledge	41.25%	41.95%	13.98%	2.79%

The statistical results in Table 7 also show that the highest proportion of students with poor problem-solving competence is at level 2. Students' competence to propose practical situations, receive information from practical situations, learn the content of situations, and mathematize practical situations is still limited. The ability to find solutions to established situations is limited, which shows that even though students can identify information, they have difficulty transferring to mathematical models. The ability to solve mathematical models is quite good. Most of the students solved the mathematical model correctly, but there were a few students who did not solve it correctly. This shows that students do the established math problems quite well. The ability to transfer from solving results on mathematical models to answering results of practical problems is still limited, some students cannot answer correctly.

Through the survey, we found that students have some difficulties in solving problems related to real contexts. The first is the problem of understanding the terminology that describes the practical problems in the situation. Students do not understand or extract important information of the situation to convert into mathematical language, often incorrectly represent relationships, do not understand correctly or clearly the requirements of the situation, and are often influenced by illustrations. Students do not have the skills to select and connect necessary information. Second is the problem of mathematicization (it is impossible to translate practical language into mathematical language). Students have difficulty in simplifying the problem, handling the problem's conditions, establishing the problem from real situations, clarifying the problem's objectives. In particular, students have difficulty in determining appropriate variables, parameters, relevant constants, finding relationships between variables, collecting actual data to provide more information about the situation, eliminating non-mathematical elements and converting the problem into mathematical language. Third is the problem of solving math problems. Some students forget old knowledge, not flexible in finding solutions to the built mathematical model, often influenced by newly learned knowledge and often satisfied with finding a solution to the problem. Moreover, students have a habit of solving math problems in a format that has little connection to reality, which limits creative thinking and becomes a barrier when they encounter an unfamiliar situation. Fourth is students' practical experience (not knowing how to use practical knowledge to solve problems). Engaging with real-world contexts involves moving between mathematics and practice in both directions, so both mathematical

knowledge and practical knowledge are essential. Fifth is the problem of comparing reality (difficulty answering practical situations). Students are only interested in the mathematical results found but not really interested in finding answers to the situation, considering the reasonableness of the actual results as well as a relationship between the results and given factors in the situation or understanding the reality of the situation.

Through surveying the current situation of teachers and students in seven high schools in all three regions (North, Central, South) in the Lao PDR on context-based teaching algebra 10, the results show the level of understanding of students in different regions is different. As for teaching algebra in a real-life context, teachers do not understand the term 'context-based teaching' and how to implement it in the classroom. However, after carefully learning about teaching mathematics in a real-life context, some teachers have done it and a few teachers have exploited situations close to students, linked to the students' living as well as learning context. Research on the current situation also shows that the system of exercises and situations associated with real contexts in Laotian textbooks is quite few, and the competence of teachers to design such situations is still limited. Most students like to apply mathematics in practice and especially in situations that are 'close' to them, resulting in a favorable condition for teaching mathematics in a real-life context. The survey results also show that students' problem-solving ability is not good, which is a difficulty that requires solutions to effectively implement mathematics teaching in real-world contexts.

4. Dicussions:

Through analyzing the curriculum, textbooks, and analyzing the opinions of teachers and students, it can be seen that context-based teaching mathematics in general and teaching algebra in particular in Lao PDR has the some advantages and disadvantages. Although the textbook does not have many real practical situations, mainly hypothetical situations, it is also a favorable premise for teachers and students to approach teaching in connection with practice, associated with real contexts. Teachers understand about teaching in connection with practice and some teachers practice this teaching approach based on a small number of examples and practical exercises already in the textbooks. Ther are very few teachers collect or design practical situations for teaching and most of them still do not regularly teach in connection with practice. Almost all teachers do not understand teaching in real contexts and do not design and implement teaching in real contexts. The survey also showed that there is consistency between the curriculum, textbooks, teachers' teaching and students' practical problem-solving competence. The results of the student questionnaire survey also coincided with the results of the teacher survey regarding teachers' regular teaching based on practice and teaching based on real contexts. The results of assessing the level of students' practical problem-solving competence also show that students do not have many opportunities to practice and their competence is still limited. Over 90% of students reach the 'weak' and 'average' levels, nearly 10% reach the 'good' level and no students reach the 'excellent' level. Especially in-depth analysis of students' work has clearly shown the limitations of students' competence to read and understand real-life situations and mathematicize real-life situations. Through the survey, it can be seen that although there are certain premises in terms of programs, textbooks, teachers and students, implementing mathematics teaching in connection with practice still has many difficulties, that is, the premises and seeds for implementing context-based teaching in mathematics are still limited. Therefore, implementing context-based teaching requires preparation of materials, proposed pedagogical measures, and training for teachers on how to do it.

From the analysis situation above, we propose some algebra teaching orientations associated with the real context in the Lao PDR. Teaching linked to real contexts is the process where teachers organize activities to help students build

mathematics linked to real contexts to solve real-life problems. Therefore, the process of teaching algebra in real contexts is carried out according to the following steps: (i) starting from mathematical situations associated with real contexts; (ii) find out the content of the situation, mathematize the situation; (iii) find solutions to established mathematical situations; and (iv) present solutions and answer questions from situations and clarify knowledge. Therefore, the knowledge to be taught will be formed from the process of students exploring problems arising from practice as a result or a means of solving problems. Thus, it can be understood that teaching in connection with real contexts is teaching how to build mathematical situations in connection with real contexts, aiming to answer questions and problems arising from practice. Therefore, the knowledge that needs to be taught will arise through the process of solving practical problems. Mathematics associated with real contexts is understood as a mathematical explanation for a system outside mathematics in order to answer the questions that students ask about this system. From the perspective of a teaching method, mathematics associated with real contexts helps students understand mathematical concepts; simultaneously helps students read, understand, establish and solve specific problems based on real-life situations, develop creative thinking and critical thinking. To apply this teaching method, teachers can choose any field that students are interested in and design mathematical models to teach. The teaching steps associated with specific real-life contexts are as follows:

Step 1: Teachers propose mathematical situations associated with students' real learning and living contexts. The teacher must exploit the situations or design situations that are close to learners in life, which can be learning situations, students' living situations, situations related to the environment, economy, society.

Step 2: Teachers need to help students understand the practical meaning of the situation, recognize mathematical objects, mathematical relationships in the situation, recognize the learned mathematical model that can be used to solve the situation, use mathematical language to describe the practical situation to convert from practical situations into mathematical situations.

Step 3: After identifying the situation, teachers need to help students mobilize their known mathematical knowledge to solve the situation. Students need to know how to use methods that have the nature of guessing, transforming or proving what must be found, relating what is known to what must be found with known knowledge, relating the problem to be solved with similar problems, special cases or general problems, etc. then recheck the solution. If the solution is not suitable, they should start the process of finding a solution again.

Step 4: From the discovered solution, arrange the solution steps in the appropriate order and execute those steps to present the solution.

Step 5: After solving the practical situation, the teacher should help students answer the questions for the initially posed practical situation. After solving the practical situation, teachers should clarify the mathematical knowledge that needs to be formed or finalize the knowledge that needs to be reinforced for students.

Thus, context-based teaching shows the meaning of learning mathematics because students see the application of mathematical knowledge in practice. Context-based teaching in mathematics allows mathematical knowledge to arise through the process of attaching to real contexts to solve a practical problem. The teaching process linked to real contexts saves time, but loses the practical origin of mathematical knowledge. On the other hand, students often tend to build mathematical models associated with the mathematical knowledge they have just learned. This can make it difficult for students to navigate mathematical models when faced with a non-mathematical situation that is not within the context of the lesson. Meanwhile, context-based teaching mathematics allows overcoming this deficiency because the knowledge that needs to be taught arises from the process of students exploring,

converting, building, and solving mathematical models.

5. Conclusions:

Through context-based teaching in mathematics, students practice solving problems in five steps of the math process in a real context, from converting practical situations to mathematical situations, modeling the problem to setting up, solving the problem and converting the results of the problem to real results. Research results show that teaching with real contexts is still quite new for teachers when teaching mathematics in high schools in the Lao PDR. There are few research projects close to this direction and especially there are not many research projects on teaching mathematics with real contexts in general and teaching algebra 10 with real contexts in the Lao PDR in particular. Moreover, teachers' math teaching premises associated with real contexts are limited and students' competence to solve situations associated with real contexts is limited. The goal of general education in Lao PDR is to enhance students' ability to apply mathematics, but the mathematics curriculum and textbooks do not have many good premises and do not encourage the application of mathematics in practice. The results of this research will be the basis for in-depth research on context-based teaching algebra 10 in Lao PDR.

References:

1. Ammone, P. (2022). Teaching algebra in high schools of the Lao PDR towards developing mathematical modeling capacity for students. *A Dissertation of Doctor of Science in Education*, University of Education - Thai Nguyen University, Vietnam.
2. Bitterlich, E. (2020). About real-world contexts in mathematics education and their impact on language and learning. In *the seventh ERME Topic Conference on Language in the Mathematics Classroom*.
3. Blum W. (2007). *Modelling and applications in mathematics education*. Springer.
4. Boaler, J. (1993). The role of contexts in the mathematics classroom: Do they make mathematics more 'real'? *For the Learning of Mathematics*, 13(2), 12-17.
5. Curry, K. W. (2012). Scientific basis vs. contextualized teaching and learning: The effect on the achievement of postsecondary students. *Journal of Agricultural Education*, 53(1), 57-66.
6. Done, S. (2019). Designing and using modular materials in teaching mathematics teaching methods for students at pedagogical colleges of the Lao PDR. *A Dissertation of Doctor of Science in Education*, Hanoi National University of Education, Vietnam.
7. Education Science Institute (2014). *Mathematics 10*. Education Publishing House, Vientiane, Lao PDR.
8. Education Science Institute (2015). *Mathematics 11*. Education Publishing House, Vientiane, Lao PDR.
9. Education Science Institute (2016). *Mathematics 12*. Education Publishing House, Vientiane, Lao PDR.
10. Fauzan, A. (2002). *Applying realistic mathematics education in teaching geometry in Indonesian primary schools*. Citeseer.
11. Hang, N. V. T (2014). *Design of a social constructivism-based curriculum for primary science education in Confucian heritage culture*. Faculteit Betawetenschappen Flsm, Utrecht University, The Netherland.
12. Her, C. (2021). Organization of teaching practice in training high school mathematics teachers in Lao PDR. *A Dissertation of Doctor of Science in Education*, Hanoi National University of Education, Vietnam.
13. Ho, T. M. P., & Nguyen, T. T. A. (2002). Using contextual teaching approaches to promote equation problem-solving competence for grade 10 students. *Journal*

of Science, Hue University of Education, 19(12), 2002-2015.

14. Nguyen, P. T., & Huynh, M. T. (2024). Designing situations with real contexts in teaching the lesson 'Functions and Graphs' (Mathematics 10). *Vietnam Journal of Education*, 24(1), 26-30.
15. Nguyen, T. M. T. (2021). Contexual approach to math teaching with react approach and supporting the process of mathematical modeing. *Hue University Journal of Science: Social Sciences and Humanities*, 130(6B), 193-214.
16. Nguyen, T. T., Kim, A. T., & Nguyen, B. D. (2019). Thinking and numbers: Applying mathematics education theory associated with practice in teaching mathematics. *Vietnam Journal of Education*, 458, 37-44.
17. Pham, T. H. C. (2022). Designing practical situations with real contexts in teaching mathematics in elementary schools. *Vietnam Journal of Educational Sciences*, 40, 30-35.
18. Romberg, T. A. (2001). *Mathematics in the context*. Education Development Center, Inc.
19. Thanh, H. T. L., & Nguyen, T. H. (2021). Designing middle school geometry problms associated with mountainous pratices. *Science Jounal*, Northwest University, 22, 67-72.
20. Tran, T. (2018). Exploiting real contexts in teaching mathematics in high schools. *Vietnam Journal of Educational Sciences*, 3, 52-56.
21. Tran, T., & Nguyen, T. D. (2020). Some measures for teaching algebra and calculus grade 11 in a way that is relevant to the practical context in high school. *Vietnam Journal of Education*, 479, 8-12.
22. Tran, V. (2009). Using mathematization to enhances high school students' quantitative understanding. *Vietnamese Journal of Educational Sciences*, 43, 23-26.
23. Trinh, T. P. T., & Chu, H. L. (2021). Designing teaching situations for the topic 'statistics' (algebra 10) associated with real contexts in high schools in Cao Bang province. *Vietnam Journal of Education*, 505(1), 30-35.
24. Vonglathsamy, T. (2022). Teaching probability and statistics in high schools of the Lao PDR in the direction of connecting with practice. *A Dissertation of Doctor of Science in Education*, Hanoi National University of Education, Vietnam.
25. Wijaya, A., Van den Heuvel-Panhuizen, M., & Doorman, M. (2015). Opportunity-to-learn context-based tasks provided by mathematics textbooks. *Educational Studies in Mathematics*, 89, 41-65.