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STUDYING THE MATH SELF-LEARNING CAPACITY OF HIGH SCHOOL STUDENTS

Nguyen Van Quyen
Tran Phu Specialized High School, Hai Phong city

Abstract. Regarding to learning in general and learning Math in particular, self-study ability is an important factor to promote effective learning. *Objectives of the study*, to build a framework of Math self-study capacity of high school students. *Research methods*, theoretical research through previous studies on competence, and students' mathematical self-study; based on the results of my proven practice research. *Research results*, proposing a framework of Math self-study ability of high school students including 6 basic competencies, including: Math cognitive competence; Capacity to observe situations; Mathematical connection competence; Capacity to solve problems; Ability to use effective self-study strategies and methods; Ability to self-assess learning results. At the end of the study, I provide some suggestions for developing components students' Math self-study capacity, then improve the quality of Math learning of high school students in the future.

Keywords: seft - study capacity, 21st century skills.

1. Introduction

The challenges of globalization and modernization of the contemporary world have set new requirements for the research process. In recent years, increasing attention has been paid to self-study, communication skills and intellectual and ethical qualities. According to Rupšienė and Mažionienė (2011) [1], student's self-study becomes especially relevant due to the change from traditional teaching model to constructivist and capacity-building learning, in which, learning provides intensive independent activity learners. It is understandable because one of the factors affecting the success of researches is self-study experience. Education has not yet given a unanimous opinion on what should be considered self-study. Lithuanian language dictionary (2006) defines self-study as work performed independently. According to Rajeckas (l999), while forming learners' autonomy as a personal quality and their skills to self-study, it is necessary to create natural conditions that encourage people to act independently. An important role played by teachers is to encourage students to learn on their own, otherwise it may be deemed unnecessary by the learner. Jovaiša (2007) emphasizes that independence is inseparable from motivation, while the role of teachers is to increase students' motivation to independently find ways to act, apply knowledge, combine it, independently pose research problems to solve them. Motivation is a complex structure, especially in relation to learning.

The idea of self-study is closely related to the philosophy of construction, which states that knowledge cannot be deepened (given): instead, it must be owned (built) (Pukelis et. al., 2011). The student will be a more successful learner if the teacher shows the benefits of the given course

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Contact Nguyen Van Quyen, e-mail address: q19vietnam@gmail.com

(Čiburienė & Guščinskienė, 2012) [4]. Student research is understood as studies of the individual modules of a research program. In this process, students will study the course theory in depth, apply it when doing exercises, and analyze scientific literature and papers. On the other hand, students face a problematic situation: how should an individual learn to master the course content and not be left behind the latest developments in this area? and how can he/she use the latest information and how to apply it to a professional operation? The way of learning is just as important as the learning content. Self-study can be understood as a versatile activity of independent learners. Scientific literature related to current research includes articles related to the specificity of self-study activities (Teresevičienė et al., 2006 [5]; Tandzegolskienė & Pileckaitė, 2010 [6]; Beaumont et al., 2011 [7]). The researchers mentioned investigating the aspects of high school self-study organizations, student self-study capacity, developing common abilities through the level of awareness of self-study and the components of self-study

Based on international research and empirical research results of the author (N.V. Quyen, 2019) [8], [16], the main part of the article will present the framework of mathematical self-study capacity of high school students in Vietnam proposed by the author.

2. Content

2.1. The framework of self-studying capacity of high school students

2.1.1. Mathematical cognitive competence

Cognition is a complex process, starting with a direct, positive, creative and factual consideration of the phenomenon. Accordingly, cognition is not a purely abstract or purely specific process. It is a reflection on the human activities in the form of ideas and symbols. Beyond the limits of practical activities there will be no cognitive process.

According to (Results from the COACTIV Project) [17], (N.V. Quyen, 2019) [8], in order to help students be aware of math, teachers should help students build learning based on their learning instincts. Learning must have the participation of students; this participation is not only intellectual but also emotional. Learning should be a spontaneous activity of students, although the content of teaching is arranged by teachers, students should be required to complete through internal activities such as perception, discovery, discovery and comprehension; Learning is thorough activity, in other words, learning Math not only affects students 'mental well-being, but also affects students' personal, physical and mental development.

Accordingly, mathematical cognitive competence is understood as personal psychological characteristics (firstly intellectual activities), meeting the requirements of mathematical learning activities and helping to understand mathematical content and respective learning skills creatively. With such an understanding, the structure of mathematical cognitive competence associated with the skills: 1) acquiring mathematical information; 2) Processing mathematical information; 3) Storing mathematical information; 4) Orienting mathematical trend

Mathematical cognitive competence is important for students to pay attention, clarify and interpret aspects of math practice. Cognitive competence is related to each student's knowledge and stems from a realistic context inside and outside the classroom. Because of the above arguments, the author thinks that mathematical cognitive competence is important and is a basic component of students' ability to self-study Math.

2.1.2. Capacity of observing situations

Observe and identify situation is an extremely valuable tool of the process of learning and learning Math in particular. It gives students the ability to identify the implications of each incident in the context. Most of us don't pay attention to the world around us. The point of creating a good self-study capacity is the ability to observe and identify essential details of a

situation. This is common in students who have a habit of paying attention to their surroundings. Maria Konnikova is a journalist, psychologist and author of the book: Mastermind: How to Think Like Sherlock Holmes, saying: "This is not the power of superheroes. It should be noted that Holmes has devoted his entire life to training the habit of focusing attention. This is not his innate ability. What we choose to pay attention to or not to mind is one way of shaping this ability in our minds. Everything we do is connected to the brain, but intense focus can make this connection extremely easy".

The bad habit of many students is distraction. Students always try to get things done quickly, and so they lose concentration. So, like any habit, increasing observation is synonymous with identifying bad habits of students first (students prioritize getting things done quickly and omitting smaller details), and then practice new habits (learn to pay more attention).

The constant practice of capacity to observe situations creates students' intellectual activities, always actively exploring everywhere, anytime, in every case and with many different angles.

Regularly applying mathematics in practice will help students see mathematical aspects in common situations in life, enhance the ability to solve problems in life with mathematical thinking, help practicing scientific work habits, raising the sense of optimization in working ...

The ability to observe situations is important to workers in today's society. In order to do this, students must be able to acquire mathematical information from the actual situation, convert information between reality and mathematics, and establish mathematical models from real situations.

Therefore, in order for students to have good self-study capacity, we should look for ways to improve the ability to identify problem situations, this is one of the components according to the author that should be concerned and compensated.

2.1.3. Capability of connecting Mathematics

The Industrial Revolution 4.0 defines the transformation and change to a digital age. The digital age is also known as the technology era. The Industrial Revolution 4.0 is a revolution that requires the use of technology in everyday life, which has implications for all aspects of life, including education. Therefore, education must be able to change the learning process, it creates students after graduation to be able to compete globally.

The purpose of learning math for high school students is to understand and apply concepts (internal and non-mathematical) in problem solving, using good reasoning, problem solving, communicating Topic and highly appreciate the usefulness of mathematics in life. It can be seen that, studying mathematics in high school has a useful purpose in everyday life, especially during the fourth industrial revolution.

Learning Math is not a memorization. It doesn't only requires understanding a concept but also involves problem solving, reasoning, communication and connection. Learning math is a relation between concepts both in and out of mathematics. The relationship between concepts is called a mathematical connection. Mathematical connection is a learning process connecting concepts in mathematics with concepts inside and outside mathematics.

Camilla R. Otte, Mads Bølling, Peter Elsborg, Glen Nielsen & Peter Bentsen (2019) [19], an emerging field of research indicates that the use of learning environments other than the classroom can improve pupils' academic achievement in several subjects, including their skills in mathematics.

Mathematical connectivity is the relationship between ideas or processes used to connect topics in mathematics and is a process of the relationship between ideas of mathematical entities. It can be concluded that mathematical connection is a process of connecting mathematics with ideas and concepts both inside and outside mathematics. Many experts think

that mathematical connections can link mathematical ideas, therefore, students' understanding of ideas will be more sustainable and they can understand the whole of mathematics. This is because the mathematical connection skills can link previous knowledge with the acquired knowledge, which is very useful for building relationships between ideas, concepts and mathematical representations. Connecting mathematics can improve the ability to conduct mathematics, increase the ability to connect mathematics with other sciences, and increase the ability to connect mathematics with everyday life.

For this purpose, mathematical connection should be developed in learning Math process. However, fostering mathematical connection competence of high school students in Vietnam has not been paid much attention.

Therefore, the author has found that to develop students' self-study capacity, the consideration of mathematical connection ability should not be ignored. Because the goal of education is to create students who are self-motivated, creative learners who can face the challenges of the 21st century.

2.1.4. Capacity of solving problems

Self-study is always associated with problem solving, it refers to the process of finding solutions to problems encountered in life. The solution to these problems is usually the situation or the specific context. The process begins with problem finding and problem shaping, in which the problem is discovered and simplified. The next is to create possible solutions and evaluate them. Finally, a solution is chosen for implementation and verification. The problems that have an ultimate goal to achieve and how the students achieve them depend on the problem orientation (style and problem-solving skills) and systematic analysis. According to (Goldstein FC, & Levin HS (1987) [9], problem solving has been defined as a process of cognitive and advanced intellectual functioning, requiring the operation and control of basic or regular skills. According to Nguyen Canh Toan (2011) [10], solving the problem is intellectual activity, which is considered to be the highest level of complexity and awareness because it requires the mobilization of all intellectual capacities of the individual. To solve the problem, the object needs to solve the problem, mobilize memory, understand, conceptualize and use language concurrently with emotions, motives, beliefs in the capacity itself, and capacity to control situations. Baars, M., Leopold, C., & Paas, F. (2018) [20], the ability to learn in a self-regulated way is important for students' academic achievements. Monitoring one's own learning is a prerequisite skill for successful self-regulated learning.

The ability to solve problems, in the view of (OECD 2012) [11], is that an individual's ability to understand and solve situations when the solution is not clear. It involves participating in solving that problem, demonstrating potential as an activity and contributing to civil rights. According to Tu Duc Thao (2012) [12], when dealing with all problems, students must rely on accumulated knowledge and experience, conduct reasoning to find answers, and also by reasoning, students can create new idea. So, problem solving allows students to learn and practice thinking. Thinking and problem solving are closely related; Thinking to solve problems, through problem solving to develop thinking.

From the above analysis, the author said that problem-solving competence can be understood as an individual's ability to mobilize personal knowledge, skills and experience in problem solving, finding solutions and perform problem solving effectively.

In order to develop the self-study capacity of high school students, according to the author, it is necessary to help students have the ability to solve problems, help each student himself / herself solve problems in Math and in everyday life.

The author believes that, in order to develop problem-solving capabilities, students need to build and develop four basic skills, namely: exploration and discovery skills; hypothesis formation

skills; planning and problem-solving skills; solution evaluation and giving conclusion.

2.1.5. Capacity of using self-study strategies and methods effectively

As a teacher, one of the biggest challenges is planning lessons that inspire your students to be actively involved in the learning process. The author finds that traditional classroom-based, or teacher-centered learning plans are not always conducive to achieving that inspiration. Creating excitement and the passion of self-study is much more difficult. In this section, the author outlines a number of teaching strategies and methods, which, according to the author, are effective for students' learning process and more effective for their self-study.

2.1.5.1. Learning strategies from a real context

John Dewey (2017) [13] is a great educator, an outstanding philosopher. According to him, learning with practicing is not entirely new, but for Dewey, it is based on a unique concept. If traditional education often views education as a process of imparting knowledge and experience or an enlightening process to help learners freely use reason, Dewey thinks "education is life itself.", therefore, the school cannot be separated from practical activities and knowledge cannot be imposed from the outside. There is not any common education for all, teachers must be aware of and respect the differences of learners. According to Dewey, education is life itself so it must be the process of the learners, not the teachers. Education is the process in which learners are the center, promoting self-study ability in the context of their life.

King D., Ritchie S.M. (2012) [21] Curriculum developers and researchers have promoted context-based programmes to arrest waning student interest and participation in the enabling sciences at high school and university. Context-based programmes aim for connections between scientific discourse and real-world contexts to elevate curricular relevance without diminishing conceptual understanding.

Dewey said that education is not for life, education is attached to life. He emphasizes the importance of self-study in real context and the need to change fundamentally from the concept "education for the benefit of society" to "society for the sake of education". In education, self-study of learners is not only exploiting values, but also improving and enriching the meaning of life.

Thus, the author thinks that learning from the real context is very important for each individual, students learn a lot of knowledge from the context, they can use their inherent knowledge into problem solving, applying skills and experience. Through reality, students not only apply known mathematical knowledge, but through the problem-solving process, many new knowledges are added, enriching the understanding of the students themselves. Therefore, according to the author, learning strategies from a real context are essential for the self-study capacity, contributing to the progress of students.

2.1.5.2. Distance learning strategy

Distance learning or distance education is a method for students who may not always be at school (Kaplan Andreas M., Haenlein, Michael, 2016 [14]; Honeyman M., Miller G., 1993 [15]). A distance learning program can be a complete distance learning, or a combination of distance learning and traditional classroom instruction.

Distance learning is not a phenomenon. It really appeared in 1728 when Caleb Phillips, a teacher in Boston, Massachusetts, provided short lessons to students through weekly mailing lessons. In the early 1840s, long before the Internet was born, Isaac Pitman, an English educator, also taught stenography through mailing courses. Distance learning has a long history, but its popularity increased a hundredfold as more advanced media and technologies were available by the end of the twentieth century.

Greenberg (1998) [22] defines contemporary distance learning as "a planned teaching/learning experience that uses a wide spectrum of technologies to reach learners at a

distance and is designed to encourage learner interaction and certification of learning" (pg. 36). Teaster and Blieszner (1999) [23] say the term distance learning has been applied to many instructional methods: however, its primary distinction is that the teacher and the learner are separate in space and possibly time". Desmond Keegan (1995) [24] gives the most thorough definition. He says that distance education and training result from the technological separation of teacher and learner which frees the student from the necessity of traveling to "a fixed place, at a fixed time, to meet a fixed person, in order to be trained".

Distance learning has quickly been adopted as the chosen training and education method to meet the learning needs with a variety of learning styles. Distance learning is often mentioned with the support of the Internet, software designed for learning. Distance learning has solved the problem of distance, geography, time and even language. Distance education is now widely used in primary/secondary education, higher education and professional development for teachers themselves. With the growing pace of the Internet and other digital media technologies, the use of distance education will certainly expand in the coming years.

However, in order to learn Math with effective distance learning strategies, teachers and educational program managers need to design and build content suitable for each learner and group of learners. In addition, facilities and tools for distance learning and teaching are also issues of concern.

For students, self-study Math with distance learning strategy will require student's certain ability to meet. Therefore, when studying the students' problem of self-study in Math, the author proposes to consider distance learning as a beneficial learning strategy and method.

2.1.5.3. Pause strategy in Math class

Use pausing strategies to alternate pauses in the teacher's classroom Math lessons and enhance students' understanding of the content of instruction.

During the short breaks, the teacher encourages students to discuss or redo their notes in pairs to clarify the main points raised, ask questions and solve problems given by the teacher or instructor. In addition, students can work together to write a link or highlight the main ideas outlined in their classmates' notes.

A study (2014) concluded that breaking a lecture into short pauses can increase students' attention and learning outcomes. Research identifies "pausing" as a positive learning strategy, helping students review their notes, reflect on them, discuss and explain key ideas to their classmates. The use of pausing strategies involves a minimum amount of extra time; however, it can be significantly beneficial compared to continuing lectures without breaks.

2.2. Capacity of self-assess learning results

Obviously, it is absolutely necessary to have the evaluation of students themselves in meaningful learning, because only students can understand how to meet their requirements, best understand themselves, what they want to find out.

The self-assessment of students will promote their creativity and autonomy. The major problem in general education in Vietnam is disregarding the autonomy and independence of students, underestimating the ability of students to self-assess. So, how are students? What are their advantages and disadvantages? All are judged by the teacher and parents, the teacher said that A is smart, that is, A is smart, the teacher says B is hard-working, that is, B is hard-working. Just like that, from an early age, students have lost the opportunity to self-assess, since then, students cannot know how to assess themselves. The most important thing for fostering creative-minded students is to help them get free from the constraints of the outside world. Because students who only rely on their family and school's appreciation can grow

tremendously in two directions: forever rely on the judgment of others, the mentality is not always mature; or have an attitude of resistance to all judgments from the outside world.

However, to be able to assess their own learning outcomes, students need to have the capacity to perform. Based on the above views and explanations, the author thinks that in order to develop students' ability to self-study Mathematics, they need to have the ability to self-assess, which is an important factor to push the learning process and innovation in each individual. Therefore, self-assessment competence should be considered in the framework of high school students' ability to self-study Math.

2.3. Findings

According to General Education Program 2018 [16], Results from the COACTIV Project [17], Marjorie Montague, Cynthia Warger & Thelma H. Morgan (2000) [18; Camilla R. Otte, Mads Bølling, Peter Elsborg, Glen Nielsen & Peter Bentsen (2019) [19], Baars, M., Leopold, C., & Paas, F. (2018) [20]; King D., Ritchie S.M. (2012) [21]; Greenberg, G. (1998) [22]; Teaster, P., & Blieszner, R. (1999) [23]; Keegan, D. (1995) [24]l; Jian-Jie Dong, Wu-Yuin Hwang, Rustam Shadiev, Ginn-Yein Chen (2017) [25]; Thomas R. Guskey, 2003 [26]; Lorna Earl and Steven Katz et al, 2006 [27]

Students are encouraged to explore the lessons by themselves to improve their skills and apply the knowledge and skills in practice. The teacher's role has been switched from inactively delivering knowledge to guiding students' exploration of lessons.

From the above analysis, the author gave a description of the mathematical self-study capacity framework of high school students in Table 1.

Table 1. Framework of mathematical self-study capacity of high school students

Capacity	Description
1. Math awareness	- Students could identify situations that can be solved through mathematical application - Collect Mathematical information from situations - Process mathematical information; - Store mathematical information; - Describe the situation by mathematicalizing problems [16, 18]
2. Maths connection	- Understand and apply relevant concepts in problem solving; - Connect internal and external mathematical concepts - Describe by mathematical representation from problematic situations in real context [19].
3. Problems solving	- Identify issues: To understand and communicate the problem effectively, we must be clear about what the problem is... - Collect information. What is the situation? ... - Discover knowledge (Science and methods) related to the problem to be solved - Skills to collect, analyze and process information for problem-solving directions - Create possible solutions. Work together to brainstorm all possible solutions. ... - Choose the right solution to solve the problem - Assess the ability to implement and present the selected

	solution - Review the implemented solution, adjust the solution if needed [9,10,20]
4. Effectively use self-study strategies and methods	
4.1. Learning from real contexts	- Identify problematic situations in real contexts - Summarize mathematical knowledge necessary for application (sometimes interdisciplinary knowledge is required). - Using existing knowledge, your own experience in solving problems or problematic situations in the real context; be able to generate and receive new knowledge in the learning process [13,21]
4.2. Distance learning	- Exploit open knowledge resources - Exchange information about the process of self-study with teachers and classmates through traditional and modern means [22,23,24].
4.3. Pausing strategy in classroom	- Learn about the lesson in advance, find the best resource related to the lesson and read it. - Listen actively when teachers and classmates present. - Recover main ideas at the end of each section. Students do not try to copy the words that the teacher says, but try to rewrite it to understand and apply it. - In break time (or a few minutes for the students' individual activities), students discuss or redo the notes in pairs to clarify the main points of the lesson. - Ask questions and solve problems raised by a teacher or instructor [25].
5. Implement the process of self-study	- Set clear self-study goals. - Have specific and detailed self-study plan. - Implement self-study. - Mobilize related knowledge, recreate relevant knowledge - Access and process information: reading - understanding; Listening; write down the main idea; Ask and answer questions. - Remember information: Identify the connection between knowledge and show relationships. - Applying information in many different situations.
6. self-assessment	- Thinking about your thought processing - Reassess thought processes for work and modify (if necessary) to perform again. - Self-assess the results of the self-study process compared to the initial goal. In addition, it is also possible to assess the results of self-study with peers or with the overall goals of the course (program, ...). - Change the learning method to better suit the reality [26,27].

3. Conclusions

In this study, I have proposed the framework of mathematical self-study capacity of high school students, including: Mathematical cognitive competence; Capacity of observing situations; Mathematical connection competence; Capacity of solving problems; capacity of using effective self-study strategies and methods; Capacity of self-assess learning results. The research result is an important evidence for finding ways of fostering mathematical self-study capacity for high school students.

In my opinion, teachers should focus on the following measures:

(1) Set up learning habit on the instinct of learning

(2) Effectively use the pausing strategy to enhance student math participation and learning

(3) Design learning tasks as a teaching method, in which, increasing the difficulty for students to practice solving tasks, thereby, developing self-study capacity for students

(4) Train students to solve problematic situations in many contexts, thereby, improve students' ability to self-study Math.

I believe that, with the proposed competence framework and the ideas of measures for fostering Math self-study capacity of high school students in Vietnam proposed in this research, the quality of Math learning of high school students in Vietnam will be strengthened, responding to rapid changes in the form of learning in the 4th industrial revolution era.

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