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The Proposal for Developing Mathematics Self-Study Capabilities in Vietnam High School: A Theoretical Study

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Abstract---*In terms of general learning and Mathematics study, in particular, self-study ability is a fundamental element to promote learning efficiency. The research objective focuses on proposing specific measures for developing the math self-study ability of high school students. Secondly, the research result reveals 5 methods for developing math self-study ability of high school students in Vietnam, including (1) Fostering motivation, attitude, sense of self-study, nurturing passion, and forming knowledge about Math self-studying for students through field trips or extra-curricular activities; (2) Applying objective tests as a tool to examine and evaluate students' self-study at home; (3) Training and developing students' self-instructed math skills in terms of finding and reading documents of the specific content of Mathematics and skills in listening, communicating and taking notes in class; (4) Designing and organizing for students learning activities in the direction of practicing scientific research; (5) Fostering and improving student's self-assessment skills, mistakes correction after each process of studying a specific content. The final part of the study will discuss several issues and solutions that need to be considered when putting these teaching Mathematics measures into practice at Vietnamese high schools.*
Keywords---*active learning, high school students, mathematics study, self-study development, self-study.*

Introduction

The globalization and modernization of the contemporary world have born numerous challenges with new demands for the research process. In recent years, there is a rising concern for self-education, communication skills, intellectual and moral qualities. According to Rupšienė & Mažionienė (2011), Quyen (2020), students' self-study becomes significantly relevant to the change of traditional teaching model to constructivist learning and capacity development, in which studying provides learners with a range of intensive independent activities (Keyser, 2000; Wolff et al., 2015). This result is reasonable because one of the most influencing factors of pedagogical success is the self-study experience self-study. However, education has not yet come up with a unanimous opinion on what should be considered self-tutor. Rajeckas, (l999), Dung & Quyen (2019), mentioned that creating natural conditions which encourage people to act independently is important in shaping learners' autonomy as well as a personal quality and their skills for self-study. The teacher plays a decisional role in encouraging students to learn on their own, otherwise, it may be seen as unnecessary from the learner's perspective. In (Jovaiša, 2007), independence cannot be separated from motivation, while the teacher's role is to strengthen students' incentives to independently seek to practice, apply knowledge, then combine them and find out which ones are problems and appropriate solutions. Besides, motivation has been defined to have a complex structure, especially to learning (Daly & Pinot de Moira, 2010). The idea of self-study is closely related to the philosophy of the construction industry, which states that knowledge cannot be inculcated (given): rather, it must be mastered (constructed). The student will be a more successful learner in the condition that the teacher shows the student the benefit of the course taken (Čiburienė & Guščinskienė, 2012; Ha, 2021; Perera & John, 2020). The student's research can be understood as individual studies of each module over a program of investigation. During this process, students need to comprehend the theory of the course in-depth, apply it to assignments, and analyze relevant scientific literature and articles (Baepler et al., 2014). On the other hand, the student can be faced with a problematic situation: how should the individual learner master the course content and not fall behind on the latest developments in a certain field? and how can the latest

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information be used and later applied to professional practice? The learning direction is as crucial as the knowledge range of the study. Thus, self-study can be classified as a versatile activity of independent learners. The scientific literature relevant to the current research includes articles linked to the characteristics of self-learning (Teresevičienė et al., 2006; Mahayukti et al., 2017; Tandzegolskienė & Pileckaitė, 2010; GEP 2018). Those mentioned researchers investigate aspects of the self-study organization of the high school, students' self-educated capacity, and the development of general abilities through the perceived level of self-study and the components of them.

Research Methodology

This study is based on international and national research in Vietnam on general education, active teaching, and learning methods. In detail, the research targets previous documents on self-study and the way to develop this capacity for students.

The author has experimented through the teaching process, where the author has directly taught math and colleagues' outcomes. Especially, teaching students self-study Mathematics learning at high schools has been conducted many times in the first semester of the 2017-2018 scholastic, the 2018-2019, and the 2019-2020 school year in several high schools. Furthermore, we also organize some polls over 80 teachers who are teaching Math of 10th, 11th, and 12th grade at Tran Phu Hai Phong High School, Ngo Quyen Hai Phong High School, Vinh Bao Hai Phong High School, Thai Phien Hai Phong High School, Kinh Mon Hai Duong High School, and Chi Linh Hai Duong High School by questionnaire. Those questionnaires are designed based on potential situations when teachers teach students to implement self-study in teaching Mathematics (Moenikia & Zahed-Babelan, 2010; Savelsbergh et al., 2016). As a result of the theoretical research, specific experiment, and discussion with numerous Vietnamese educational experts, I have proposed several measures to develop the math self-study ability of high school students, which will be presented in the final results section (Eaton et al., 2010; Brener et al., 2003).

Research Result

Proposing measures to develop math self-study ability for high school students

Solution 1: Fostering motivation, attitude, sense of self-study, nurturing passion, and forming knowledge about Mathematics self-studying for students through field trips or outdoor activities.

Objectives

The arrangement of practical experiences for students is aimed at fostering the self-consciousness and self-study attitude, raising the passion for self-instruction in Math, and contributing to the formation and development of knowledge about individually studying.

Content deployment and operation

Depending on specific circumstances and conditions according to time and space aspects, teachers can exploit and take advantage of that moment and organize experiential activities for students such as: discovering the history of Mathematics and highlighting the common examples of self-study capacity from national and international mathematicians. Hence, they can learn about the local tradition of self-study, identify and solve real-life problems related to Mathematics. Moreover, teachers may have the ability to create for students practical journey in an extracurricular lesson or experiential hours (following the provisions of the new general education program) such as:

- Setting up a trip to visit temples of cultural celebrities like Chu Van An, Nguyen Binh Khiem, etc. Through the introduction of their career background, the teacher can emphasize the awareness, self-study attitude, and appliance method of previous generation celebrities.
- The homeroom teacher might add the content of weekend activities and regular youth branch activities the following activities: Learning and disseminating the history of Mathematics, finding out and following good examples of self-study of domestic and international mathematicians such as Francois Viete (1540-1603), Isaac Newton (1643-1727), Niels Henrik Abel (1802-1829), Evariste Galois (1811-1832), Nguyen Canh Toan (1926-2017), etc. The lesson also needs to suggest several bright individual examples in their localities. Through the career status introduction of those mathematicians, the teacher can emphasize the consciousness, attitude of self-study, and the way to improve this capacity.

- Establishing a Mathematics committee and also being the mentor of the Math club in each class, including 3 students who are quite good at Math and have a passion for this subject self-instruction. In addition to the usual tasks, these leaders also have collaborative tasks with the homeroom teacher and Math lecturers to organize the study activities, which relate to exploring and solving real-life problems in both theoretical and practical environments (not only in the high school Math scope).

Solution 2: Using objective multiple-choice as a tool to test and evaluate the students' self-study at home

Objectives

In terms of Math self-study development, the teacher must determine clearly which skills are fundamental for weak students to foster and practice individual education? The available source only depends on student performance in lesson information, consisting: Asking students to answer the question, presenting the test on the board, interviewing, checking the student's workbook, and the exam result (Gallagher et al., 2011; Lunenberg & Samaras, 2011).

In contrast, the above activities are not enough for teachers to identify which self-study skills are potential for each student to improve? Meanwhile, only students can fully demonstrate their self-study ability when they learn on their own. The examination of workbooks does not show the self-study ability of students because the students who do not put effort into their work can search for help from their parents and friends. Also, there is no shortage of students rushing to copy others' answers into notebooks before coming to class. Moreover, the method of calling students to answer orally or onboard presents just an influence to only a small number of students. Thus, assessing students' self-study at home is an extremely difficult job for teachers. The main purpose of this solution is to create a methodology for teachers to recheck and evaluate students' self-study at home, and motivate, and promote students to actively work at home (Weigl, 2009).

Content deployment and operation

Before class, teachers spend 4 minutes (for a 1-hour lesson) or 6 minutes (for a 2-hour lesson) to check and evaluate students' self-study at home in the form of an objective test (OT) as follows:

- Before each lesson, the teacher could design the OT questions in 4 minutes (or 6 minutes) based on the goals and content of the old lesson.
- Students' work will be returned and marked by the teacher in the next class.
- The OT tests are numbered for each semester.
- The teacher uses a notebook to record information about each student's score and self-study skills.
- After every 3 times of using OT questions, the teacher can mark the average score and keep it as a fifteen-minute test score.

Solution 3: Training and developing students' self-study math skills through searching and reading documents of self-education for the specific content of Math, listening, communicating skills as well as taking notes in the classroom

Objectives

The skills of Maths self-study play a crucial role in the learner's study process (researching and reading documents, listening comprehension, communicating, and taking notes). Those abilities depend on the personal cognitive, health situation, working habits of each person, which reflects the consequence of the long-term training and experience of different students. Students are allowed to do as many activities as possible to gain knowledge throughout the lesson. Therefore, listening comprehension, taking notes, and math communication with teachers and classmates are the basic elements of students in every lecture (Whitehead & Fitzgerald, 2007). According to specific circumstances and conditions of time and space, math teachers can provide guidelines on how to find and understand the materials. Additionally, the skills of listening, comprehending, communicating, and taking notes are necessary for self-studying a variety of Mathematics contents.

Content deployment and operation

Following the skills of finding and reading documents, we apply these steps:
Step 1: Determining the goal and content to research and observe
Students need to research the content to be self-study to classify the specific requirements and questions that need to be solved. Those contents can come from:

- A home self-study task assigned by the teacher
- The need of completing an answer, a problem-solving method;
- The demand of knowledge systematizing knowledge for content, a topic;
- Drawing an overall experience of a learning activity;
- The need to understand, supplement and tolerate a new knowledge about science, methods, etc that is outside the training program at school.

Step 2: Identifying the data to read, selecting, and highlighting the places to apply
Based on determining the content, there should be a collection of goals and requirements of self-study, own experience, and advice from teachers, parents, or friends about relevant readings; students can make a list of what they need to do on their own. In specific, that list includes: textbooks, exercise books, reference materials, and some internet web pages, unless the different need comes from understanding, supplementing, or comprehending a new knowledge about science, law, etc in addition to the school training program.

Step 3: Skimming to evaluate which material is suitable for the self-study content.
Students need to skim through relevant content in the listed documents (pay attention to the introduction, structure, table of contents, and main body of the document) to get an overview of the paper. After that, learners need to digest which documents are suitable for specific goals, requirements, and questions that they should solve by themselves.

Step 4: Detaily reading to scan the content in the document in parallel with researching, detecting, and solving the possible issues.
The process of reading a document in detail paralleling finding, exposing, and problem-solving can be divided into several stages in a spiral direction (repetition and enhancement):

- Stage 1: Learners read the document carefully one or many times until they can penetrate the concepts, the content of the theorems, and illustrative examples (temporarily ignoring the theorem proofs, the solution of the theorem questions). Therefore, students need to mark the statement that they find difficult to understand and pay attention to the highlight points for the next re-reading.
- Step 2: From the previous reading knowledge, students need to double-check and search for the subject and solution. If the identified problem is satisfied, the study and reading process is over, otherwise, they can go to stage 3.
- Stage 3: Re-reading the study materials carefully until the learner can understand the theorem proofs, answers for the illustrative examples. Depending on the reading knowledge, students can return to solve given questions. Stage 3 can be repeated many times until the problem is clear.

Solution 4: Designing and organizing for students learning activities in the direction of practicing scientific research

Objectives

High school students are in the stage of completing their psychology and personality. In this way, the young always want to assert themselves with independent thought and action. These changes are the ideal condition for teachers to design and organize for students a range of learning activities according to the direction of scientific research practice.

Content deployment and operation

The content and implementation method can be summarized as follows: At the end of each topic, chapter, or even semester, the teacher synthesizes the basic contents and then converts them into large assignments for groups to

perform in experiential lessons (the new general education program), Math Club activities, extracurricular hours or lecture review. Thus, each group needs to present a result report in the following steps:

Step 1: Starting from the Mathematics knowledge circuits, topics, or a real-life situation related to the knowledge of the subject that students have learned, the teacher would build the specific research topics (in the form of assignment).
Step 2: The teacher divides the class into groups (each group has enough learning ability level: fairly good, average, and weak) with various activitíe to implement the lesson topic.
Step 3: Due to the content and level of the students, and especially at the first times appliance, the teacher must give instructions for students to perform at different levels (a brief guide, detailed illustration) in terms of:

- Setting the goal to be achieved, the question to be answered of the topic center
- Selecting documents and Web sites for reference.
- A variety of diagrams can be used (block diagrams, mind maps, etc.)
- How to organize activities and assign tasks to team members?
- Suggesting for students to outline (detail or a summary) the topic's content.

Step 4: The teacher creates the group's activity to report their research results. After each presentation, the teacher organizes for the whole class students to analyze, evaluate, and critique those outcomes with a question system.

Step 5: Teacher summarizes and institutionalizes knowledge in each report and mark out (equal to fifteen-minute test scores)

Solution 5: Boosting and training students self-assessment skills, correcting mistakes after every process of self-studying a specific content

Objectives

The evaluation of a student's learning result may contribute to delivering feedback on the self-studying process with knowledge and skills of cognition of certain content. Hence, they can have the ability to detect and cover the mistake, adjust behaviors, or individual study approaches. Additionally, the support can improve their sense of responsibility in learning, strive to inspire and strengthen their self-belief.

The main goal of this measure is to engage students forming the habit of observing and re-evaluating the self-education flow, as well as the process of performing solving tasks for a math problem. Considering some statistical calculations to locate the step of inference, students can independently find out and correct the error, then adjust their study plan.

Content deployment and operation

Besides, the assessment of students' learning results also needs a profound innovation in both perception and formation. In the perspective of operation, evaluating the student's learning outcomes should be generated actively regarding the following forms: teachers - students; students- students; students - self evaluate.

Within this solution framework, we are only interested in the two forms of assessment: students evaluate colleagues, students self-judge after each process of individual studying for content, the operation of performing learning tasks, or problem tackling. On the way of forming and training a habit for students, teachers need to activate the objective analysis with questions and assigned tasks to engage the ability to review and re-evaluate the entire process of self-studying during a particular period. Subsequently, that is the time for the teacher to create and control the learning activities with given purposes and release the feedback on the course performance. There are several procedures that lecturers can use to foster and develop self-assessment skills for students.

Research recognition

Possibly, self-study is a form of pedagogy where the learners are their instructors. This method can be performed through reading books, magazines, manuals, internet resources or expert consulting, etc to deal with the difficulties of discovering a specific topic and taking advantage of it. Some benefits are coming from the self-study process:

- Actively directed self-study helps learners maintain the passion flame and the hunger of gaining knowledge about science and the world operation to enhance their awareness.
  The process of self-instruction separates from the stereotype pressure limiting the content and study time so that students can choose what they want to set and achieve. Thus, successful self-study on a certain topic can improve not only human awareness but also passion and excitement in researching and obtaining knowledge without any stress.
- Developing the learner's ability of problem-solving and practice
  Self-taught brings numerous opportunities to apply the skill of exploring and defining problems, then develop intellectual qualities in finding a recommendation for those troubles and challenges. Although the failure in the operating system can cause obstacles that might be incentives to get experience to change the methodology of study instead of weakening the apparent motivation.
- Enhancing cognition and some necessary skills for students in the learning pathway.
  In terms of efficient self-study, the student may freely train some thinking qualities such as: prudence, scientific work habits, creativity, logical conception, etc;
  That is an appropriate situation for students to practice numerous fundamental soft skills such as time management, planning in general and learning schedule building in particular, documents reading and researching, Mathematical language usage and expression, self-assessment and establishing goals in different study stages, etc.
- Through experiential activities in a self-study environment, students will be prepared with attitudes and abilities to get ready for applying learned knowledge into real life. Especially in the form of self-study without guidance, students must intentionally determine the content derived from the desire to acquire new information, that comes from personal needs arising in the actual learning process. Therefore, students always need to experience a study environment associated with real-world problems and use their cognition to solve those obstacles. These are the "exercises" that help students construct their minds and capacity to apply their understanding in a certain curriculum.

Conclusion

In terms of the proposal with many measures, there is still a conflict that those recommendations are not enough to develop the math self-study ability because students also need more innovation in the reading skill, documents researching, technology and virtual information usage, and thinking arrangement, etc. To answer those comments, the author has presented his own opinion on building study methods to develop math self-study competence for high school students. With the previous experience and research, the author believes that when delivering too many specific and detailed approaches, limitations may occur in practical application. In the 4.0 century, the requirement of technology utilization in communication and study can burden students to ensure this capacity for learning and living. While describing the measure, the researcher aims to reveal several definite skills and self-instruction ways to achieve the set goal. However, this study is carried out on the theoretical side so the author will continue to publish more experimental results to evaluate the effectiveness of the proposed measures.

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