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## **A STUDY ON CAPACITY DEVELOPMENT OF MATHEMATICAL PEDAGOGY STUDENTS**

At present, there are many research results, opinions of educational experts in the world and especially in Vietnam about the capacity of professional performance of teachers. Although this concept has been approached by experts in a variety of ways, one point is always identical: It is a combination of multiple elementary capacities to ensure that the lecturer can fulfill the teaching task of a certain standard and it is concretized in each field. However, experts affirmed that their performance capacity development must be carried out in accordance with the scientific process, often through teaching the methodology of teaching maths and elementary mathematics, which is one of the most important tasks of pedagogical universities.

In this article, we would like to mention some of the performance capacities that need to be developed for students in the faculty of mathematics, and propose two pedagogical measures to develop student performance.

### **Methodology**

This research mainly uses quantitative methods to test whether the shift from content-based training to performance-focused approaches has attained its primary objective that is to improve the quality of core image training affecting the quality of training, curriculum, resources, curriculum and students.

The actuality of these factors was collected through field surveys using reports from Hong Duc University and ten high schools (10 employees, 30 high school teachers and 20 students) to assess whether there is a mismatch between requirement and reality. Comparative results were analyzed and discussed in this paper.

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## Results

### Model of Teacher Capacity

The term “Teacher Capacity” comes from the literature on school improvement, school leadership, and system reform (McDiarmid 2006; Fullan 2010). When used in this context, teacher capacity often involves the teacher’s ability to understand and act on the reforms that policymakers are seeking to implement (Spillane 1999). It is close to our definition of teacher capacity as professional judgment and action orientation. Some researchers, including Floden, Goertz & O’Day (1995), emphasize that teacher capacity is multidimensional and developmental. Firstly, they argue that their ability to support their studies depends on their knowledge, including their knowledge of the subject, their knowledge of the curriculum, their knowledge of the student, and their knowledge of pedagogy in general and specific subject. Secondly, while knowledge interacts with skills, there is a significant gap between what teachers believe they should do in the classroom and the ability to teach in the ways they desire; thirdly, they point to the importance of directions because the promulgation of reform requires the introduction of new standards for student learning and the introduction of necessary changes.

There are obvious similarities with Ball et al. (2008), who emphasized that any definition of mathematical knowledge for teaching should begin with teaching rather than teachers. Any such definition must be “related to the tasks related to teaching and the mathematical requirements of these tasks because teaching involves showing students how to solve problems, answering students’ questions and checking students’ work, it demands an understanding of the content of the curriculum”.

### Teacher Performance Capacity

The term “performance capacity” is the ability to complete work according to the standard of work under a particular condition (Sullivan 1995). K.E. Paprock (1996) points to five fundamental characteristics of this approach: it is based on the learner-centered learning mindset; it meets the requirements of professional practice; it is oriented to human realism; it demonstrates flexible and dynamic teaching views; it allows the definition of competency standards to be established in the learner clearly.

In Vietnam, when studying capacity-based training, it is important to note that the ability to perform activities (skills, occupations) in the profession in accordance with the standards is set for each task and job. Performance capacity involves numerous aspects, many of which refer to personality, which represents a certain degree of correspondence of mental or physiological attributes with one or more activities. This clearly demonstrates the relationship between performance and the factors that make up personality and capacity assessment through the performance of individuals who

meet the standards of the profession. Based on the performance results, it is possible to see the relation between the concept of performance and the skills in Table 1.

Table 1. Comparison between skill and performance

Skills	Performance Capacity
The ability to perform/complete part of a job or the whole job; Represents the level of competence or proficiency	Demonstration of knowledge, skills and attitudes through the performance/accomplishment of the activities or work of a profession according to the standards set for each activity/task
Results: a part or all of the work	The result: work
There are many levels of completion	There is a criterion, the general criteria of the job

Source: Authors' own work.

In the comparison table it is possible to see the hallmarks of performance that can be observed through “do” actions, ie: skills and observed performance accomplishments as “benchmark output”.

### **Vocational training model for mathematical pedagogy students**

The result of vocational training for mathematical pedagogy students mainly depends on the model of the training program. There are two popular models today.

**Parallel model:** In this model, students are trained simultaneously in the science of science and education in a teacher training course that is oriented at the beginning of the course. This model has been implemented in many pedagogical universities, as well as other multidisciplinary universities in Vietnam. The advantage of this model is that students are soon oriented to teaching profession, have a long time to acquire knowledge and practice performance capacity. However, this model does not adapt to the needs of society.

**Continuous training model:** According to this model, students must graduate from a specialized discipline (3 or 4 years) and then take a teacher training course up to two years for a pedagogy certificate or a master's degree and become a teacher. The advantage of this model is that it adapts to the changing labor market dynamics. The downside is that students are late for instruction in teaching and science education so professional preparation is not high, difficult to handle pedagogical situations as well as the choice of appropriate teaching methods.

According to the report of the Ministry of Education and Training, development of performance capacity has many advantages over the new requirements of Vietnamese education. This is an approach that organizes the training process in a school-oriented output. Vocational training in this way shows that the goal of the subject is described through the competency groups that the learner needs to achieve. These capacities are

specified in different occupations. Teaching in the direction of capacity development not only focuses on activating the learner intellectually, but also cares for the ability to solve problems associated with professional situations, in order to effectively implement the training objectives.

### **Performance capacity should be equipped and experienced by mathematical pedagogy students**

General capacity assessment, including the professional capacity of graduate students, is a mandatory requirement for any institution, particularly teacher training institutions. The results of the assessment of the professional capacity of graduated students is to assess the quality of training, and at the same time propose solutions to build and develop the program to suit the labor market.

The Faculty of Natural Sciences, Hong Duc University has launched a survey aimed at developing a career profile of graduates from the Bachelor of Mathematics, thus building the performance capacity of the Bachelor of Mathematics pedagogy in the direction of career application and deployment of training.

We conducted fieldwork research at 10 high schools in Thanh Hoa province, Vietnam (with many alumni graduating from Hong Duc University) with the participation of 10 educational managers (Alumni of Natural Sciences), 30 high school teachers (Alumni of Natural Sciences); 20 mathematical pedagogy students, Hong Duc University. Research was based on methodology and the research tools were questionnaires. Below is a summary of the data and the results from the surveys.

Table 2. Evaluation of staff, teachers and students on the need of capacities for Math teachers

No.	Capacity	Staff	Teacher	Student	Result
1	Applying advanced mathematics to solve primary problems	0.26	0.27	0.40	0.31
2	Conducting the teaching process	0.22	0.23	0.26	0.24
3	Studying and designing lessons	0.25	0.25	0.25	0.25
4	Organizing extra-curricular maths activities	0.36	0.37	0.31	0.35
5	Scientific research	0.48	0.49	0.50	0.49
6	Integrated teaching	0.24	0.25	0.19	0.23
7	Diverse teaching	0.43	0.44	0.35	0.41
8	Developing subject curriculum	0.42	0.43	0.27	0.38
9	Applying mathematical knowledge in practice	0.22	0.25	0.20	0.23
10	Assessing student achievement in the direction of capacity development	0.41	0.42	0.26	0.37
11	Primary settlement	0.25	0.24	0.21	0.23

(From 0 to 0.25: really necessary; From 0.26 to 0.5: Necessary; From 0.51 to 0.75: less necessary; From 0.75 to 1: Unnecessary)

Source: Authors' own work.

Looking at Table 2, most of the performance capacity of the teachers is assessed by staff, teachers and students at the really necessary and necessary levels, including the assessed capacities at a very high level, such as “primary settlement” and “Applying mathematical knowledge in practice”. Some of the competencies that we think are new capacities are: “Ability to apply advanced mathematics to solve primary problems”, “Integrated teaching capability” are highly appreciated.

We use the questionnaire as the content in Table 2 to find out how much the performance of student capacity was achieved when learning the teaching method and elementary math. To the question: When learning the modules of teaching methods and Elementary Mathematics at the university, how well did they do for each of the following competencies? (From 0 to 0.20: Very good; From 0.21 to 0.4: good; From 0.41 to 0.60: average; From 0.61 to 0.80: not good; From 0.81 to 1: no comments).

After analyzing student questionnaires, it is assumed that the capacity 1, capacity 6, capacity 10 (Table 2), 100% of students fail to perform very well; Mostly students perform these competencies on an average level. In the interviews, students said that they often did not know how to do capacity 8 and capacity 9 and confirmed that the primary problem solving skills were paid very little attention in the learning process.

An assessment of the extent to which the student expects the lecturers to develop these competencies. To the question: What is your desire of the teacher’s teaching? (0 to 0.20: like very much; 0.21 to 0.4: like; 0.41 to 0.60: normal; 0.61 to 0.8: dislike; 0.81 to 1: no comments), the results show that the students like or like very much when lecturers develop these capacities.

From the results obtained in the survey we have confirmed: 1. The performance capacity of a math teacher in particular is the combination of skills that the teacher performs in correspondence with each specific educational content so that the educational activity gives the best results. 2. Maths teachers, in addition to the basic competencies such as: conducting teaching process; studying and setting the lesson; primary resolution; scientific research, also need other capacities: assessing student achievement in the direction of capacity development; applying mathematical knowledge in practice; developing subject curriculum and integrated teaching.

### **A number of capacity development measures are implemented for students**

***In the process of training in the teacher profession some performance capacity should be pay attention to:***

1. *Making students understand and master the core concepts of active teaching methods with examples of teaching mathematics in high school*

For students to master teaching maths in high schools, teachers need to clarify the knowledge with examples that are typical in teaching mathematics in high school. For

example, for teaching methods to detect and solve problems, before introducing the concept of problem-provoking situations, teachers should provide some examples for students to initially visualize the basic features of this concept; After introducing this concept, it is very important for teachers to organize students to find out how to create problem-solving situations.

## *2. Organizing students to apply theories and methods of teaching mathematics to prepare some typical lessons*

The results of traineeships in high schools during February – April/2017 for 45 students of Mathematics Pedagogy K16, Hong Duc University, showed that to improve the use of theories and methods of teaching mathematics to design lectures:

### *– Students should master the preparation steps of the lecture*

Step 1: Studying textbooks and related materials to accurately understand the content of the unit; Identifying the knowledge, skills, attitudes that need to be developed in the student; Determining the logical order of the lecture. It is important to read carefully and learn how to use the textbook to understand and evaluate the content of the lesson; read more material to understand the content of the lesson; discover, analyze and evaluate the details of knowledge, skills; summing up, build up a system of questions and exercises to help students realize knowledge and skills in the appropriate way.

Step 2: Defining lesson objectives based on knowledge, skills and attitude requirements in the program. The goal is both the destination and the demand of the school, or in other words it is a measure of the outcome of the teaching process. It helps teachers determine what tasks they will have to do (lead them to apply knowledge, skills, scope, and extent).

Step 3: Determining the ability to meet cognitive tasks of the student including identifying the knowledge and skills that the student has and needs, anticipating difficulties, situations that may arise and the solution. This step is set by the classroom, teachers not only have to master the content of the lesson but also to understand students to choose teaching methods, teaching aids, teaching forms and evaluation. Thus, before preparing new lectures, the teacher must anticipate situations, how to solve the task of learning for students.

### *– Instructors guide students to prepare the lesson according to the following steps*

Step 1: Providing students with knowledge including: Teaching methods, How to organize maths instructional activities, How to teach case studies, Evaluation process, must be done actively, positively and creatively.

Step 2: Training the students on the skills: goal setting, method selection, building teaching activities through the question system, exercises; Focusing on group work, encouraging each student to draw out their own options for themselves.

Step 3: Allowing students to refer to the sample lesson of good teachers; conducting assessment analysis, drawing lessons for themselves.

Step 4: Composing specific lecture.

Step 5: Demonstrating how to teach lectures during the training sessions to test the rationality and effectiveness.

Step 6: Teaching experience, adjusting and completing the lecture.

### 3. *Appreciating the student's lectures, strengthening contact with high school in regular pedagogical activities*

After the student has completed the composition, the teaching activity is the initial demonstration of the students in the lesson in practice. To be effective in teaching, it is necessary to do well the following steps:

- The lectures must be written papers that have been discussed, revised and approved by instructors.
- All students have to prepare a lecture.
- The lectures should be full of typical situations in the Mathematics curriculum, including: theory, exercises, review.
- The placement and arrangement of student training should be appropriate; students have to take it seriously, it must be fully recorded.
- Encouraging the use of e-lesson plans.
- Discussing, contributing, learning experience right after lesson. Contributions should focus on organizing teaching activities, on teaching methods as well as on achieving goals.

Apart from training activities, there must be plans to invite experienced teachers to teach samples and to request students to register for classes at high schools. Strengthening the link between training institutions and schools is really effective in developing the skills of teaching students.

### 4. *Helping students access modern teaching facilities, especially learning how to use the software*

Practicing the application of information technology in teaching mathematics to students according to the following process:

Step 1: The lecturer introduces students to some popular softwares in teaching mathematics in high school, such as: MS Powerpoint, Cabri Geometry, Maple.

Step 2: In this step, the teacher divides the class into groups, provides documentation for all members of each group, instructs all members to master the basic operations of the software. Teachers task the teams to organize practice based on the materials and complete the discussion exercises at the end of each chapter as required: Learn how to use the functions of each software; Organize typical case studies in maths instruction with the support of software for high school students; Get an illustration of the software. Team members help each other in learning how to use it.

Step 3: Each student conducts an electronic lecture for a mathematics class in a high school, and each student group presents their results.

The preparation of electronic lectures must follow certain rules, especially to exploit the advantages of software compared to boards and chalk or other means such as exploiting dynamics, graphics capabilities, how to create a situation for student activity.

#### 5. *Practicing student skills in dealing with pedagogical situations during lecture*

To train students to behave in class, the instructor first needs to project and introduce some common situations that occur during the promotion process which is not easily solved. After that, the students have to suggest situations and how to deal with them.

### **Designing the teaching process of learning the method of teaching maths and elementary mathematics**

Step 1: Analyzing the output of the training program in terms of performance capacity approach, standard performance capacity of mathematics teaching methodology, elementary mathematics and instructional objectives.

Developing criteria for assessing the achievement level of the methodology content of teaching mathematics and elementary mathematics to the performance capacity standard of the curriculum. We determine 4 levels (Know – Understand – Apply – Analyze), in each level we determine the detailed content knowledge, skills, attitudes which students can achieve performance capability through teaching methodology of teaching mathematics, elementary mathematics. The latter is always higher and covers the previous level.

Studying the implementation capacity structure and content of teaching methods program of mathematics and elementary mathematics, determines achievement goals after completing these courses. Conducting benchmarking of the performance capacity standards of the curriculum with the content of the curriculum in mathematics and elementary mathematics. Determining the goals achieved after completing these courses.

Table 3. Level of objectives that can be achieved after completing the course in methodology of Maths and Elementary Mathematics

Output standard according to performance approach	Degree of achievement			
	1	2	3	4
	Able to know	Able to understand	Able to apply	Able to analyze
<b><i>Capacity to conduct teaching process</i></b>				
Organizing maths learning activities for students			x	
Applying pedagogy when communicating with students			x	
Selecting and applying methods of teaching mathematics			x	



Using math teaching aids			x	
Understanding how students learn math			x	
Exploiting and using information technology to support math teaching				
Capacity to research and design a unit				
Designing specific, detailed, feasible teaching system				x
Making plans for each lesson and each activity				x
Designing evaluation plan			x	
Designing rich, diverse, attractive resources		x		
<b>Capacity to assess students' learning outcomes in the direction of ability development</b>				
Method of assessment for students			x	
Designing content that evaluates the student's math learning results			x	
Using assessment results to adjust teaching and learning			x	
Capacity to organize extra-curricular maths activities				
Organizing maths game activities			x	
Practicing extra-curricular activities			x	
Integrated teaching capacity	x			
Diverse teaching capacity	x			
<b>Primary settlement capacity</b>				
Proficiency in maths problems in mathematics textbooks in high school			x	
Using the knowledge provided in the pedagogical university to find the original problem and give direction in creating a new class of problems; Having in-depth knowledge to support good students		x		
Systematizing the types and solutions for each type of problem, summarizing and know how to equip knowledge corresponding to each teaching content			x	

Source: Authors' own work.

Identifying skill goals that can build student performance capacity through the math and elementary mathematics teaching program. After determining the performance of the student can be achieved by completing the math and elementary mathematics instructional module, we determine in each performance capacity there are basic skills. Here we illustrate the primary settlement capacity:

Table 4. Skill objectives are formed through teaching mathematics and elementary mathematics to form students' primary solving abilities

Output standard according to performance approach	Level	Performance capacity skills are achieved through teaching methods of teaching maths and elementary mathematics
Solving problems in mathematics coursebooks in high school	3	<ul style="list-style-type: none"> <li>- The ability to solve tasks in coursebooks and workbooks: to master and to understand each task, to group exercises presented in coursebooks and workbooks on the basis of maths skills, knowledge is provided in pedagogical college, the links between subjects, the ability to manipulate mathematics in practice</li> <li>- Exploiting and developing basic maths problems into new mathematical problems requires generalization and synthesis of the knowledge that students have learned</li> </ul>
Using the knowledge provided in pedagogical university to find the original problem and giving direction in creating a new class of problems; Having in-depth knowledge to foster good students	2	<ul style="list-style-type: none"> <li>- Proficiently using coursebook exercises in the direction of creating new maths problems for good and excellent students</li> <li>- Applying dialectical materialist philosophy to the exploitation of knowledge in coursebooks</li> <li>- Applying two basic principles of dialectical material philosophy which are the principle of the relationship and the principle of development</li> <li>- Applying logical inference and reasonable inference</li> <li>- Applying pairs of categories to the common and the individual, the nature and the phenomena, the content and the form</li> <li>- Applying psychology associate, method of solution by G. Polya</li> </ul>
Systematizing the types and solutions for each type of problem, summarizing and knowing how to equip methodological knowledge corresponding to each teaching content	3	<ul style="list-style-type: none"> <li>- Demonstrating proficiency in a variety of ways, suggesting similar problems and general problems</li> <li>- Systematizing mathematical forms, proposing solutions for each mathematical form of the system, and creating new maths problems</li> <li>- Effectively performing language transformation to solve problems in a variety of ways, recognizing mathematical problems in different aspects</li> <li>- Exploiting maths coursebooks by generalizing them from a mathematical problem into a series of mathematical problems</li> </ul>

Source: Authors' own work.

Step 2: Designing a program to teach methods of teaching maths and elementary mathematics in the following order.

Describing a course content which can meet performance standards; Defining teaching objectives and formulating integrated teaching objectives for performance capacity standards; Developing a teaching syllabus based on the description and goal of integrating performance benchmarks; Adjusting teaching content based on integrated teaching objectives; Identifying required and referenced learning resources; Determining

the duration for each lesson and the type of teaching organization; Building a specific schedule for each content; Determining how to evaluate.

Step 3: Designing lesson plans for teaching maths and elementary mathematics.

Determining the method and form of teaching organization: questions, problems, case studies, micro teaching, action oriented teaching, contract teaching. The teaching forms include: self-study, discussion, seminar, class. Forms of teaching organization include: individual form, group type, full grade. Lecturers should be prepared to know the conditions of facilities, and to use computers, projectors, software, pictures, models, study cards. The instructors will carry out the following tasks: designing the content, tasks, mode of operation, time and requirements for each teaching activity of the instructor and student learning activities.

Step 4: Organizing the process of teaching methods of teaching maths and elementary mathematics.

*Preparation:* For instructors: In this step the instructor performs four successive tasks: Determining the objectives of the unit; Designing and preparing study notes, feedback cards, teacher assessments and student self-assessments; Preparation of teaching aids; Student grouping. For students, corresponding to each of the above tasks, the student must create the following activities: Determining the learning objectives; Studying the content of the study; Self-study group planning; Preparation of learning conditions.

*Organization of teaching:* with each type of lesson (theory, practice, seminar, ...) that proceeds the sequence of steps, activities accordingly.

*Assessment of Student Performance:* The assessment is done through a teacher's assessment (assuming a decisive role) and a student self-assessment (as an information channel for the teacher to evaluate the student). Then the instructor will evaluate the level of knowledge and level of proficiency of the students.

If the results of the assessment and self-assessment show that the student has met the performance goal to a certain extent, then they move on to complete the next task. If they do not meet the standards, the limitations are pointed out and the student resumes the work.

Step 5: Evaluating the results of teaching methods of teaching maths and elementary mathematics.

In assessing the learning outcomes the instructor should construct the following four types of assessment standards: Content Standards which is a statement describing what the student must know, or be able to do on the basis of a unit of course content; Process Standard which is a statement describing the skills that students must train to perform and improve their learning; Skill Standards which are the basic skills that apply to all subjects not only in methods of teaching maths and elementary mathematics;

Value Standard is a statement describing the qualities that students need to practice in the learning process of methods of teaching maths and elementary mathematics.

Mathematics and elementary mathematics tasks are designed to ensure the following two requirements: Students are required to construct their own answers rather than select the correct one; This task reproduces the challenges students face in the course of their future pedagogical work.

Types of tasks can be constructed to evaluate the learning outcomes of teaching methods of teaching maths and elementary mathematics: Tectonic Question: To answer this question students have to construct answers based on knowledge and skills learned; Practical exercise: To complete this type of exercise, students must create a specific, valuable product, evidence of the application of the knowledge, skills learned, or the ability to apply, analyze, synthesize and evaluate such knowledge and skills; Product activity: Performing an activity, discussing, presenting to the class, learning project; designing and practicing a maths lesson. Determining the criteria for evaluating the fulfillment of tasks according to the identified standards.

Constructing evaluation guidelines: The instructor (with the scorecard) provides descriptions or indicators of each level of accomplishment of the task. For example, creating skills assessments, works on achievement standards (output standards), including assessment forms after each course, Evaluation forms for designing teaching materials, use of teaching aids; Evaluation sheet for teaching practice, teaching theory; Evaluation card after the course. As such, the instructor helps to accurately assess students' level of achievement and provides feedback so that students can learn from it and improve their learning process.

The relationship between the steps in the process: We set up a system of steps to implement the teaching process of methods of teaching mathematics and elementary mathematics in the direction of performance capacity development based on theoretical research and practical teaching at Hong Duc University. We ensure that system is systematic, practical and effective.

As it is affirmed in the above analysis, teaching methods of teaching maths and elementary mathematics need to be coordinated synchronously to achieve high efficiency.

## **Conclusions**

In order to develop the performance capacity for our students, in addition to the students who need to have the ability to solve primary mathematics, to apply the theory to teach mathematics practical, the instructors should pay attention to: Promoting the personal abilities and performance capacity (in the implicit or explicit form) in each

student; Creating a practical, highly interactive environment to implement student performance development activities.

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## A study on capacity development of mathematical pedagogy students

**Abstract:** This paper presents some courses in Bachelor of capacity development of mathematical pedagogy students. Firstly, we analysed Bachelor of Mathematical Education program. Secondly, we conducted a survey to identify Vietnamese students who need to be equipped and experienced some performance capacities. Thirdly, we suggested some solutions to be taken during courses related to the module of teaching methods and pedagogic practice in order to contribute to the promotion of these competencies for students. Finally, we answered the question "How to develop such capacities for students?"

**Keywords:** performance capacity, mathematical pedagogics student, method teaching, mathematics, elementary mathematics

### **Studium na temat rozwoju umiejętności studentów matematyki ze specjalnością nauczycielską**

**Streszczenie:** Niniejszy artykuł przedstawia kilka kursów, które mają na celu rozwój umiejętności dydaktycznych z zakresu matematyki wśród studentów. Po pierwsze, przeanalizowaliśmy program studiów licencjackich z zakresu edukacji matematycznej. Po drugie, przeprowadziliśmy ankietę w celu ustalenia, którzy wietnamscy studenci powinni być wyposażeni w określone doświadczenia i umiejętności. Po trzecie, zaproponowaliśmy kilka rozwiązań, które należy podjąć podczas kursów związanych z modułem metod nauczania i praktyką pedagogiczną, aby podnieść kompetencje studentów. Na koniec odpowiedzieliśmy na pytanie: „Jak rozwijać takie możliwości wśród studentów?”

**Słowa kluczowe:** zdolność do działania, matematyka pedagoga, nauczanie metod, matematyka, matematyka elementarna