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PROFESSIONAL COMPETENCY PROFILE OF DESIGNING MATHEMATICS LESSON PLANS FOR GRADE 3 IN THE DIRECTION OF STEM EDUCATION

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ABSTRACT

In the current era of Industrial Revolution 4.0, the development speed of science and technology in the direction of STEM education is increasing day by day; the amount of scientific knowledge is produced at an increasingly rapid rate; Occupational structure in society is also changing rapidly... requiring people to have enough capacity to adapt the world context and the needs of society. Those competencies can be formed and developed through the STEM education model. In this article, we propose the process and illustrate the lesson plan for Maths subject based on theoretical research on STEM education and the reality of STEM teaching Mathematics in Grade 3 in some primary schools in Vietnam.

KEYWORDS: lesson plan, STEM education, STEM, Mathematics, Grade 3.

1. INTRODUCTION

In order to enhance the role of STEM-oriented teaching activities, in the 2018 General Education program of Vietnam, promulgated according to Circular 32, December 26, there are all STEM subjects such as Mathematics, Natural Science, Technology, and Informatics. The position of Informatics Education and Technology education is also enhanced. The requirement for integrated teaching and innovative teaching methods in the new general education program facilitates the organization of STEM education topics. This is not only a clear demonstration of the STEM model but also a timely adjustment of general education before the 4.0 revolution.

Mathematics - specifically Primary School Mathematics - as one of the four core subjects of STEM is a highly interconnected subject with great potential and opportunity in the design of lessons and activities in STEM education-oriented. Therefore, the study of STEM education in general and the study of designing and organizing Mathematics lesson plans in the direction of STEM education in Grade 3, in particular, are completely grounded and consistent with the orientation to fundamentally renovate Vietnamese education in the direction of developing learners' capacity to meet the requirements of modern society.

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2. RESULTS

2.1. STEM and STEM Education

2.1.1. STEM

Competency

STEM is an instead of the words Science, Technology, Engineering, and Mathematics.

STEM is a shortened term used when discussing the development policies of Science, Technology, Engineering, and Mathematics in the United States. The term was first introduced by the American Science Foundation (NSF) in 2001. Before that, in 1990, the NSF used the term SMET but the term is pronounced the same as "SMUT" (a word with a negative connotation), so SMET was later changed to STEM.

Currently, the term STEM is used in two different contexts: educational contexts and professional contexts.

In the context of education, referring to STEM means emphasizing the interest in education in Science, Technology, Engineering, and Mathematics subjects. Interested in integrating the above subjects with practice to improve learners' capacity, STEM education can be understood and interpreted at many levels, such as: STEM policy, STEM program, STEM school, STEM subject, STEM lesson or STEM activity.

In the professional context, STEM is understood as an occupation in the fields of Science, Technology, Engineering and Mathematics, for example, IT industry group; Biomedical; Engineering, Electronics and Communication... Depending on different contexts, STEM is understood as subjects or fields.

2.1.2. STEM Education

Currently, STEM education is interested in research by many organizations and educators. Therefore, the concept of STEM education is also defined based on different interpretations. There are three main interpretations of STEM education today:

- STEM education is understood in the sense of being interested in Science, Technology, Engineering and Mathematics subjects. This is also the concept of STEM education of the US Department of Education, "STEM education is a program that provides support, reinforcement, and Science, Technology, Engineering, and Mathematics (STEM) education in primary schools and high schools to graduate level". This is the expanded meaning of STEM education.

- STEM education is understood in the sense of integrating (interdisciplinary) two or more fields of Science, Technology, Engineering, and Mathematics. According to this concept, author Sanders defines "STEM education as an approach and discovery in teaching and learning between two or more STEM subjects, or between a STEM subject and one or more subjects in the school.

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- Besides, STEM education is also conceived of STEM as a training program based on the idea of teaching students (students) four specific fields - Science, Technology, Engineering and Mathematics - in an interdisciplinary and applied approach. Instead of teaching these four areas in separate and discrete subjects, STEM integrates them into a seamless learning model based on real-world applications.

2.2 ***Designing lesson plans in teaching Mathematics in the direction of STEM education***

2.2.1. Principles of designing lesson plans in the direction of STEM education

- STEM lesson topics focus on practical problems

- Structure STEM lessons according to technical design process;

- The method of teaching STEM lessons is to bring students to explore and discover, action-oriented, experience and create products;

- The form of organization of STEM lessons attracts students to the construction group;

- The content of STEM lessons applies mainly from the science and math content that students have been learning;

- STEM lesson progression takes into account multiple correct answers and treats failure as a necessary part of learning.

2.2.2. The design process works

By researching and referring to some STEM-oriented lesson design processes and based on the Maths program in Grade 3, we propose a specific STEM education-oriented lesson design process as follows:

- Step 1: Select a lesson in the 3rd grade Math program (according to the 2018 General Education Program) to determine the content of the lesson that will be designed in the direction of STEM education.

When choosing lessons to design, it is necessary to pay attention to the following issues: (1) Why choose this issue for research? (2) The scientific basis of that problem? (3) Applying knowledge from the lesson, can students solve problems in practice? (How practical is the problem?) (4) Can students do it? If it can be done, what benefits will it bring?

- Step 2: Determine the goals of the lesson and the STEM knowledge integrated into the lesson.

This step identifies the requirements that students need to achieve after finishing the lesson. Determining the requirements to be achieved is an important step to developing criteria for assessing the learning outcomes of learners as well as the content that the selected research topic is appropriate or not. In addition, teachers need to clearly define the lesson aimed at developing knowledge and skills based on the four components of STEM education.

- Step 3: Design teaching activities in the direction of STEM education

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Based on the required content and the elements of STEM education mentioned in step 3, teachers design activities. Estimated time, place, equipment and supplies to be prepared. Clearly define the role of the teacher and the duties of the students in each activity.

- Step 4: Design criteria and evaluation tools

+ Determine evaluation criteria and distribute points reasonably for each criterion;

+ Design assessment rubrics, and study rubrics to serve as a basis for evaluating groups of students and each student individually

2.3.2. Example of lesson plan.

Lesson plan: The cube. Rectangular prism

I. Learning goals

1. After completing this lesson, students achieve the following requirements:

- Recognize the basic elements of a cube and rectangular prism which are vertices, faces, and edges.

- Count the number of vertices, faces, and edges of the cube, rectangular prism.

- Opportunity to develop problem-solving capacity, ability to use tools, and means of learning mathematics through forming activities and recognizing the basic elements of those shapes.

- Opportunity to develop the quality of hard work, and honesty in doing exercises, performing tasks and practicing carefulness and accuracy.

2. STEM knowledge and skills mobilized in the lesson:

- Science (S): Characteristics of the shape, and size of the lantern and how to light the lantern.

- Technology (T): Using some simple materials such as bamboo sticks, colored paper, crayons, watercolours, stick, ... to make models of lanterns.

- Maths (M): Correctly recognize the elements of squares, triangles, circles, rectangles, cubes, and rectangular prisms (vertices, sides, faces) and count the number of objects

- Technique (E): Assembling and shaping cubes, techniques using some tools such as paper scissors, glue, etc

II. Teaching and learning tools

- For the teacher: textbook, block of the cube and rectangular prism

- For students: textbooks, notebooks, rulers, ready-made tools for practice (pre-cut colored paper with a size of 9×9cm squares, pencils, wooden or bamboo sticks, glue, scissors, ...)

III. Main teaching and learning activities

1. Warm-up

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- *Students participate in the game to start the lesson "Who is fast? Who is right?".*

Students are divided into 3 teams to compete: Name the rectangular and cube-shaped objects in the life that you have observed and collected. The team that can tell fastest and with the most items will win.

- *Connect*

Teachers connect with the lesson: Predicting the characteristics of the rectangular prism and the cube, what elements of the shape do you recognize?

Teachers led into the lesson, connecting from the sides and vertices of squares and rectangles: Just like squares, rectangles, rectangular prism and cubes have vertices, and edges. In addition, they have sides.

2. Background knowledge discovery activities

2.1. Activity 1: Identify cube, rectangular prism

The teacher divides the class into groups of 4. Students discuss in groups of 4 people to observe and complete worksheet number

Worksheet No 1

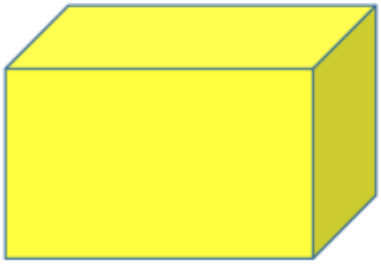
Observe the cube and the rectangular prism and answer the following questions:

Question 1: The rectangular prism consists of:

- How many faces? What shape is each face?

……..……
……...

- How many vertices and edges?



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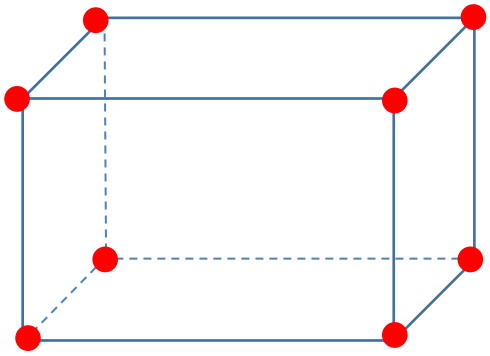
In turn, 2-3 groups of students practice pointing and saying the faces, vertices, and edges of the rectangular prism and cube that their group has found. The other group will comment, and add if necessary.



The teacher presents a model of a rectangular prism that marks 8 red vertices, 12 blue edges and 6 faces each made up of 4 blue edges.

What are the shapes of the faces of the rectangular prism?

After that, do the same with a model of a cube.

The teacher introduces that the rectangular prism and the cube both have 8 vertices, 6 faces and 12 edges. The faces of the rectangular prism are all rectangles. The faces of the cube are all squares.

Students discuss in pairs and introduce each other to the faces, vertices, and edges of rectangular and cube-shaped objects in the classroom space.

2.2. Activity 2: Practicing and applying: Make a lantern model

Step 1: Connecting and proposing ideas

a. Connecting

Students observe the cube which the teacher has already folded, each side of the cube is a different color. Students answer two questions: (1) How many sheets of paper are needed to fold that cube? What shape is each sheet of paper?

Students access this address https://www.youtube.com/watch?v=aoBXkCCdM4k to learn how to make a cube.

b. Proposing ideas

- The teacher and students check the tools and materials that students have asked to prepare in advance.

- Observe the image of the lantern, and say the common lantern shapes.

- Students answer the following questions:

+ To make a lantern in the shape of a rectangular prism or cube, you need to determine what shape the frame of the lantern is, made of what material and how many faces are there? What material is each side made of?

+ How many rectangles do you need? How many squares?...

+ What materials will you decorate around the lantern? How to decorate it beautifully?

- Students work in groups and share their ideas:

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+ We can make the frame of the lantern with bamboo sticks, need to determine how many bamboo sticks are used for each side.

+ Need to use glue to fix each bamboo stick.

+ You can use cellophane, colored paper or draw pictures to decorate the lantern more beautifully. You can cut paper or draw decorations on paper at home.

+ Learn on the Internet how to make rectangular or cube-shaped lanterns.

- Each group of students presents their group's ideas after discussing and agreeing on ideas in the group.

- Groups of students present their ideas in front of the class.

- Student comments, teacher comments.

Step 2: Designing - implement ideas

Students work in groups of four to practice folding the cube with coloured paper. The team leader assigns team members to act on the ideas discussed.

Compete to see which group folds the cube correctly and decorates it best.
Step 3: Report and share the results in the Art gallery.
- The group's representative reports and shares about their group's lantern model.
- Other group students comment and give suggestions.
Step 4: Evaluate and expand
- Students self-assess the process of participating in activities of themselves and of the group.
- Students present the meaning and feelings that the lesson brings to them. Teachers emphasize for students to connect the application of Mathematics in everyday life.
- The teacher comments, evaluates the results of the groups, and summarizes the lesson.

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3. CONCLUSION

Mathematics is a tool subject. Mathematical knowledge is used and exploited in many other subjects. Such integrated, multi-disciplinary explorations are both effective with the subjects and contribute to the consolidation of Maths knowledge, and at the same time contribute to training students' ability to apply mathematical knowledge in practice. The mathematical competence of students greatly affects the implementation of STEM education, which is an important condition for the implementation of STEM education. On the contrary, STEM education contributes to the development of the ability to apply mathematics, and the ability to discover and solve problems.

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