MODELS AND MODELING STRATEGIES IN IMPLEMENTING STEAM EDUCATION

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Abstract: *This article discusses models and modeling strategies for implementing STEAM education. The article also provides recommendations for integrating models and modeling into the development of authentic STEAM curricula and programs.*

Key words: *STEAM education, model, modeling, STEAM program, STEAM approach, integration.*

Modeling and models are one of the main explanatory tools in the implementation of new and modern STEAM education. It is important to carefully develop strategies for modeling and models so that STEAM-based education is understandable to teachers and students. We have outlined these strategies in the following sections.To promote a model-based STEAM learning approach, science teachers need to show students how to model topics. focus on designing meaningful modeling activities that involve students' active model building, selecting, developing, or modifying the appropriate model to use, demonstrating the scope and limitations of different models, and will be

1. The following modeling strategies can be promoted in the educational process: - targeting a specific model or modeling activity;

- describe a meaningful modeled state of the event during any practical work;

describe the resource in a specific emerging model;

support mental visualization of the model;

to show the interdependence of the model and the components that make up different models in the description of various specific phenomena.

2. To teach students modeling strategies to develop the mental image of the model;

understand that a model can exist in several forms;

determine whether models contain objects to convey concepts; understanding that a model can help predict or solve a problem; determine whether the solution to the problem of the value of the model is correct or incorrect;

3.Teaching and modeling models contribute to science learning because mental modeling is central to understanding. Articulating and testing models reflects the practical nature of science, and understanding science relies on the interpretation of scientific and historical models. Modeling in science and technology involves the

visualization of a development cycle associated with iterative changes of the produced model, the intended purpose and the intended outcome of the process;

4. Students should be given the opportunity to experience how mathematical models are created and to question the trade-offs involved in developing a mathematical model, including evaluating the limitations and strengths of different models;

5.Combining modeling and design activities promotes STEAM learning because design connects scientific, technological, engineering, and mathematical elements. Also, the modeling activity serves as a bridge between the practical situation and the mathematical analytical tools needed to model different versions of reality. It helps in solving the problem, especially in the understanding of science and the manipulation of reality;

6.Internal, external, and internal-external perspectives of models—can inform teaching strategies for talking about the nature and applications of models and modeling in science, technology, and engineering;

7. Developing students' conceptual understanding of modeling supports technological practice in technology while enabling individual modeling skills and can be used by teachers as a pedagogical strategy for learning concepts in science. In relation to models and modelling, mathematical knowledge and skills can be developed along various dimensions, including

from the concrete to the abstract, from the particular to the general, from the global to the concrete, or from planning to formalization. This, in turn, helps students evaluate and monitor their work using real tools, engage in model-making activities, and build practical models that are powerful in all aspects of putting their theoretical knowledge into practice.

Here are some recommendations for integrating models and modeling into the development of authentic STEAM curricula and programs:

First, the integration of models and modeling can be implemented in STEAM curricula by educating science teachers about the precise nature and role of models. Integrating models and modeling in STEAM curricula can be promoted by teaching students to use models, revise models, reconstruct models, and construct new models.

Secondly, the use of models as a tool in the implementation of STEAM education is considered the most correct way, and in its implementation, it is necessary to pay attention to the following:

- any subject should consist of several topics;

- paying great attention to following the historical sequence of model development of a given topic;

-how to use;

- cognitive restructuring in modeling;
- correct assessment of strengths and weaknesses of models.

Third, implementing models and modeling to promote STEAM education that encompasses science and technology education requires an understanding of the importance of learner context. This means that approaches and training programs must be targeted, reliable and personally meaningful. This allows students to understand the relationship between science and technology content and apply knowledge to find solutions to real problems.

Fourth, models and modeling should be seen by educators and curriculum developers as a valuable bridge between science and technology, which in turn can promote authentic STEAM education, authentic provides an opportunity to develop the ability to find solutions to problems and make rational decisions by combining science and technology concepts.

Fifth, through Modeling activities, students understand the strengths and weaknesses of the traditional model and potentially gain a better new position. They will also be able to apply, adapt and even create new mathematical models for new situations of STEAM subjects.

Sixth, the comprehensive aspects of modeling in STEAM curricula allow integration at different points in student development.

In conclusion, we can say that the implementation of models and modeling in STEAM educational programs helps students to build, modify and improve conceptual models that are relevant not only to mathematics, but also to engineering activities.

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