НАУЧНАЯ АРТЕЛЬ
АКАДЕМИЧЕСКОЕ ИЗДАТЕЛЬСТВО

16+

ISSN (p) 2712-9489
ISSN (e) 2542-1026

№ 5/2023

НАУЧНЫЙ ЖУРНАЛ «COGNITIO RERUM»

Москва
2023

НАУЧНЫЙ ЖУРНАЛ «COGNITIO RERUM»

Учредитель:
Общество с ограниченной ответственностью «Издательство «Научная артель»

ISSN (p) 2412-9489
ISSN (e) 2542-1026

Периодичность: 1 раз в месяц

Журнал размещается в Научной электронной библиотеке elibrary.ru по договору №511-08/2015 от 06.08.2015

Журнал размещен в международном каталоге периодических изданий Ulruch's Periodicals Directory.

Верстка: Мартиросян О.В.
Редактор/корректор: Мартиросян Г.В.

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Подписано в печать 15.05.2023 г.
Формат 60х90/8
Усл. печ. л. 27.80
Тираж 500.

Отпечатано
в редакционно-издательском отделе
академического издательства «Научная артель»
https://sciartel.ru
info@sciartel.ru
+7 (495) 514 80 82

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ТЕХНИКА И ТЕХНОЛОГИЯ

СЕЛЬСКОЕ ХОЗЯЙСТВО

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RESEARCH METHOD OF DEVELOPING STUDENTS'S SPACE- THINKING CAPACITY THROUGH VISUAL PERFORMANCE TECHNOLOGY

Abstract

3D, 4D representation is especially important in all branches of construction engineering as well as mechanical engineering, technical graphic design... and in explaining many complex scientific phenomena. Researchers in the fields of mathematics and engineering have relied heavily on the object's ability to visualize the diverse and complex structural arrangements, from small molecular structures to structures. works in many different sizes, thereby building mathematical models to study objects and solve problems posed in practice.

After high school, learners need spatial visualization skills and abilities to study and research in a university environment. The current situation of teaching Drawing and Technical Drawing at technical schools has shown that very few first-year students have the necessary spatial thinking ability. Even when students graduate, they still lack spatial visualization skills due to the lack of opportunities to practice and develop fully in the learning process.

This article presents the nature of spatial visualization and spatial thinking capacity, proposes measures to develop spatial thinking capacity for students in the period of scientific revolution 4.0.

Keywords:

Thinking, capacity, Spatial thinking, 3D, 4D technical drawing.

1. Thinking and the role of spatial thinking with science and technology

Thinking is a creative process that helps people learn, train to possess the knowledge to see problems and how to solve them. Scientific thinking is a high-level, high-level stage of the cognitive process, which is carried out through a certain system of thought manipulations in the minds of scientists, with the help of a system. Scientific thinking "tools" (such as languages and forms of scientific thinking) aim to "shape preconditions and build new scientific knowledge in the form of concepts and judgments." New inference or hypothesis, theory, new scientific reasoning, reflecting perceived objects more accurately, more fully, more deeply, more authentically.

The ability to think spatially is obtained thanks to the visual element, which is the process of using the eyes to observe, orient, and locate in the world of countless phenomena. It also includes the formation, storage, transformation and inference of spatial visual information in the mind.

In fact, understanding the relationship between structure and function to the problems of modern science is of increasing importance. Scientific discoveries of the nineteenth and twentieth centuries depended heavily on the ability to visualize and explain scientific phenomena through intuitive spatial thinking. Scientific progress cannot be achieved without the ability of scientists to observe, think, visualize, and imagine. Even in the field of physical sciences, abstract theory, visual representation plays an important role in promoting scientific ideas [1-2].

Simulations: Simulation, often used in scientific research, is the process of developing a model and then simulating an object of interest. Instead of having to study a specific object, which is often impossible or very expensive, we build models of that object in the laboratory and conduct research on that subject based on the model. this visualization. The results obtained must be verified with the actual measurement results. Most simulations are based on computer hardware and software. Based on the results obtained after the simulation process, we can draw a direction for future research and production. Simulation in teaching is a special case of simulation in scientific research. Therefore, we can define simulation in teaching as a type of simulation of scientific research in which both "pedagogical treatment" and "organization of teaching activities" are interspersed. This method can help achieve output standards such as: Modeling skills; Survey testing skills; Graphical interface.

4D modeling (4D is the transformation of 3D models over time) has an important role in science and engineering, positively affecting complex problem solving. This impact has prompted psychologists and educators to delve into positive measures to develop spatial visualization skills. Over the past decades, the ability of computers to create and process images has evolved into visualization simulation technologies. When 4D simulation is applied to affect intuitive thinking, the natural perception of people also changes. There are many studies that show that graphic design is a powerful cognitive tool, helping to enhance and expand our brain [3].

The essence of spatial visualization and visualization is cognitive development skills. That means these skills need to be developed and can be developed over time and in different areas [4-5].

The remarkable fact is that the development of spatial skills rarely happens spontaneously. Pupils and students need many opportunities to practice and apply these skills in study and daily life. If we want students to be able to visualize complex mechanical structures and buildings, they need the opportunity to continuously develop their perception based on simple skills and prior knowledge. The development of spatial visualization abilities needs to be concentrated in a particular field of study in order for students to take the initiative in their cognitive development. In fact, in universities today, there is a lack of visual laboratory equipment, it is only equipped in the laboratories of large research institutes, students have little access. Research into methods of developing spatial capacity is necessary to provide a means for scientists and students to use in research. Therefore, the problem of cognitive development from intuitive to thinking becomes one of the main goals of higher education, especially in the field of science and technology in Vietnam. This path is extremely difficult as the majority of students in the country go to universities with only rudimentary spatial visualization skills [6]. Equipping students with 3D and 4D skills is critical to their continued success in the fields of science, math, and engineering.

2. Teaching spatial visual knowledge to high school and college students

2.1. Spatial visualization skills in high school The report of the US National Research Council Committee [7] highlighted the importance and power of spatial thinking skills in science, in industry, and in science. work and daily life. According to a report of the US National Research Council, current national standards in math and science do not pay enough attention to students in developing spatial skills, more supportive measures are needed. further to develop their skills and thinking in order to provide high quality scientific and technical human resources for society.

The spatial visualization skills of middle and high school students will be developed through access to images of information systems. STEM education is an interdisciplinary approach that blends the fields of science, technology, engineering, and math to provide students with meaningful, real-world experiences that help them see recognize the relevance of what is learned. Education should value resources other than textbooks, the advantages of information and communication technology, a multimedia learning environment that goes hand in hand with practice.

2.2. 3D spatial visualization skills in technical college. The most central function of technical graphics in teaching is for students to visualize the shape of the details as the basis for assembly and operation, thereby understanding the necessary technical requirements. Students are required to use design drawing software to do exercises in technical drawing and machine design. Besides professional knowledge, students need skills in using 3D software. Software skills help them understand structure and how to build spatial objects quickly according to design thinking. Visual learning activities must become an important part of the curriculum. Students need to be continuously assessed for their level of engagement and proficiency in applying spatial visualization skills during and after the course.

3D visualization software is now a powerful tool to help students acquire spatial visualization skills, but students must use the software actively for their learning tasks.

In the subject of Drawing and technical drawing, the transition from 2D to 3D drawing is supported very quickly by 3D rendering software to overcome the limitations of traditional reading comprehension methods, a new method is proposed. will concretize and detail the traditional reading comprehension theory and apply it in a suitable way with the application of a popular 3D design software (Auto CAD, Solidworks). The sequence of this method is to recognize the object in turn from the edges, then the surfaces, the shapes and finally identify and model the entire structure of the object by software. (figure 1).

Example: A 3D cube combinatorial exercise used in research We conducted a study to develop spatial skills at the University, initial research results show that spatial visualization is very important for students. engineering industry [10]. These findings are particularly relevant for the civil and mechanical engineering disciplines through the creation of technical drawings and graphics.

The course material includes a variety of exercises with topics aimed at developing 3D spatial skills such as performing the transformation of 2D shapes, projecting axes and 3D objects, visualizing and drawing cross-sections of transverse objects.

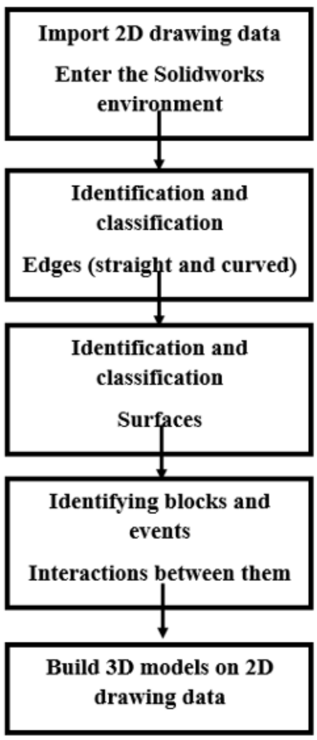

Figure 1

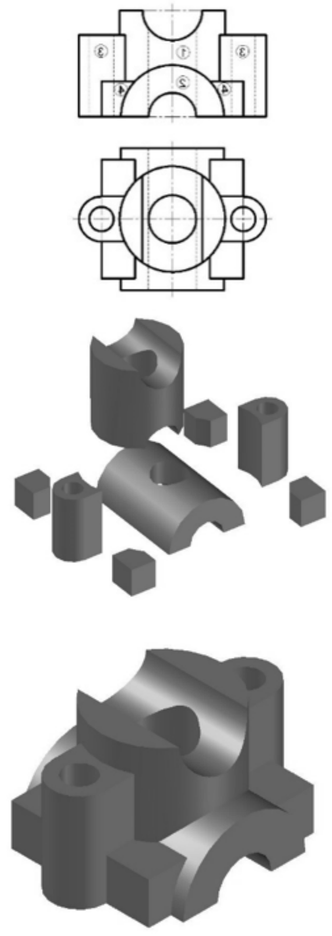

Figure 1 Figure 2

- Group 1: 50% of the students draw the axis projection of the object by visualization in the traditional way

- Group 2: 50% of the students draw the object's axis projection using AutoCAD, Solidworks software applications...

Through survey by ballot:

- The results show that students in group 2 quickly visualize space, deploy projections and sections with few errors.

- The ability to identify situations from practical contexts has improved, interest in the subject has increased significantly, and students have actively implemented drawings.

The ability to recognize situations	
Capacity	**Indicators**
1. Observation	1.1. Observe 2D and 3D situations 1.2. Observe the relationship
2. Associating, connecting ideas with practical elements	2.1. Make connections between what students see and know 2.2. Enhance spatial thinking ability
3. Deployment capacity	3.1. Perform the drawing operation 3.2. Deployment time 3.3. Check the accuracy of the situation

- Based on the data synthesized and described by SPSS software, we found that, most of the participants who answered the questionnaire agreed that the software application is really necessary and necessary (both levels are very low). This accounts for 97.6%).

2.3. Technical college 4D spatial visualization skills Spatial visualization as a powerful tool has the potential to help students use the properties of space as a means to structure problems, to find answers and presents solutions. We can use a variety of multimedia graphical representations or 4D simulations to explain the structure, operation, and function of any object [11-12]. Through cognitive, spatial information, we can statically analyze and understand the dynamic properties of objects and the relationships between them. The main challenge of teaching simulation is the difficulty of learners in visualizing the 4D nature of building structures and mechanical structures; understand the interactions between components and structure over time. 3D models are simulated by designing constraints, conditions similar to those in reality of the product. Modeling will produce results so that we can customize the product to be the most optimal in terms of aesthetics, engineering, and durability over time. It is necessary to study and compare the actual results with the simulation results to have the most optimal simulation process. The approach and 4D simulation is often at a high level for professionals, so even students who are proficient in 3D software may not be able to fully simulate.

To visualize its change over time (4D thinking) students must be relatively fully equipped with specialized knowledge. According to the learning process, students gradually perfect the simulation design completed in the last year before graduating from university, then they have a general understanding of specialized knowledge. In the process of designing and building 4D models, the exchange of information between steps, right from the ideation stage to detailed design, professional knowledge can all be directly involved in the same file. database. This helps the related fields to interact directly and synchronously, significantly reducing design time and high quality products. Tailor-made simulations suitable for different disciplines give students a proper understanding of the complex operating processes of a bridge or a mechanical system. It is therefore essential to apply the necessary expertise and develop resources for the production of 3D and 4D models. The development of multimedia resources is long-term educational and highly cost-effective, but it is important that students are helped to learn complex technical processes. If such models become popular, graduates will be assured of spatial visualization competence and deep technical understanding with 4D thinking.

Conclude

Most high school and even post-secondary students do not have the opportunity to develop a sufficient level of understanding of spatial visualization. Engineering students lack 3D and 4D visualization skills that play an important role in modern science. The evolving nature of visual-spatial skills suggests the need to focus on developing this competence in many subjects. Initial assessment of students' spatial capacity development after having more access to 3D models at Technical Drawing course at Technical University. Activities that facilitate general cognitive development and 3D and 4D visualization for learners through learning tasks are part of the secondary and post-secondary curriculum.

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