Use of 3D problem visualization method in training

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Abstract

Objective: The utilization of three-dimensional problem visualization as a novel pedagogical approach to the instruction of medical informatics at the post-secondary level. **Methods**: Use of a new method of 3D problem visualization training on the basis of Google and Microsoft cloud platforms using InVersalius software **Findings**: A novel approach to pedagogical practice within the context of medical disciplines was devised, and the user interface of the InVersalius application was enhanced. The impact of the implementation of a three-dimensional visualization methodology on the quality of educational outcomes was evaluated. **Novelty/improvement:** This marks the inaugural instance of utilizing a three-dimensional problem visualization methodology founded upon InVesalius software, in conjunction with Google and Microsoft cloud platforms, within the context of medical education.

Keywords: 3D problem visualization, medical education, Google and Microsoft cloud platforms.

1.Introduction

The healthcare sector is rapidly evolving, and with it, the methods of teaching future medical students are changing. Information technology (IT) is playing an increasingly important role in modern medicine, so it is essential that medical students have the skills to use it. Traditional methods of teaching IT, such as lectures and seminars, are no longer always effective. Students require a more interactive and practice-orientated approach to learning. One of the new teaching methods is the use of 3D models [1][2].

The utilization of three-dimensional physical models comprising diverse materials in the field of medicine has a long historical precedent. In ancient China, bronze models of the human anatomical structure were employed. In Europe, models crafted from colored wax with intricate anatomical details were constructed for the purpose of studying human anatomy. In the present era, models are typically produced from plastic [3].

According to the results of numerous studies, 3D model has been shown to be effective in terms of the learning skills and knowledge gained by medical students. Students who work with 3D models are able to navigate their way through questions more quickly. They also show great interest in using this technology [4][5].

With the advent of computer technology in our lives, the direction of 3D computer modeling began to develop [6].3D printers have made it possible to produce various models for teaching medical students [7][8]. But the progress of information technology implementation did not end there. He is penetrating deeper and deeper into education. Improving it and making it cheaper [9][10].

The advent of new software applications that facilitate the construction of virtual 3D models based on computer tomography images and X-ray images [11], as well as magnetic resonance tomography [12], has the potential to revolutionize the educational experience of students. This study demonstrates the efficacy of an innovative approach to teaching 3D problem visualization, and its suitability for imparting knowledge in the field of medicine [7][8][13].

2. Materials and Method

In order to ascertain the efficacy of the three-dimensional method of problem visualization in the context of medical education, an analysis was conducted on the control sections of knowledge pertaining to human anatomy [9][10][14].

A preliminary learning model was constructed with the objective of assessing the efficacy of student learning (Fig. 1).

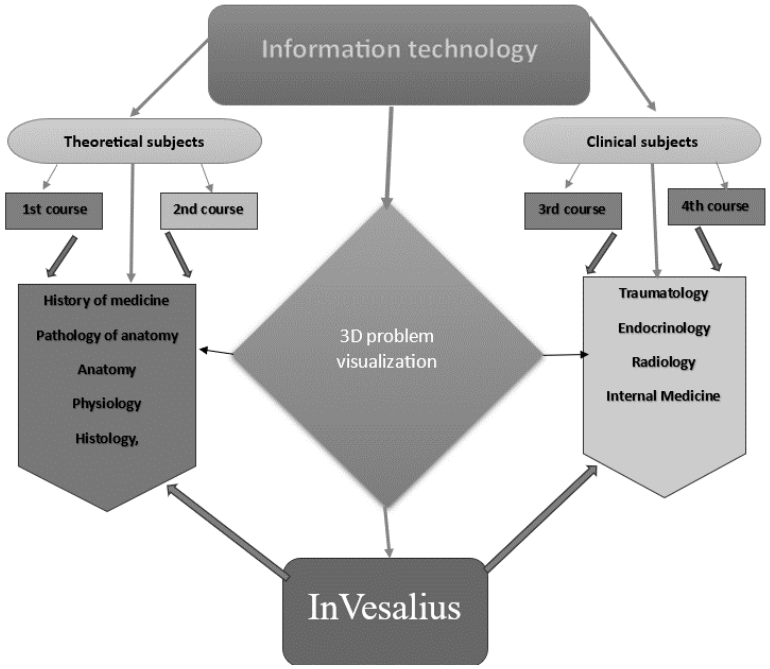

Figure 1. Model of interrelation of medical disciplines and information technologies by courses

The study involved a total of 616 students, comprising those from the Paediatric faculty of the Tashkent Medical Academy, as well as students from the Tashkent State Technical University named after I. Karimov, Department of Biomedicine, Bukhara Medical Institute, and the Tashkent Pediatric Medical Institute.

The training method utilises a three-dimensional visualisation approach, whereby a task is created using magnetic resonance imaging (MRI) images and a cohort of students from diverse academic backgrounds. Student groups were constituted on the Google Classroom platform with the objective of elaborating a description of the

aforementioned 3D model. The students produced a comprehensive report on the pathology of the facility in question. The submitted reports were subjected to a process of discussion and evaluation in order to ascertain their correctness. Concurrently, the entirety of the information repository remained accessible for public discourse. Each student was afforded the opportunity to express their opinion and propose a solution to the problem. Other groups of students were instructed in accordance with the conventional pedagogical approach. At the conclusion of the study, a comparative analysis of the academic performance of the groups was conducted. The 3D models were constructed by the students using the InVesalius software, which had been adapted into the Uzbek language. In comparison to other applications, this one has a simple interface and is straightforward to use.

3.Results

The use of this method has given a positive result, the students' knowledge has increased not only in their field of study, but also cross-curricularly, as well as developed skills in computer devices (Fig. 2).

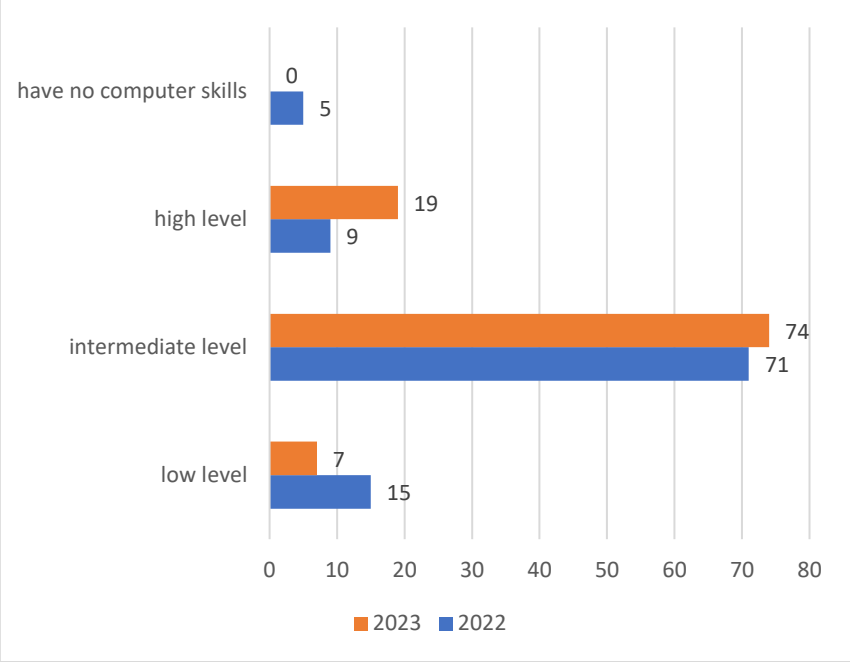

Figure 2. Skills in the use of ICT(PC)

The effectiveness of the method was determined by the formula of the Pearson criterion:

$$\chi^2 = \sum_{j=1}^{k} \frac{(f_{эj} - f_T)^2}{f_T}$$

$f_{эj}$ — is empirical frequencies;
f_T — is the theoretical frequency;
k — is the number of digits of the attribute.

Table 1. Analysis of the effectiveness of the experimental results obtained

Tashkent State Technical University			
Student's score	**Experimental groups**	**Control groups**	**Effectiveness**
excellent	21	14	1,16
good	19	12	
satisfactory	12	18	
unsatisfactory	0	13	
sum	52	57	
average value	4,01	3,47	
Tashkent Medical Academy			
Student's score	**Experimental groups**	**Control groups**	**Effectiveness**
excellent	29	15	1,15
good	24	18	
satisfactory	25	38	
unsatisfactory	0	8	
sum	78	79	
average value	4,05	3,51	
Bukhara Medical Institute			
Student's score	**Experimental groups**	**Control groups**	**Effectiveness**
excellent	29	21	1,13
good	34	22	
satisfactory	16	24	
unsatisfactory	0	12	
sum	79	79	
average value	4,16	3,66	
Tashkent Pediatric Medical Institute			
Student's score	**Experimental groups**	**Control groups**	**Effectiveness**
excellent	41	24	1,14
good	35	41	
satisfactory	20	9	
unsatisfactory	0	22	
sum	96	96	
average value	4,01	3,47	

According to the results of Table 1, it can be seen that the effectiveness of students of the Tashkent State Technical University is 16%, the effectiveness of the Tashkent Medical Academy is 15%, and the effectiveness of the Bukhara Medical Academy is 13%. The results of the experiment prove the effectiveness of the proposed new methodology in comparison with the traditional teaching methodology. The efficiency of using the new methodology is on average 14.6%, as a result of the implementation of the developed methodology.

4. Discussion

Traditional assessment methods such as tests and exams are not always appropriate for assessing IT skills [15][16]. More comprehensive assessment methods such as portfolios, presentations and practical assignments should be used. The use of new IT teaching methods can make the learning process more effective and interesting for students [17][18]. As a result, future health professionals will be better prepared to work in today's world where IT plays an increasingly important role [20] [2]. Here are some examples of how new IT teaching methodologies are being used in medical schools:

Harvard Medical School is using simulation training to help students learn how to use electronic medical records;

The University of Pittsburgh uses game-based learning to help students learn how to diagnose diseases;

The University of Toronto uses problem-based learning to help students learn how to use IT to improve the quality of care;

The University of California San Francisco uses project-based learning to help students develop mobile health applications;

Johns Hopkins University is using social media to create an online community for health IT students [18][19].

New methodologies for teaching health IT are still under development, but they have great potential to improve the quality of education for future health professionals [22]. The efficacy of medical education is contingent upon advancements in information technology and the pursuit of novel pedagogical techniques, which represent the primary objective of the educational endeavour. In comparison with the aforementioned methods, the three-dimensional problem visualization method is the most effective in terms of technological progress, thereby propelling medical education into a new phase of development.

5. Conclusion

The results of the conducted research demonstrate the effectiveness of a new approach to three-dimensional problem visualisation in medical education. Utilising magnetic resonance imaging (MRI) images and a collaborative learning platform, students from disparate educational institutions were able to successfully create and analyse three-dimensional (3D) models of medical pathologies. The findings indicate a notable enhancement in students' knowledge, abilities, and overall academic performance when compared to the outcomes of traditional teaching methods.

The students exhibited enhanced comprehension of human anatomy and associated medical disciplines.
The students have acquired valuable skills in the utilisation of computer devices and software for the purpose of three-dimensional modelling.
A collaborative approach to learning fosters effective teamwork and communication between students.
The utilisation of three-dimensional visualisation techniques was observed to engender a heightened level of interest and motivation amongst the students, thereby facilitating a more conducive learning environment.
The study underscores the potential of three-dimensional imaging to transform medical education. By offering students engaging and stimulating learning experiences, this approach can more effectively equip them to navigate the complexities of contemporary healthcare. Further research is required to examine the long-term impact of 3D imaging on student academic performance and to investigate its potential applications in other medical disciplines.

6.Financial Disclosure/Conflict of Interest

The authors declare that there was no financial aid received and no conflict of interest associated with this research work.

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