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DIGITALIZED EXERCISES VERSUS PRACTICAL EXERCISES IN TRAINING PHYSIOTHERAPISTS TO IDENTIFY MOTOR MOVEMENTS

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Abstract: *This study proposes a comparative analysis between two tasks carried out with students from the study program with a physiotherapy profile – the digitalized version and the practical version. The aim was to determine which is the most optimal option in developing the skill of physiotherapists to identify movements and the muscles related to each movement in a motor process. Methods used in data collection - observation sheet; worksheet for identifying stages - movements - muscles; 30-second verification test of association of movements used in making the origami module with similar movements used in daily routine activities. For comparative analysis, the Mann-Whitney U test was used. The conclusion was that in terms of developing the skills of future physiotherapists to identify movements and the muscles associated with each movement, practical tasks are those that favor performance.*

Key words: *digitalized exercises, practical exercises, physiotherapists, identifying motor movements.*

1. Introduction

The impact of technology on the learning process is a topic that has been the focus of specialists and researchers in education for several years. However, the central component in the training of physiotherapists remains the practical one, as working directly with patients is the essence of their profession. The practical component has dominated and continues to dominate the study field of physiotherapy, including the analysis of motor movements and motor dysfunctions (Lippert, 2006; Sahrmann et al., 2017), the proposal of pedagogical methods for developing practical and analytical skills in the field of physiotherapy (Plack & Driscoll, 2017), the provision of social support by the physiotherapist (Moecke & Camp, 2024), and intervention methods for musculoskeletal disorders (Silva-Guerrero, 2024).

In the era of digitalization, however, technology is also transforming the way physiotherapists are trained. Apps, simulations and virtual reality platforms are

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increasingly used tools. Digitalization is also present in this field in explaining the principles of biomechanics applied to the movement (Uchida & Delp, 2021), in exploring technological applications and the use of digital simulations for motor analysis (duffi, 2021), in the use of digital tools for diagnosis, treatment planning and patient involvement (Røe et al., 2024) or in the use of mobile health applications (mHealth) in musculoskeletal physiotherapy (Grodon et al., 2024). Together, these studies illustrate a growing trend in the integration of digital technologies in physiotherapy education and practice. Some examples of software that can be used in physiotherapy activities are: Dartfish for movement analysis used in physical education and rehabilitation; Kinovea for biomechanical analysis and video recording of movements; Vicon Nexus used in imaging movement capture for research. The integration of digital solutions, such as real-time feedback devices and computer simulations (Kwakkel et al., 2023) into the rehabilitation process, to provide accurate information about the patient's movement and progress, can be a model to be applied in physiotherapy education, where digitized exercises, such as simulations and biomechanical analysis, can accelerate learning. These methods allow students to observe and understand in detail aspects of motor skills that might escape observation in traditional practical sessions. However, digitalization brings new challenges such as the need to improve digital literacy among students or overcoming patient resistance to digital tools in therapy.

There are multiple studies regarding the effectiveness of practical interventions in the development of fine motor skills (Harsismanto et al., 2021; Meilati et al., 2021; Prayogo et al., 2024). By using the origami game, these studies have demonstrated that practical and creative activities significantly improve fine motor coordination, involving components such as attention, hand-eye coordination and precision of movements. The challenges of dynamics in the origami technique are an exciting topic even for engineering science (Hongbin et al., 2024) or robotics (Freeman et al., 2024; Cao et al., 2024). These conclusions can be extrapolated to the training of physiotherapists, suggesting that practical exercises, involving complex and interactive activities, not only develop technical skills but also stimulate their deep understanding of how movements are generated and controlled. In our study, the didactic application for identifying movements and their associated musculature - both the digitized and the practical version - is based on the complex modular origami technique.

2. Research Methodology

2.1. Purpose and questions

The purpose of this study is to compare two types of tasks, digitalized and practical, in training physiotherapists to identify the work stages, the movements related to each stage, and the muscles used in movements in a motor process, with a focus on evaluating efficiency.

Q1: Does motion identification register different frequencies in the visual stimulation from the digital task compared to the tactile touch from the practical task?

Q2: Is the identification of the correspondence between movements and the muscles involved in each movement optimally achieved in the visual stimulation of the digital task or the one with the practical realization of the product?

Q3: Which of the two tasks has the highest efficiency, under the given conditions, for learning?

2.2. Participants and procedure

The participants were students enrolled in the Occupational Therapy discipline (optional) from the Physiotherapy and Motor Rehabilitation study program at Transilvania University of Brașov; 16 students were present at the activity, and we divided them by drawing lots into two groups of 8 people/group. In terms of school performance both in the discipline and throughout the school year, the two groups are homogeneous. Participation in the study was voluntary and based on informed consent.

The working procedure consisted of formulating the requirement, the same for the two groups, to identify the work stages – movements – the muscles involved in the movements based on:

1 - the video tutorial for the digitized task;

2 - the creation of the module starting from the diagram printed on paper for the practical task (materials specific to the complex modular origami technique were required 9x9 cm origami paper, rigid plastic plate-type support).

The groups carried out their activity in delimited spaces. The general objective of the didactic exercise: correlating the modular origami technique with motor movements and the related muscles from the perspective of recovering motor functions. The specific objective of the didactic exercise – identification, in the work stages, of the movements and muscles involved in each movement. Targeted competencies – identification of the movements and muscles related to each movement; design of practical activity for motor recovery starting from biomechanics aspects; association of the movements used in making the origami module with similar movements used in daily routine activities. Both groups completed the activity by completing the ppt document of the identification sheet.

The stages of developing the module in the origami technique for a modular unit (the cube - six modular units) and for assembly are shown in Figure 1. Only the stages for a modular unit (17 stages) were considered as identified stages without repeating them for five more similar modular units. The four stages for assembly were also considered as identified stages.

2.3. Materials and method

Methods used in data collection - observation sheet; worksheet for identifying stages - movements - muscles; 30-second verification test of association of movements used in making the origami module with similar movements used in daily routine activities. For comparative analysis, the Mann–Whitney U test was used.

The observation sheet considered three indicators: participant involvement in the workload; positive nonverbal behavior; flexibility of the exercises (independence from special conditions). The indicators were measured on a scale from 1 (to a very small extent) to 5 (to a very large extent).

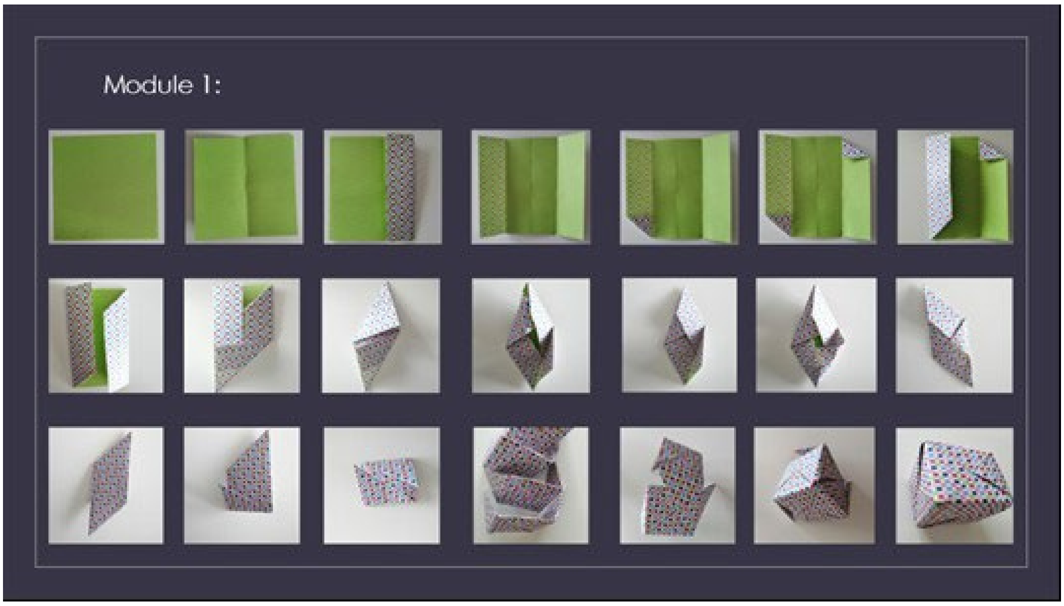

Fig. 1. *Module development stages*

The identification sheet of stages - movements - muscles, presented in the form of a table, was presented to the participants in electronic format, an editable ppt document, and included a four-column structure (image captured by the participant, stages, movements, muscles), indicating the names of the columns and mentioning the possibility of adding rows depending on the number of individual identifications. The worksheet analysis descriptors targeted the number of stages (maximum 21 for the proposed module), the number of movements identified per stage (gross motor movements between 6-9 per stage, fine motor movements – multiple possibilities), the number of muscles involved in movements (multiple possibilities from those involved at the primary or secondary level to the tertiary level). Score awarded – 1 point for each identification.

Verification test (30 seconds) of the association of the movements used to make the origami module with similar movements used in daily routine activities. The score awarded was 1 point for each solution found in the allotted time.

3. Results

For the comparative analysis between the two groups ($N_1 = 8$, $N_2 = 8$), the Mann–Whitney U test was applied, the values being shown in Table 1.

Significant differences were observed for the group that performed the practical task compared to the one that performed the digitized task for involvement the work of the participants ($z = -3.04$, $p < .001$), positive nonverbal behavior ($z = -2.57$, $p < .005$), number of identified stages ($z = -3.30$, $p < .001$), number of movements identified on each stage ($z = -2.73$, $p < .003$) and the number of muscles involved in movements ($z = -2.62$, $p < .05$), and for 30-second verification test ($z = -2.25$, $p < .05$).

The results of the Mann–Whitney U test Table 1

Indicator	**z-score**	**p-value**
Involvement in the work of the participants	-3.04	.001
Positive nonverbal behaviour	-2.57	.005
Flexibility of exercises (independence from special conditions)	0.05	.480
Number of identified stages	-3.30	.000
Number of movements identified on each stage	-2.73	.003
The number of muscles involved in movements	-2.62	.004
30-second verification test	-2.25	.011

4. Discussion

In the training of physiotherapists, acquiring the ability to identify and analyze motor movements is essential for diagnosis and planning therapeutic interventions. In this context, the integration of digitalized and practical exercises brings complementary perspectives. Comparing these methods highlights both the benefits and limitations of each approach. Recent studies (Pagels et al., 2024) evaluate the effectiveness of digital versus traditional learning methods in mastering anatomical structures, and the results suggest that digital tools, such as 3D models and virtual exercises, significantly improve learners' ability to visualize and understand anatomical structures compared to traditional textbooks and static images. However, there is a gap in the formation of digital competence in the use of digital technologies in practice (Røe et al., 2024).

In our study, practical tasks are more interactive and allow for a tangible experience, which stimulates the level of involvement in the task. The increased level of stress in practical tasks could be explained by the fact that they are more mentally and physically demanding (also involving motor dexterity), as participants must also create the product while observing and analyzing movements in a real physical context.

Both types of tasks were designed to be adaptable to different environments and situations, which makes them easy to implement without depending on special resources. The ease of identifying the work stages – the movements related to each stage – the muscles used in the movements during the practical exercise is a result of the tactile-kinesthetic exploration and full execution of them because otherwise they would not be able to achieve the product. In the digitalized exercise, the analysis is based only on the visual, and, even if they can replay the video tutorial as many times as they want, a good part of the stages is not noticed, hence the gap in identifying the movements.

Feedback on the effectiveness of the two tasks is provided by the results of the test of association of the movements used in making the origami module with similar movements from daily routines. The motor skills and dexterity acquired secondarily in making a 3D product through the complex modular origami technique are those that indirectly contribute to cognitive skills, information transfer and association being achieved more quickly.

Advantages of digitized tasks: students can practice repeatedly without time or human resource constraints; advanced software, such as 3D simulations, allow for the exploration of functional anatomy and dynamic visualization of motor movements from multiple angles; digital platforms can provide detailed biomechanical analyses, such as flexion angles or movement speed, which contributes to the rapid correction of errors; digital applications and courses allow for autonomous, personalized learning at the pace of each student.

Disadvantages of digitized tasks: they do not develop students' motor skills and abilities; digitized exercises cannot completely replace the contextual feedback provided by an experienced trainer; identifying motor movements through palpation or physical contact is difficult to replicate digitally; the quality of the experience depends on technical resources and access to state-of-the-art equipment.

Advantages of practical tasks: they develop students' motor skills and abilities of dexterity, speed of execution, eye-motor coordination, finesse, etc.; they allow students to observe and palpate muscle structures, joints and other anatomical elements during movement, and this type of learning is indispensable for developing an acute clinical sense; they expose students to variables that digital simulations cannot fully reproduce, such as the diversity of atypical or compensatory movements; observation of motor and tactile nuances that cannot be captured digitally.

Disadvantages of practical tasks: organizing practical exercises requires space, tools and materials, which can generate significant costs; requires permanent supervision by a specialist.

5. Conclusions

The conclusion was that in terms of developing skills (identifying movements and the muscles associated with each movement) for future physiotherapists, practical tasks are the ones that promote performance. Although digital tasks play a crucial role in the initial stages and the development of analytical skills, practical tasks are the ones that develop the ability to identify motor movements in real life in direct experience with patients. The emergency system analysis of motor dysfunctions in situations where access to technology is unlikely can be a concrete situation for the fruition of practical experience.

In optimizing the training process of physiotherapists, both types of tasks have their well-defined role - digitized tasks come with the promise of quick access to information and objective feedback, while traditional practice offers a real connection to the complexity of the human body.

Hands-on interventions, such as those described by Harsismanto and colleagues (2021), stimulate tactile and perceptual development, while digital solutions analyzed by Kwakkel and colleagues (2023) bring precision and accessibility. Together, the two methods can form a complete professional, able to listen to both their patient and technological tools, without relying exclusively on either. Although each approach has unique benefits, maximum efficiency can be achieved by integrating them, with a greater emphasis on hands-on activities. The emergence of advanced hybrids (e.g., mannequins with realistic haptic feedback combined with AI), VR simulators that can even reproduce physical contact or technologies that integrate real motor movements and biometric data will complement the training of a physiotherapist but will not replace the need for them to possess skills acquired through tactile-kinesthetic exploration.

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Online Resources:

Origami diagram: https://kr.pinterest.com/pin/563018693130577/

Cube merge tutorial: https://nl.pinterest.com/pin/107945722293108175/

Origami video tutorial: https://ro.pinterest.com/pin/648870258781971856/