Online-Journals.org

iJOE International Journal of Online and Biomedical Engineering

iJOE | eISSN: 2626-8493 | Vol. 20 No. 10 (2024) | OPEN ACCESS

https://doi.org/10.3991/ijoe.v20i10.49543

SHORT PAPER

Effectiveness of Microlearning as an Additional Teaching Instrument in Orthopedics and Traumatology University Course

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ABSTRACT

Orthopedics and traumatology are clinical specialties that require continuous learning and skill enhancement. Traditional teaching methods may not always be sufficient to meet the needs of contemporary learners. This study aims to compare the effectiveness of microlearning as an additional tool in orthopedics and traumatology university courses alongside traditional teaching methods. The study concluded that microlearning significantly improved students' knowledge retention, practical skills, and overall performance compared to traditional teaching methods alone. The findings suggest that integrating microlearning into orthopedics and traumatology curricula can improve student learning outcomes and better prepare them for real-world practice.

KEYWORDS

microlearning, orthopedics and traumatology, healthcare education

1 INTRODUCTION

Orthopedics and traumatology are medical specialties that deal with musculoskeletal disorders and injuries, respectively. These fields necessitate continuous learning and skill enhancement due to advancements in technology, treatment techniques, and research. Traditional teaching methods, such as lectures and textbooks, may not always cater to the needs of modern learners, who prefer more interactive, personalized, and convenient learning experiences [1].

In recent years, microlearning has emerged as a promising alternative or supplementary tool to traditional teaching methods.

Microlearning refers to short, focused learning modules that are delivered in small chunks over time [2]. These modules typically cover specific topics or skills and can be accessed on various devices, making it convenient for learners to consume

Molchovski, P., Tokmakova, K., Tokmakov, D. (2024). Effectiveness of Microlearning as an Additional Teaching Instrument in Orthopedics and Traumatology University Course. *International Journal of Online and Biomedical Engineering (iJOE)*, 20(10), pp. 151–159. https://doi.org/10.3991/ijoe.v20i10.49543

Article submitted 2024-03-07. Revision uploaded 2024-04-22. Final acceptance 2024-04-22.

content whenever and wherever they want. Some advantages of microlearning include increased engagement, improved knowledge retention, and enhanced practical skills [3].

According to Theo Hug [4], microlearning, as a new educational concept, overlaps with the concept of mobile learning. This highlights the necessity for instructors and course developers to utilize mobile learning methods and tools to provide educational content to learners. Microlearning typically utilizes digital resources and advanced information and communication technologies to deliver learning objects, focusing on the creation of short lessons [5] ranging from a few seconds to a few minutes. Learning objects in microlearning can take various forms of digital content, such as a short video, an audio recording, plain text, an animation, a wiki page, a social network post, a mobile phone game, a questionnaire, or a quiz. According to Lindner, M. [6], microlearning is the conscious or unconscious process people engage in when they encounter the task of acquiring new information and constructing knowledge about a problem through the utilization of digital resources. According to Torgerson et al. [7], microlearning is defined as providing a concise form of learning content, often referred to as microcontent, that is precise, clear, and meaningful enough to give learners what they need at that moment to solve a task or project.

Microcontent is a small unit of digital information. It contains very limited and important information compared to regular learning content due to screen size and interface complexity. Microcontent can always be reused based on the user's needs, the application's processing method, and the device's screen. Content can always be split to form new patterns. Microcontent is very appealing because it is also personalized.

However, it is always beneficial to specify the time it should take for learners to become familiar with the microcontent. Most definitions assume that the process should last between 1 and 10 minutes, which is the recommended duration [8].

The applications of microlearning as an innovative learning approach have been extensively researched in various educational domains and stages of learning, such as higher education [9], workplace learning [10], language training [11], training of health and medical professionals [12], [13], the medical field [14], [15], and the professional training of future teachers [16].

The concept that microlearning is a key educational approach for implementation in corporate and workplace settings stands out in most studies. In [17], it is concluded that microlearning is appealing to the industry due to the growing number of deskless workers—2.7 billion people worldwide. Deskless workers, such as maids, do not have a specific workplace; hence, their learning needs to be accessible through mobile devices at any time and place.

In the field of medicine [12], a large-scale scoping review was conducted on 3096 literature sources from specialized databases such as PubMed, Scopus, Web of Science, and Google Scholar. Only 17 sources were found to be related to microlearning and topics in medicine and health, including medical education (n = 8), nursing education (n = 3), pharmacy (n = 2), dentistry (n = 2), and allied health (n = 2). The courses that were taught through various forms of microteaching covered a wide range of topics, including violence response, psychology, splinting techniques, pharmacology, public health, embryology, dentistry, internal medicine, biochemistry, cell biology, anatomy, and physiology.

Numerous studies have investigated the effectiveness of microlearning interventions in medical education, highlighting their ability to enhance knowledge retention, learner engagement, and skill acquisition. For instance, a study by Iqbal et al. [21] demonstrated that microlearning modules improved medical students' ability to recall and apply clinical knowledge compared to traditional lecture-based instruction. Similarly, research by Glenn et al. [14] found that short, interactive microlearning activities led to higher levels of learner satisfaction and performance in surgical training programs.

Our research in specialized scientific databases indicates that there are only five publications related to microlearning in the field of clinical medicine and the training of medical students and future physicians [14], [18–21]. Four of the papers describe the methodology for applying the microlearning approach in a specific clinical discipline, along with statistically processed data on the effectiveness of the method when applied in an educational setting.

While much research has been published on the topic of microlearning, there is a lack of research on the effectiveness of mobile microlearning and its application as an adjunct to traditional educational activities and programs in training future physicians in various clinical disciplines.

However, there is limited research on the effectiveness of microlearning in orthopedics and traumatology education as well.

2 MATERIALS AND METHODS

The study on the effectiveness of a mobile microlearning course was conducted during the winter semester of the academic year 2022–2023 at the Department of Orthopedics and Traumatology of the Medical University of Plovdiv, Bulgaria.

Medical students complete a full university course of study, including 14 lectures and 28 practical exercises during the semester.

As a supplement to the traditional training activities, we developed a mobile micro-learning course in orthopedics and traumatology containing micro-lectures on the same topics covered in the traditional face-to-face course.

The syllabus of the microlearning course is summarized in Table 1.

Table 1. Microlearning course syllabus

Week	Micro-Lecture Topic	Learning Objectives
1	Congenital hip dysplasia and dislocation. Coxa vara. Slipped capital femoral epiphysis. Rickets deformities.	Illustrate most important clinical symptoms. Compare diagnostic tests.
2	Congenital deformities of the upper extremity. Diseases of the mussels, tendons, and insertions due to overload.	Differentiate pathology and select treatment protocol.
3	Foot deformities. Obstetric palsy.	Differentiate pathology and predict outcome.
4	Spine deformities. Degenerative joint disease.	Compare and differentiate pathology.
5	Fractures in general. Fractures of the clavicle, scapula, and proximal end of humerus.	Demonstrate different types of fractures.
6	Fractures of the middle and distal third of humerus. Fractures of the proximal and middle third of the antebrachium.	Analyze types of fractures and choose method of treatment.
7	Fractures of the distal part of radius. Fractures of the carpal, metacarpal bones and phalanges. Traumatic joint dislocations. Dislocation of the humero-scapular joint and elbow.	Demonstrate different types of fractures. Acquire knowledge on clinical symptoms of joint dislocations.
8	Spine fractures.	Compare and evaluate spine fractures.
9	Traumatic hip dislocation. Fractures of the pelvis.	Understand symptoms and predict outcome.
10	Fractures of the proximal and middle third of femur. Intraarticular fractures of the knee joint.	Build on knowledge on treatment options based on fracture type.
11	Fractures of tibia and fibula. Ankle fractures.	Differentiate open and closed fracture treatment.
12	Bone tumors. Soft tissue injuries of the knee joint.	Compare bone tumors. Analyze knee injuries.
13	Bone and joint tuberculosis. Aseptic necrosis.	Differentiate types of pathology.
14	Central and peripheral palsy.	Compare central and peripheral palsy.

The micro-lectures were developed as educational content in the form of short presentations, designed to be studied in 2–5 minutes.

To deliver the micro-lectures to the students, we utilized the Moodle LMS with its mobile application (Moodle mobile application). For this purpose, the system was installed on a specialized server. The micro-learning course can be found at the following address: https://orthopaedics.edu-learn.eu.

The micro-lectures were sent to the students via push notifications on their mobile phones after the weekly traditional lecture and the day before the first practical exercise for the week.

Figures 1 and 2 depict the user interface and a portion of the micro-content of the course as displayed on students' mobile phones.

The total number of students studying in the orthopedics and traumatology course in the winter semester of 2022–2023 was 150, with 83 Bulgarian students and 67 foreign students from the following countries: Austria, Great Britain, Germany, Greece, Italy, Sweden, Norway, Ireland, Turkey, Morocco, and Somalia.

The distribution of participating students by gender and age in the study is shown in Figure 3.

The participants were randomly assigned to either the microlearning group (n = 75) or the traditional teaching group (n = 75). The students in the group receiving additional microlearning participated voluntarily.

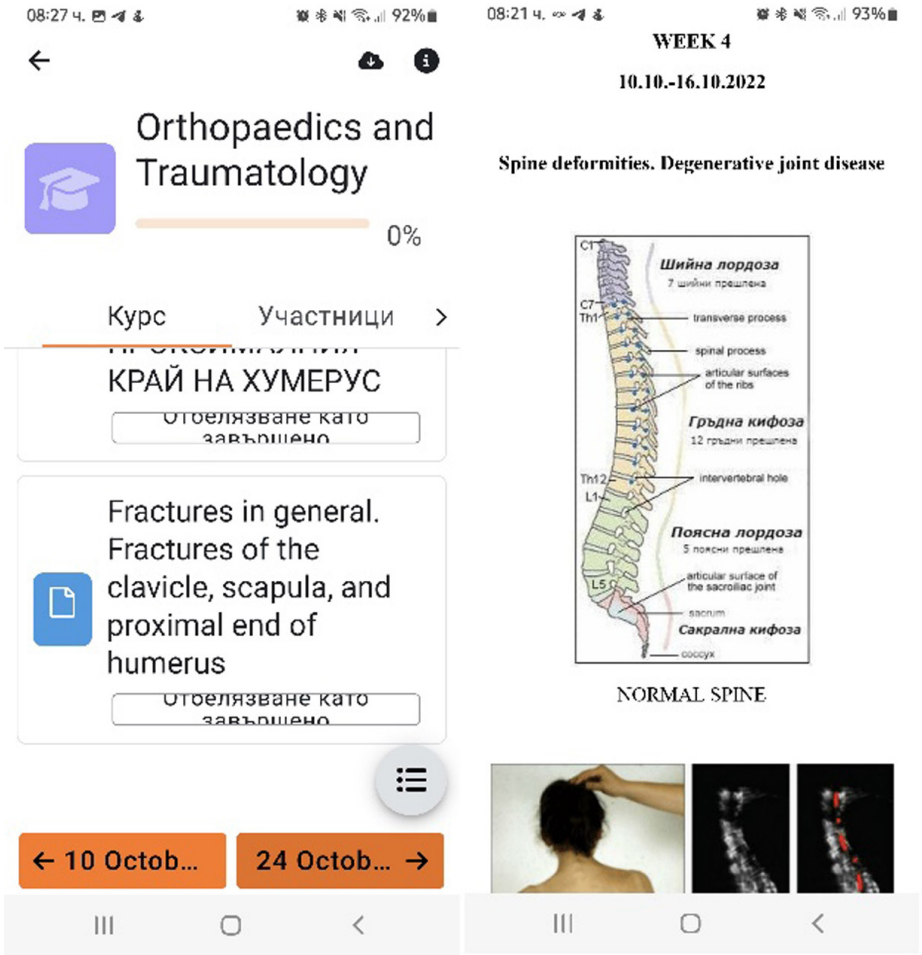

Fig. 1. User interface of a Moodle mobile training application with two screens presenting the topics in the Orthopedics and Traumatology additional training

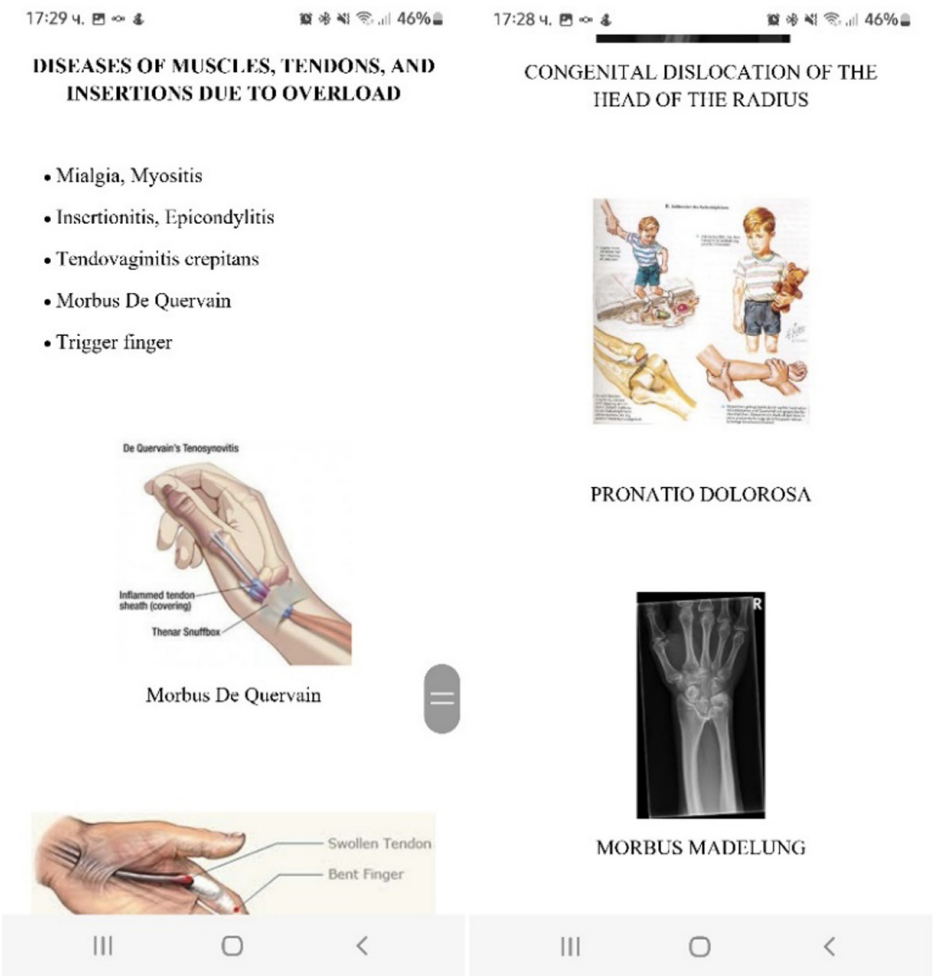

Fig. 2. Part of the micro content displayed to the students on their mobile phones

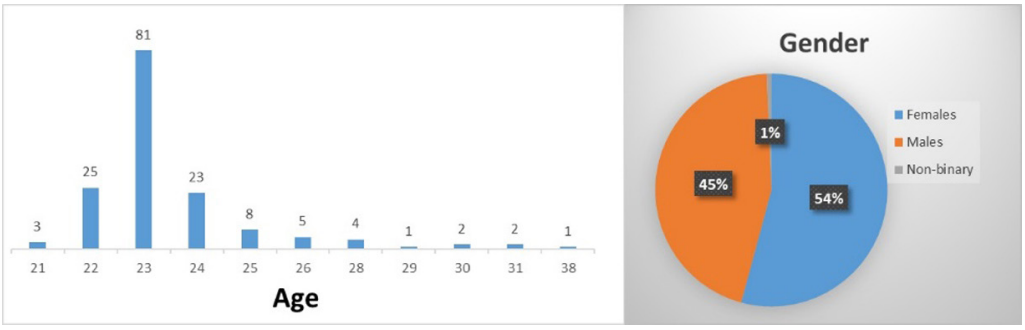

Fig. 3. Age and gender distribution of participating students

The microlearning group received access to a custom-designed online platform based on Moodle LMS and a mobile app that contained short lectures related to the traditional course materials. Students in the traditional teaching group attended regular lectures and practical exercises as their primary sources of learning materials.

3 RESULTS AND DISCUSSION

To assess the effectiveness of mobile microlearning as an additional educational tool in the orthopedics and traumatology university course, all 150 students took a

mid-semester test in the seventh week of their studies and a final test in the 15th week after the course ended. The test consisted of 10 multiple-choice questions, each worth 1 point, with a maximum score of 10.

Both test results were statistically processed using IBM SPSS 26.0. An independent sample t-test was employed to analyze the variance between the conventional learning methods utilized in the traditional teaching group and the experimental group that received supplementary training through mobile microlearning.

Both Kolmogorov-Smirnov and Shapiro-Wilk tests were performed initially to assess the normality of the data distribution (see Table 2).

Table 2. Test of normality

Tests of Normality

Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
MidTest	Control Group	0.154	75	0.053	0.938	75	0.060
	Microlearning Group	0.185	75	0.062	0.924	75	0.070
FinalTest	Control Group	0.159	75	0.111	0.944	75	0.113
	Microlearning Group	0.183	75	0.113	0.927	75	0.080

a. Lilliefors Significance Correction

As can be seen from Table 2, the significance value >0.05 in all cases indicates that the data is normally distributed.

After testing for normality, an independent sample t-test was carried out, and the results are shown in Table 3.

The study hypothesis is stated as follows in the standard independent sample t-test:

i) H0: There is no difference in learning outcomes using microlearning as an additional teaching instrument compared to traditional teaching methods.

ii) H1: There are differences in learning outcomes using microlearning as an additional teaching instrument compared to traditional teaching methods.

Table 3. Results from independent sample t-test

Independent Samples Test

		Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Interval of the Lower	Interval of the Upper
MidTest	Equal variances assumed	6.283	0.009	-4.450	148	0.001	-5.05800	0.20972	-1.34777	-0.51890
	Equal variances not assumed			-4.450	146.520	0.001	-5.05800	0.20972	-1.34780	-0.51886
FinalTest	Equal variances assumed	3.958	0.046	-6.828	148	0.000	-15.23400	0.23042	-2.02867	-1.11800
	Equal variances not assumed			-6.828	147.350	0.000	-15.23400	0.23042	-2.02869	-1.11798

As can be seen from Table 3, the significance values of the mid-test (p = 0.009) and final test (p = 0.046) are below 0.050. This rejects the null hypothesis (H0) and confirms the alternative hypothesis (H1) that there are statistically significant differences in the results of students using microlearning as an additional tool.

Students in the microlearning group demonstrated an average improvement of 13.9% in knowledge (M = 7.61) compared to those in the traditional learning group (M = 6.68) as early as the mid-semester test. On the final test, the total score increased by 23.5% (M = 8.28) for the group that used the microlearning module compared to the group that used traditional learning methods (M = 6.70).

4 CONCLUSION

The findings of this study suggest that incorporating microlearning into orthopedics and traumatology university courses can enhance student learning outcomes. Compared to traditional teaching methods alone, microlearning significantly improves students' knowledge retention and overall performance. This suggests that microlearning can be a valuable supplementary tool in orthopedics and traumatology education, equipping students for clinical practice. Further research is needed to explore the long-term effects of microlearning and its potential integration with other innovative teaching strategies in healthcare education.

5 ACKNOWLEDGMENT

The study was financed by Project PMD-05/2022 of the Medical University of Plovdiv, Bulgaria.

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