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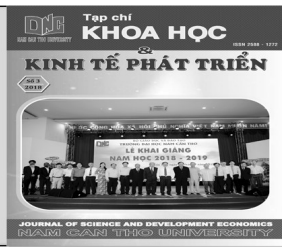

Enhancing knowledge retention in it education: an investigation into the impact of improved microlearning course structures and segmentation strategies

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ABSTRACT

This study introduced an improved structure for microlearning courses and investigated how the segmentation method within the microlearning system impacts students' ability to retain knowledge. We conducted an experiment before and after the treatment, involving 90 first-year students who were enrolled in an IT course, specifically the Information System Module. The students interacted with course content that was created using Gagné's Nine Events of Instruction. Both before and after the treatment, they were required to answer a set of 3 short-answer questions and 2 essay questions. Utilizing quantitative research methods, we assessed the effectiveness of the proposed microlearning segmentation process throughout an entire semester. We compared the final exam grades (post-test) with those of the mid-term exams (pre-test). The results indicate that students demonstrate the ability for self-directed learning in a self-regulated learning environment when they use the suggested segmentation approach. Furthermore, the findings show that students who followed the course design incorporating this segmentation process exhibited better knowledge retention compared to a traditional learning group. This increase in retention can be attributed to the key factors of intrinsic motivation, specifically perceived choice and perceived value.

TÓM TẮT

Nghiên cứu này đã giới thiệu một cấu trúc cải tiến cho các khóa học microlearning và điều tra xem phương pháp phân đoạn trong hệ thống microlearning tác động như thế nào đến khả năng

ghi nhớ kiến thức của sinh viên. Chúng tôi đã tiến hành một thử nghiệm trước và sau khi điều trị, với 90 sinh viên năm thứ nhất đăng ký khóa học công nghệ thông tin, đặc biệt là Mô-đun hệ thống thông tin. Học sinh tương tác với nội dung khóa học được tạo bằng 9 sự kiện giảng dạy của Gagné. Cả trước và sau khi xử lý, họ được yêu cầu trả lời một bộ 3 câu hỏi trả lời ngắn và 2 câu hỏi tiểu luận. Bằng cách sử dụng các phương pháp nghiên cứu định lượng, chúng tôi đã đánh giá tính hiệu quả của quy trình phân đoạn microlearning được đề xuất trong suốt toàn bộ học kỳ. Chúng tôi so sánh điểm thi cuối kỳ (kiểm tra sau) với điểm kiểm tra giữa kỳ (kiểm tra trước). Kết quả chỉ ra rằng sinh viên thể hiện khả năng tự học trong môi trường học tập tự điều chỉnh khi họ sử dụng phương pháp phân khúc được đề xuất. Hơn nữa, các phát hiện cho thấy rằng những sinh viên tuân theo thiết kế khóa học kết hợp quy trình phân khúc này cho thấy khả năng ghi nhớ kiến thức tốt hơn so với nhóm học tập truyền thống. Sự gia tăng khả năng ghi nhớ này có thể là do các yếu tố chính của động lực nội tại, cụ thể là sự lựa chọn được nhận thức và giá trị được nhận thức.

1. INTRODUCTION

The evolution and advancement of industries, coupled with shifts in labor market demands, have undergone significant transformations due to the rapid expansion of technology and society. In the era of Industry 4.0 (IR4.0), individuals must equip themselves with essential knowledge and skills while fostering a lifelong learning mindset [1],[2]. Both students and educators continuously update and enrich their knowledge systems, adapting to emerging technologies and evolving methods of applying acquired knowledge. Online teaching platforms encourage students to become self-reliant learners, demanding greater self-awareness. However, the drawback is that educators are unable to immediately gauge students' progress and adjust their teaching objectives in response to individual circumstances, potentially diminishing learning effectiveness [3]. A survey highlights that students' struggle to maintain focus and motivation during online learning is a significant reason why they may fall short of their expectations in micro-class learning [4]. Academic procrastination is prevalent among college students, with data analysis revealing conspicuous procrastination behavior in online learning [5]. It is crucial for learners to consciously cultivate self-control and reinforce self-awareness to successfully complete learning tasks [6]. Often, learners grapple with self-regulating their learning and may require both self-discipline and external support [7].

Interaction is among the most vital aspects for learners to acquire knowledge. In the context of learning, interaction encompasses activities involving engagement with teachers,

peers, learning materials, and the learning environment. The absence of face-to-face interaction in online courses presents a significant challenge, as students lack the opportunity for immediate feedback and direct communication with instructors when they encounter difficulties in their studies [8]. While online learning offers convenience, it cannot fully replace the value of in-person emotional communication, which, to some extent, impacts both student learning efficiency and teaching quality [9]. E-learning is associated with academic challenges, and the absence of face-to-face educator-student interaction is a pivotal factor, leading students to perceive traditional methods as superior [10],[11].

Learners express a preference for interactive microcontent, exercises, and immediate automated feedback as beneficial design elements for mobile micro-courses. Online learning often lacks collaborative opportunities, hindering students from developing teamwork and deep thinking skills [12]. Virtual classrooms may not engage students as effectively, and the dearth of traditional in-class social interactions results in limited real-time exchange of ideas among classmates [13]. Some students argue that distance education hampers group projects and collaborative work due to the lack of direct interaction [14].

Many micro-course resources remain unchanged for extended periods, making it challenging to tailor them to the ever-changing needs of students in today's fast-paced knowledge landscape. This static nature can lead to students losing interest in studying and even abandoning their pursuit of knowledge [15]. The inundation of negative content on the internet can also influence individuals' worldviews, life perspectives, and morals, leading to frustration and discontinuation of online learning [16]. Quality issues such as video playback problems, low resolution, and unclear content can quickly drain learners' motivation during the learning process, obstructing the widespread adoption of mobile learning and learner retention [17].

Key concerns for students revolve around the quality and quantity of mobile learning resources. The lack of specificity in course materials and issues with the quality of online learning resources significantly impact the retention rates of students in online courses. It is desirable for authoritative institutions to curate and provide high-quality resources that align with educational plans and learner needs, particularly in the context of extensive and complex teaching resources. Hence, this study investigates the impact of a novel segmentation process on enhancing the microlearning course structure within a blended learning environment. This approach integrates the Micro Learning technique with the course content of an IT module, specifically the "Information System" module, known for its practical components. The primary objectives of this research were as follows: (i) to evaluate the effectiveness of microlearning in IT education, (ii) to assess the impact of improved microlearning course structures on knowledge retention, and to determine the influence of segmentation strategies on knowledge retention.

The evolution of modern communication technology and the introduction of the "microlearning" theory have effectively bridged the gap between knowledge and learners, liberating them from the constraints of time and

space. It is expected that breaking instructional material into manageable, bite-sized portions will enhance motivation for learning and subsequently elevate learner engagement [19]. "Microlearning" represents an innovative approach to learning that aligns well with society's demands for lifelong education. It leverages communication technology to enable two-way communication, facilitating learning at any time and from any location. Typically, it employs succinct, brief content blocks to deliver and organize learning materials, emphasizing concise, loosely connected knowledge segments or modules within a limited timeframe. Microlearning primarily employs network communication technology to deliver content and facilitate interactions [20].

The distinctive features and significance of "microlearning" are readily apparent. It is typically centered around a single learning topic, featuring concise content chunks that usually span 5 to 15 minutes. This design caters to the human brain's attention span and includes time limits to prevent cognitive overload. The focus is on a clear and specific theme, which aids learners in clarifying their learning objectives and the problems they aim to solve. By concentrating on specific learning content, students can enhance their learning efficiency. Additionally, "microlearning" offers greater flexibility, as it eliminates traditional constraints related to location and time. Learners can engage in online learning activities according to their personal schedules, bolstering their enthusiasm and initiative for learning [21].

"Microlearning" can serve various purposes, such as being implemented as part of a flipped classroom approach, where learners complete microlearning activities before or after classroom teaching to reinforce knowledge concepts. Moreover, it serves as a versatile means of quickly delivering learning content and also supports social interaction, allowing learners to continuously enrich themselves and engage in self-development [22]. In the context of "microlearning," learners are not merely consumers of content; they can become content organizers. Learners with diverse interests and knowledge backgrounds can promote knowledge integration through interactive communication, forming a limitless repository of new knowledge [24].

Furthermore, "microlearning" can leverage online education tools like Moodle to facilitate teaching and communication interactions between educators and learners, even enabling educators to be present online. From a psychological perspective, "microlearning" can mitigate uncomfortable situations that some introverted or shy learners may encounter in traditional face-to-face classrooms, providing a more comfortable and accommodating learning environment [23].

Therefore, this research aims to investigate the impact of a proposed segmentation process implemented in content-based design on students' knowledge retention. The hypotheses are as follows:

H01: There is a statistically significant positive difference between the pre-test and post-test scores for students who engage in microlearning with the segmentation process.

H02: There is a statistically significant positive difference in knowledge retention gain scores between students who participate in microlearning with the segmentation process and those who do not.

3. METHODS

This study investigates the influence of a segmentation process on microlearning courses in a fully online learning environment. Specifically, it examines the effects of implementing the proposed segmentation process strategies in the course content of an IT subject, the Information System module, which focuses on practical activities. The research employs a pretest-posttest control group design to assess the effectiveness of these interventions. The pretest, measuring knowledge retention, was administered during the fourth week of the semester, while the posttest took place in the fourteenth week.

The research flow is illustrated in Figure 1. The study involved a total of 90 participants, divided into two groups. Group 'A' constituted the experimental group, which engaged with a module designed using the segmentation process, while Group 'B' served as the control group, participating in a microlearning module without integration of the segmentation process. The treatment condition was introduced to evaluate differences in outcomes. Both groups experienced the same peer learning environment, timeframe, and multimedia content but with varying organization of learning materials and knowledge structures.

To assess the effectiveness of the treatments, a pre- and post-test design was employed. One group, consisting of 45 students, underwent the treatment, while the other group, the control group of 45 students, did not receive any treatment but underwent the same testing procedures. Both groups were instructed to respond to a total of 3 short-answer questions and 2 essay questions on both the pre-test and post-test.

Quantitative research methodologies were employed to analyze the impact of the suggested segmentation procedure in microlearning on information retention and course completion throughout the semester-long lesson plan. The final exam scores were compared to the midterm exam grades to evaluate the results. The findings indicate that students demonstrate the capacity for self-directed learning within a self-regulated learning environment when utilizing the proposed segmentation approach.

The experimental groups underwent the pre-test for the two dependent variables, and the treatments were administered to these groups as they were relevant to the experimental process at that time. This design was chosen because it allows the researcher to assess participants' information retention and activity completion both before and after the experimental manipulations, facilitating a comparison of initial findings with the experiment's results. To account for potential absences and participant attrition during the experiment, 45 students were recruited for each treatment group, and the same student groups participated in both the pre-test and post-test assessments.

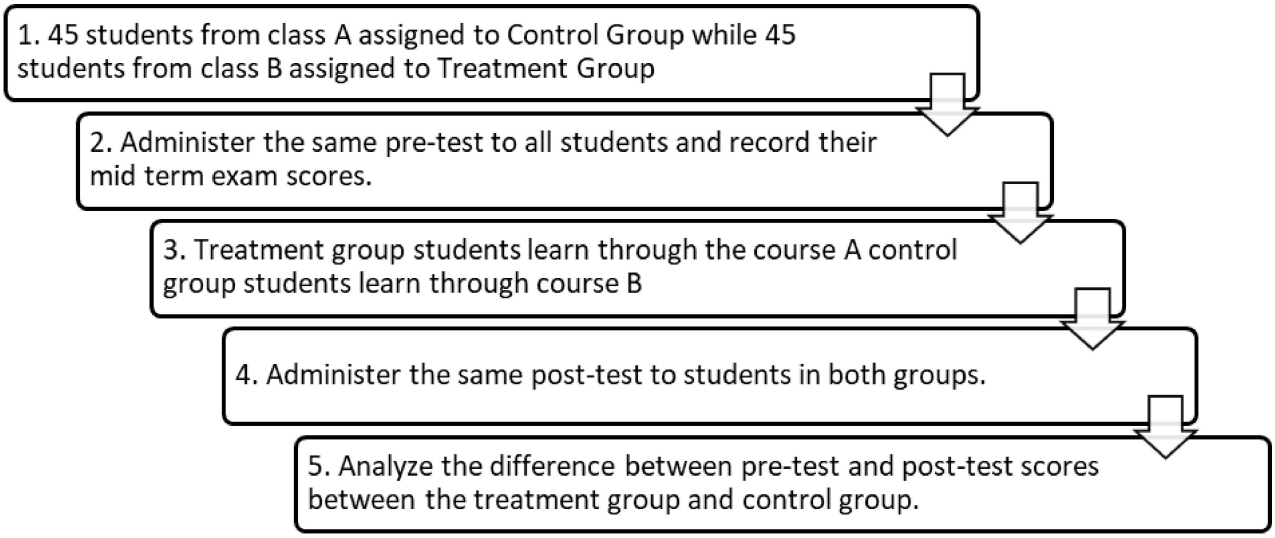

Figure 1. Research Flow

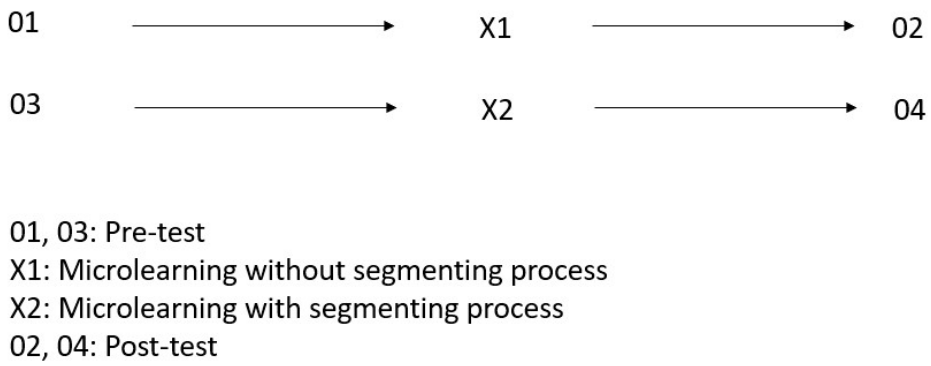

Figure 2. Design Notation

3. RESULTS AND DISCUSSION

H01: There is a positive significance difference between the pre-test and post-test scores for students who learn through microlearning with the segmenting process.

As indicated by the results shown in Table 1, the average score on the post-test was approximately 19 points higher compared to the pre-test. Furthermore, the Pearson correlation analysis between the pre-test and post-test scores (as detailed in Table 2) demonstrates a moderately positive correlation, with a coefficient value of $r = 0.259$ and a significance level of $p<0.05$. This suggests that, following their engagement with microlearning integrated with the segmentation process, the post-test results reveal an enhancement in students' knowledge retention compared to their pre-test performance.

Table 1. Paired samples statistics: Means

Paired samples statistics				
	Mean	N	Std. Deviation	Std. Error Mean
pre-test	61.22	90	15.214	1.604
post-test	79.89	90	13.474	1.420

Table 2. Paired samples statistics: Correlation

Correlations			
		pre-test	post-test
pre-test	Pearson Correlation	1	0.259*
	Sig. (2-tailed)		0.014
	N	90	90
post-test	Pearson Correlation	0.259*	1
	Sig. (2-tailed)	0.014	
	N	90	90

*Correlation is significant at the 0.05 level (2-tailed).

H02: There is a positive significance difference between gain scores of knowledge retention for students' that learning through microlearning with segmenting process & without segmenting process.

The critical value was more than 0.05, which is 0.357, as shown in the following table (Table 3). Therefore, the null hypothesis (H02) is rejected, which also suggests that there were no substantial differences between the pre-test and the post-test.

Table 3. ANOVA

ANOVA					
gain_scores					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	263.511	1	263.511	0.857	0.357
Within Groups	27048.489	88	307.369		
Total	27312.000	89			

4. CONCLUSION

The purpose of this study was to examine the relationship between 'before' (early in the To assess student knowledge retention in an Information System course at the end of the semester, we conducted examinations both before and after the course. The examination comprised three sections, including three short-answer questions and two essay questions. Notably, there was a significant difference in gain scores between the "before" and "post" tests, favoring those who underwent microlearning with the segmentation process over those who did not. Addressing real-world challenges related to Transaction Processing System components and networking and topology components necessitates a sound understanding of the relevant knowledge and procedures. The results of the examination revealed that students were able to address questions more directly and with greater clarity. It's worth noting that some students consistently made the same error on both the pre-test and post-test, possibly due to confusion between topology and its functions. The second component of the examination involved explaining a Decision Support Management System and its procedures. Students were required to provide a scenario and an example of a decision support system, as well as describe the role of such a system. The percentage of students providing correct responses remained consistently above 50%. Comparing pre-test and post-test results for each question showed an increase in the proportion of correct answers. This suggests that as the semester progressed, students developed a deeper conceptual understanding of the subject matter. This also indicates that students' ability to elucidate scenarios and processes related to information systems improved. Concerning essay questions about knowledge management systems, the results indicated varying significance for each question, with higher post-test percentages. This can be attributed to two primary factors. Firstly, the segmented nature of microlearning promotes sequential learning. The instructional materials were structured in a sequential manner, which aids students in identifying key terms and navigating the course content systematically. Secondly, the design of the learning resources distinguishes them from other online resources. For instance, lectures adhere to established pedagogical patterns, starting with introductions, followed by multiple subtopics, and concluding with summaries. Consequently, students grasp the relationships between information system components, such as servers, databases, and networking, in a visual manner, facilitating their comprehension of concepts and knowledge.

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