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The influence of preferred learning styles on students' database design acquisition in a physical education distance learning course

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Abstract
The purpose of this study was to compare two distinct preferred learning styles: the preference to learn in groups and the preference to work individually, on learning relational database design in a problem-based distance learning course at the Democritus University of Thrace. Fifty-four (n=54) third-year undergraduate Physical Education students, aged between 20-21 years old, were separated into two categories based on their learning style, evaluated using the Memletics Learning Styles Inventory: one category consisted of individuals who prefer collaborative work in small groups, involving a total of 27 students, while the other category included those who prefer independent work, totaling 27 students. The instructional period, practical exercises (activities), and tests lasted six consecutive weeks, including five 90-minute instructional sessions dedicated to learning relational databases (Libre Office Base 6.4). Following the experimental process, the students completed a knowledge test as a post-test assessment. An independent sample t-test analysis was conducted to investigate the hypothesis that students who prefer working in groups will have higher knowledge achievement than students who prefer independent work. The analysis revealed that both preferred learning style groups, working in groups and independently, could be effective for teaching relational database design. Specifically, Students who preferred to work alone were able to perform almost as well as students who preferred to work in groups when given a problem-based learning activity. These students seemed to be capable of gathering the information needed to learn the skills regardless of how they were presented.

Keywords: Independent work; working in group; problem-based learning; distance learning; physical education

Introduction

Education in the post-COVID-19 era supports personalized, productive, and collaborative teaching-learning experiences, aiming to shift the entire education system from the typical face-to-face mode to a technology-based independent mode. The primary emphasis is placed on nurturing the potential and creativity of learners in the most effective ways (Bordoloi, Das & Das, 2021) [1]. However, it is crucial to note that the information and communication technology are viewed as supportive tools within the educational realm. Their effective integration involves combining them with pedagogical models that emphasize the teaching of human values and incorporate suitable learning procedures tailored to each student (Salazar-Mata, Berlanga-Ramírez & Zapata-Morán, 2022) [2].

Ajideh, Zohrabi & Pouralvar (2018) [3] highlight that students bring their individual experiences, learning styles, and strategies to their learning process. Learning styles and strategies play a crucial role in enabling learners to explore their skills and enhance their overall learning experiences. Furthermore, learners can employ a diverse range of learning styles, which are integral to creating effective learning environments. Recognizing that each student possesses a unique way of learning, it becomes imperative to address their individual needs within the teaching-learning process (Benitez-Correa, Vargas-saritama, Gonzalez-Torres, Quinonez-Beltran & Ochoa-Cueva, 2022) [4].

Numerous studies on learning preferences have yielded varying findings. Pashler, McDaniel, Rohrer & Bjork (2008) [5] concluded that personal preferences in learning approaches had no discernible impact on posttests or other assessments. However, Pask (1979) [6] reached a different conclusion, suggesting that when students' learning styles aligned with complementary activities, posttest scores significantly improved.

Mestre (2010) [7] categorized learners based on Kolb's Learning Styles model, examining characteristics such as active-reflective, sensing-intuitive, visual-verbal, and sequential-global. Active learners favor hands-on activities, group work, and struggle with lectures, while reflective learners prefer solitary work, contemplating material before engagement.

Mohr, Holtbrugge, and Berg (2012) [8] investigated Kolb's learning style theory in the context of e-learning tools, observing that interactive tools suited concrete learners, whereas non-interactive teacher-centered tools benefited reflective learners. Choi, Lee & Kang (2009) [9] and Cook, Gelula, Dupras & Schwartz (2007) [10] found mixed results on the impact of learning style preferences on outcomes in various educational activities.

Tsai (2011) [11] implemented a hybrid e-learning model accommodating diverse learning styles, demonstrating that presenting materials in different ways aligned with students' preferences could enhance success. Shelton (2010) [12] used Memletics Learning Style Inventory and VARK to explore seventh-grade students' preferred learning styles, emphasizing the importance of teachers aligning their instruction with students' preferences.

While evidence is inconclusive on whether attitude towards group learning directly impacts achievement, studies on learning style preferences suggest that different learners

prefer distinct approaches. Active learners typically focus on the big picture and engage socially, while reflective learners work methodically, examining details before considering the broader context. Tailoring instruction to align with preferred learning styles may enhance student comfort and satisfaction, potentially motivating increased effort and deeper learning engagement.

Therefore, the purpose of this study was to compare two distinct preferred learning styles: the preference to learn in groups and the preference to work individually, on learning relational database design in a problem-based distance learning course at the Democritus University of Thrace. The goals of this study are directed at providing valuable support for instructors involved in delivering distance learning courses, with a particular focus on physical education undergraduate students. The intention is to shed light on the most efficient student learning styles, thereby assisting educators in enhancing the overall quality of instruction in the context of distance courses. The research question guiding this study was the following:

1. Is there a difference in relational database proficiency among physical education students who prefer working in groups compared to those who prefer to work individually in a problem-based distance learning course?

Methods

Participants

This research involved fifty-four (54) third-year students from the Department of Physical Education and Sport Science at Democritus University of Thrace. The participants, with an age range of 20 to 21 years (M=20.5, SD=.504), included 31 males (57.4%) and 23 females (42.6%). They were registered in the 334–New Technology in Health course during the spring semester of 2020. The students were separated into two categories based on their learning style, evaluated using the Memletics Learning Styles Inventory: one category consisted of individuals who prefer collaborative work in small groups, involving a total of 27 students (18 males and 9 females), while the other category included those who prefer independent work, totaling 27 students (13 males and 14 females). Before the assignments, participants received a briefing on the study's purpose, their assigned experimental group, the teaching method, and their participation requirements. Each student gave voluntary consent to participate, with the assurance that their involvement would not affect their grades.

Instruments

Knowledge test

The study utilized a knowledge test developed by Giannousi, Liakos, Vernadakis & Derri (2023) to evaluate students' understanding of relational databases (Libre Office Base, 6.4). The knowledge test consisted of 20 multiple-choice questions categorized into five groups: a) familiarity with the working environment (2 questions), b) creating tables and entering data (4 questions), c) creating relationships between tables (4 questions), d) creating queries (4 questions), and e) creating reports (4 questions). Each question offered five options to minimize the likelihood of guessing. Correct responses were awarded a score of (1), while incorrect answers received no score (0). The knowledge test questionnaire exhibited a Cronbach's alpha reliability coefficient of .77.

Memletics Learning Styles Inventory: The questionnaire employed to assess learning styles was the Memletic Learning Style Inventory. This inventory was crafted to identify participants' learning styles based on the seven types of intelligence proposed by Gardner & Hatch (1989) [13]. The reliability of the Memletic Learning Style Inventory has been confirmed (Srijongjai, 2011) [14]. Each question in the inventory had three options, and respondents could choose only one option for each item. The seven types of intelligence include:

1. **Visual (spatial):** Preference for using pictures, images, and spatial perceptions.
2. **Aural (auditory-musical):** Favoring the use of sounds and music.
3. **Verbal (linguistic):** Preferring the use of words in speaking and writing.
4. **Physical (kinesthetic):** Favoring the use of the body and tactile senses.
5. **Logical (mathematical):** Preferring the use of logic, reasoning, and systems.
6. **Social (interpersonal):** Favoring learning in groups or with other people.
7. **Solitary (intrapersonal):** Preferring to work alone and self-teach.

The questionnaire comprised 70 questions, with each learning style assessed by 10 questions. The questions were evenly distributed to ensure participants didn't know which learning style each question corresponded to during the test. Participants typically have a mix of learning styles, and the result of a learning styles inventory usually indicates one dominant learning style.

For this study, twenty (20) questions related to whether a person prefers to work individually (Solitary / 9, 28, 30, 31, 48, 51, 63, 64, 65, 66) or in groups (Social / 4, 8, 25, 28, 59, 60, 61, 62, 67, 70) were used. One multiple-choice question was presented at a time in an online assessment tool. The participants were instructed to assign score ratings to 20 statements using the following scale: 0 – the statement is nothing like me, 1 – the statement is partially like me, or 2 – the statement is very much like me. Examples of statements include: "You like identifying logic flaws or problems in other people's words and actions" and "You don’t mind taking the lead and showing others the way ahead."

Procedure

In this study, 54 third-year students underwent a knowledge test as a final measurement, irrespective of group design. The instructional period, practical exercises (activities), and tests spanned six consecutive weeks, comprising five 90-minute instructional sessions focused on learning relational databases (Libre Office Base 6.4).

Classes were conducted through the eClass Learning Management System, providing students access to their courses by logging into the system. Various tools, such as email, discussion boards, assignments, tests, web links, and groups, were employed in alignment with instructors' strategies and course objectives. The facilitator, a full-time instructor in computer technology for physical education, had access to each class section and established a standardized set of assignments, tests, groups, and links within the eClass Learning Management System. A dedicated folder on each class section's home page contained links to these resources.

An introductory email was sent to all students, outlining the study's purpose and tasks to be completed, with the facilitator addressing any queries. Students were grouped based on learning style, with one category consisted of individuals who prefer collaborative work in small groups (18 males and 9 females), and the other category included those who prefer independent work. A Problem-Based Learning (PBL) activity was employed for the needs of this research, involving a poorly structured problem that required collaborative problem-solving within small groups facilitated through discussion boards, chat rooms, file exchange, and email (Hmelo-Silver, 2004) [15].
At the end of the experimental process, students were given a knowledge test as a final measurement.

Statistical analysis
The experiment was a factorial design with learning style groups (students who prefer working in groups, students who prefer independent work) as independent variable, and knowledge acquisition as dependent variable. Independent samples t-test analysis was conducted to investigate the differences of knowledge acquisition among the learning style groups (students who prefer working in groups, students who prefer independent work) of the participants. The hypothesis of this study was:

H01: Students who prefer working in groups will have higher knowledge achievement than students who prefer independent work.

Results
An independent samples t-test was applied to examine the H01 hypothesis that students who prefer working in groups will have higher knowledge achievement than students who prefer independent work. The homogeneity of variance was checked using the Levene's test, and the normality of the sample was assessed with the Shapiro-Wilk test. The level of significance for measurements was set at ($p < 0.05$). The analysis revealed that the learning style groups (students who prefer working in groups, students who prefer independent work) during distance courses has a no significant impact on the knowledge acquisition of undergraduate students, $t_{(52)} = .359$, $p = .721$, $d = .099$. Online students who prefer collaborative work in small groups (M = 13.3, SD = 2.57) showed similar knowledge achievement compared to online students who prefer independent work (M = 13, SD = 2.66). Therefore, the learning style groups (students who prefer working in groups, students who prefer independent work) during distance courses did not affect the knowledge acquisition of online students. In Table 1, the mean value (M), standard deviation (SD), and the t-value with the corresponding level of significance are presented in detail.

Table 1: Mean scores and standard deviations of knowledge acquisition for the students who prefer working in groups and students who prefer independent work.

Variable	students who prefer working in groups (n=27)		students who prefer independent work (n=27)			
	M	*S.D.*	*M*	*S.D.*	*t*	*p*
Knowledge acquisition	13.3	2.57	13	2.66	.359	.721

According to the results, the H01 hypothesis, which suggested that students who prefer working in groups will have higher knowledge achievement than students who prefer independent work, is not supported. Therefore, undergraduate students who prefer collaborative work in small groups during the intervention did not gain more knowledge acquisition from their participation in the distance learning course compared to undergraduate students who prefer independent work (Figure 1).

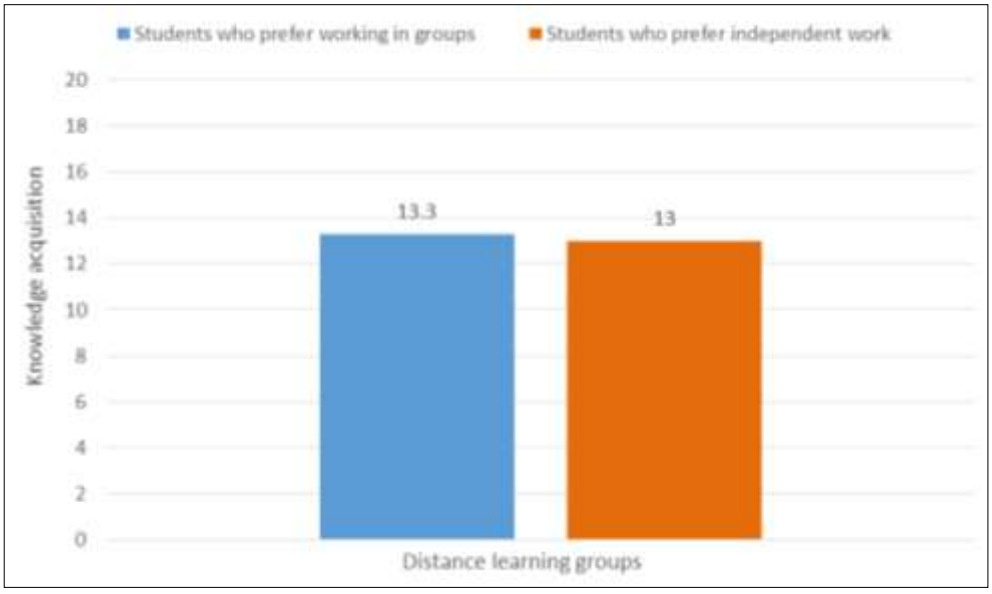

Fig 1: Mean scores of the distance learning groups (students who prefer working in groups, students who prefer independent work) in knowledge acquisition.

Discussion
Both physical education students and educators benefit from a critical awareness and understanding of student learning styles, offering valuable insights into the requirements for meaningful learning experiences and more effective teaching. Recognizing the inextricable link between teaching and learning is crucial. Acknowledging that students have diverse learning styles and may not always be

in an environment that accommodates and incorporates this diversity into teaching is essential (Leyton-Román, González-Vélez, Batista, Jiménez-Castuera, 2021) [16]. Therefore, the purpose of this study was to contribute to the distance learning literature by comparing two distinct preferred learning styles: the preference to learn in groups and the preference to work individually, on learning relational database design in a problem-based distance learning course at the Democritus University of Thrace. To fulfill this objective, a precise question was formulated, investigated, and the study's findings regarding this question are elaborated upon below.

The research question centered around examining potential disparities in relational database proficiency among physical education students based on their preference for group work or individual work in a problem-based distance learning course. The data from this study attempt to support the hypothesis that students who prefer to work in groups will have higher knowledge performance compared to students who prefer independent work.

The study results revealed that within the problem-based learning activity environment, there was no significant difference between individuals who favored group learning and those who preferred independent learning. Despite a higher frequency of active participation among those who favored group work, students with a preference for independent learning achieved comparable scores to their group-preference counterparts in the posttest, irrespective of learning style. These results align with existing research indicating that individuals who have a preference for working alone can perform equally well with either task (Gardner & Korth, 1998) [17]. Notably, students inclined towards group work consistently engaged in PBL activity discussions upon entry, while students with a preference for independent work participated in discussions only half as often as they viewed the posts. This trend aligns with prior findings indicating that students who favored independent work could access the problem-based learning activity discussions to gather information, even if they did not actively participate (Kolb & Kolb, 2013; Gardner & Korth, 1998) [17].

The observed outcomes might be explained by the adaptability of students who favored working independently. Despite their preference for solitary work, they demonstrated the ability to engage in both activities and acquire the necessary knowledge for the posttest. Their approach involved gathering information from the problem-based learning activity by reading others' posts without active participation. Although it's conceivable that they utilized additional sources, this study did not collect data to analyze the extent and nature of the resources employed.

A possible limitation of this research is its exclusive focus on students of the Department of Physical Education and Sports Science at the Democritus University of Thrace. Future research could enhance generalizability by expanding the study to include institutions in different parts of the world, potentially involving undergraduates from various programs.

Conclusions

In conclusion, students who preferred independent work achieved similar scores in the post-test compared to those who favored group work in a problem-based learning activity. Despite their individual preferences, independent learners demonstrated performance on par with their peers engaged in group activities. Further research is warranted to explore how these students approach group learning tasks while maintaining their individual learning focus. Additionally, the close proximity of scores on the selected portion of the Memletic's Learning Style Preference Inventory makes it challenging to definitively establish if students indeed had a clear preference. The instructor communicated attitude towards group learning results to each student, confirming the accuracy according to the students; however, group preference seemed contingent on the nature of projects or tasks. Employing a more robust measure of learning preference in future studies could offer deeper insights into participants' attitudes towards group learning and its significance for student success in diverse activities.

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