The Effect of Visual Notes on the Rate of Learning Theoretical Courses in the Field of Architecture

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ABSTRACT

As a study conducted on teaching and learning, the main purpose of the present research is to investigate the effect of visual notes on the rate of learning the History of World Architecture (HWA) as one of the theoretical courses in the field of architecture. The research undertaken here demonstrates that visual note-taking as one of teaching methods allows students to attach their own symbols to represent meaning. In light of visual notes, participants are engaged in more self-monitoring events than non-drawing participants. Additionally, the use of visual notes during the learning process of theoretical courses in the field of architecture is an effective strategy to enhance the educational performance of students. Referring to Bloom's Taxonomy, visual notes are considered an elaborative encoding strategy that plays a critical role in the memory performance. The statistical population of this study consisted of 59 undergraduate architecture students who attended the course of the History of World Architecture and were randomly clustered. By selecting two experimental and control groups, the present study utilized a posttest design. 39 people were allocated to the experimental group and 20 people to the control group. As well as lectures, learners in the experimental group were also required to describe the physical characteristics and geometric-spatial features of each monument and draw its design. The posttest-only control group design was used and the data were collected using a researcher-made test. The validity of the test was assessed based on the opinions of experts, and the reliability coefficient for 29 questions of the test was calculated using Cronbach's alpha to be 0.84. Data were analyzed using SPSS software and the student t-test. Bloom's Taxonomy helped to design a learning experience to identify, classify, and outline what students are expected to learn in this course. The results of the study show that the visual notes taken by students on architectural monuments has a statistically significant effect on the rate of learning and better performance in remembering, understanding, and explaining the physical and semantic features of historic monuments of the concepts taught by teachers in the classes of the History of World Architecture. Taking visual notes based on observation, recording, perception, connecting, analyzing, and encoding offers global education, through which learners are engaged in a deep cultural exchange rather than merely transacting.

INTRODUCTION

Educational technology, including visuals like videos and photos, enhances teachers' ability to simplify complex concepts and present spatial dimensions. This approach deepens students' understanding of educational concepts compared to traditional lecture-based methods (Eilam and John K 2014). The growing use of visuals in learning, connecting images with prior knowledge, and employing minimal written language enhances students' learning capabilities. Visual note-taking facilitates easier recall of information, simplifies complex ideas, develops critical and visual thinking skills, and fosters constructive learning with authentic student engagement (Zeyab, Almpdaires and Almutairi 2020). Visual reconstruction is when learners intentionally use visuals to create personalized meanings from fragmented information in traditional learning settings. (Shambaugh 1995). This approach finds application across various academic contexts (Roldan, et al. 2020).

Educators acknowledge visual note-taking as a strategy that enhances student learning, motivates engagement, and reduces stress (Fernandes, Jeffrey D and Melissa E 2018). Visual note-taking, also known as sketch-noting, involves visually capturing or representing information in a non-linguistic manner (Pillars 2015) This practice can be employed in various settings, including classrooms during lectures, at home while reading for leisure, or in public spaces while attending research presentations (Roldan, et al. 2020). The content discusses the concept of conveying ideas without relying on extensive written language (Childers, Eric H and Joan A 1998). The content highlights the process of creating notes in real-time by actively listening to lectures and discussions (Paepcke-Hjeltness, Mani and Cyamani 2017). The content highlights the versatility of visual note-taking in personal diaries, business projects, and information retention across different fields (Mills 2019).

Several studies have substantiated the significance of utilizing visuals effectively in the learning process (Udomon, et al. 2013). By incorporating purposeful visual note-taking, students integrate visualization as an essential component of their learning journey (Zeyab, Almpdaires and Almutairi 2020). As a result, students attending theory classes should receive training to leverage their visual abilities not only for enhanced theorizing but also for improved data organization (Berwick and Chomsky 2016). Notably, students who adopt visual note-taking in their learning process exhibit enhanced learning and better memory retention (Wammes, Melissa E. and Myra A 2017).

Architectural history courses are a crucial component of architectural education, encompassing the study of architectural works, buildings, and social structures from diverse civilizations, regions, and eras, incorporating multiple perspectives (Özcan 2022). Teaching architectural history in architecture faculties goes beyond imparting facts, requiring architects to understand spatial structures and analyze through drawings for creating and understanding historical architecture (Sołtysik 2020).

The course “An Introduction to the History of World Architecture” is crucial in training future architects (Piwek, Tomasz and Piotr 2020). In Iran, the curriculum planning system recognizes the importance of architectural education, aiming to familiarize students with global architectural events, evolution of architectural forms, and various factors influencing architecture. The course covers concepts such as stylistic features, social and cultural elements, and the diversity of architectural works. Teaching the history of architectural and urban forms presents challenges, such as selecting content, textbooks, and analytical methods. Research suggests students find the course uninteresting, leading to difficulties in understanding and remembering fundamental concepts (Bahadure, Amit, and Pankaj, 2013).

A visit to historical sites and monuments can greatly enhance the teaching of the History of World Architecture (HWA) course (Hein and Van Dooren 2020). The physical presence in architectural structures and the multisensory experience offer a wealth of information beyond what can be conveyed in a lecture hall (Piwek, Tomasz and Piotr 2020). Field trips serve as dynamic learning environments, exemplifying experiential learning by allowing learners to explore and experience the world outside the confines of the classroom. These trips encourage learners to challenge preconceived ideas, broaden their perspectives, and actively engage in the learning process (Sturm and Bogner 2010).

When it is not feasible to conduct field trips for teaching the History of World Architecture (HWA), students can still benefit from creating visual notes on historical monuments, which positively impact their comprehension of the concepts discussed in HWA classes. The utilization of drawing prompts can enhance learning by providing visual representations that complement verbal explanations, facilitating the sense-making process (Wu and Martina A 2018). Research examining the impact of learner-generated drawings on learning outcomes has identified that externalizing visualizations through drawing has a greater effect on learning, with the specific type of knowledge being measured influencing the effectiveness of drawing (Schmidgall, Eitel and Scheiter 2019).

Studies have shown that when students are prompted to create drawings as part of their learning process, especially for visual-spatial content, it significantly enhances and accelerates their learning experience (Schleinschok, Eitel and Scheiter 2017). It has been suggested that drawing participants engage in more self-monitoring activities compared to non-drawing participants (Van Meter, 2001). As autonomous learning gains importance, students must self-regulate their learning by monitoring and controlling their progress (Bjork, Dunlosky and Kornell 2013). Monitoring, recognized as a pivotal aspect of self-regulated learning, involves evaluating one’s learning state in relation to predefined learning objectives (Sterling 2005), as quoted in (Kostiainen, et al. 2018).

Drawing concept maps is an active learning activity that enhances student engagement with learning materials compared to passive reading (Chi and Wylie 2014). Drawing prompts aid in visually comprehending concepts alongside verbal processing, as highlighted by Wu and Rau (2018). The generation effect of drawing reveals that learners achieve better performance when they generate information themselves, as it involves greater mental effort (Schmidgall, Eitel and Scheiter 2019). Studies also suggest that engaging in generative tasks improves monitoring accuracy compared to situations without such tasks (Thiede and Anderson 2003).

Visual note-taking in education embraces a constructivist approach, allowing students to convey meaning through personalized symbols, such as representing “ancient” with diverse symbols like a spider web, an Egyptian pyramid, or a pirate ship (Pillars 2015). In architecture, drawing serves multiple functions, including communication with stakeholders, expressing design concepts, and facilitating analysis, knowledge acquisition, and comprehension (Unwin 2007). Visual note-taking in architecture enhances attention, perception, observation, and analysis skills, leading to improved accuracy in students’ observations. Additionally, according to Pillars (2015), integrating visuals into educational content significantly enhances long-term recall ability.

Previous research has explored the effects of drawings on learning in various subjects and age groups, but there is a lack of specific research on the effectiveness of visual note-taking in HWA classes. To address this gap, the authors conducted a study to determine how architecture students’ visual notes impact their learning at the remembering and understanding levels of Bloom’s Taxonomy in HWA.

THEORETICAL FRAMEWORK

REVISED BLOOM'S TAXONOMY OF LEARNING

The field of educational sciences encompasses various classifications of educational objectives, including Benjamin Bloom's taxonomy. Anderson et al. introduced a significant revision of this taxonomy, incorporating contemporary theories and refined descriptions of cognitive processes. This revised taxonomy establishes hierarchical levels of cognitive ability, including Remembering, Understanding, Applying, Analyzing, Evaluating, and Creating (Phillips, Smith and Straus 2013). The revised taxonomy comprises hierarchical levels of cognitive ability, and the research in question specifically focused on the first and second levels of the cognitive domain.

Table 1. First and second levels of Bloom's taxonomy of educational objectives (Krathwohl, 2002)

1. Remembering: Recognizing or recalling knowledge from memory. Remembering involves utilizing memory to generate or retrieve definitions, facts, lists, or previously learned information.
2. Understanding: Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.

REVIEW OF LITERATURE

Recalling the findings of Van Meter (2001) and Meter and Garner (2005) discovered that drawing participants exhibited more self-monitoring events compared to non-drawing participants. They examined learner-generated drawing as a strategy to support learning goals and reviewed applied and empirical literature to stimulate further research. (Schleinschok, Eitel and Scheiter 2017) conducted two experiments to investigate how drawing, as a monitoring task, influenced self-regulated learning and cognitive load. The experimental group created drawings depicting the content of an expository text on the formation of polar lights, while the control group only read the text. Results showed that the experimental group, using drawings for perceiving paragraphs, demonstrated superior monitoring performance compared to the control group.

(Schmeck, et al. 2014) acknowledged the potential of drawing during scientific text learning, emphasizing its benefits with certain boundaries and prerequisites. The quality of generated drawings during learning correlated positively with comprehension test scores, providing evidence for the generative and prognostic drawing effects and confirming the advantages of learner-generated drawing strategies. (Wammes, Melissa E. and Myra A 2017) found that drawing served as a powerful tool, improving memory performance similar to paraphrasing. Drawing enabled deep and elaborative encoding of information, allowing students to learn concepts effectively.

Mayer (2020) established that generative learning activities, including the use of graphics and drawing, fostered deep cognitive processing and durable learning. Visual note-taking in architecture facilitated the study of concepts related to architectural monument formation, enabling the discovery of organizational aspects and the prioritization of values within architectural space. (Schmidgall, Eitel and Scheiter 2019) recognized the contribution of generation, visualization, and externalization to the benefits of learner-generated drawing. (Ligorio, et al. 2017) described a drawing-based method that deepened understanding of young students' representations of their learning process. (Wammes, Melissa E. and Myra A 2017) confirmed that drawing was a relatively simple yet unique encoding strategy for learning complex information at the university level.

According to (Ainsworth 2006), externalizing mental images through drawing offers significant advantages over studying and mentally imagining contents, especially when encountering new ideas in academic texts. Visual note-taking in architecture provides numerous benefits as it aids in acquiring knowledge of physical and structural components in buildings. Visual notes, as tools of visual literacy, facilitate the reception and transmission of visual messages, enhancing visual acuity and the ability to perceive information accurately. Visual note-taking promotes the visualization abilities of architecture students (Crowe and Laseau 1986). Drawing allows learners to create an internal dual code, where written text represents symbolic (linguistic) mental representation and learner-generated drawings serve as pictorial codes, as stated by Paivio (1986, quoted in Schmidgall, Eitel and Scheiter 2019).

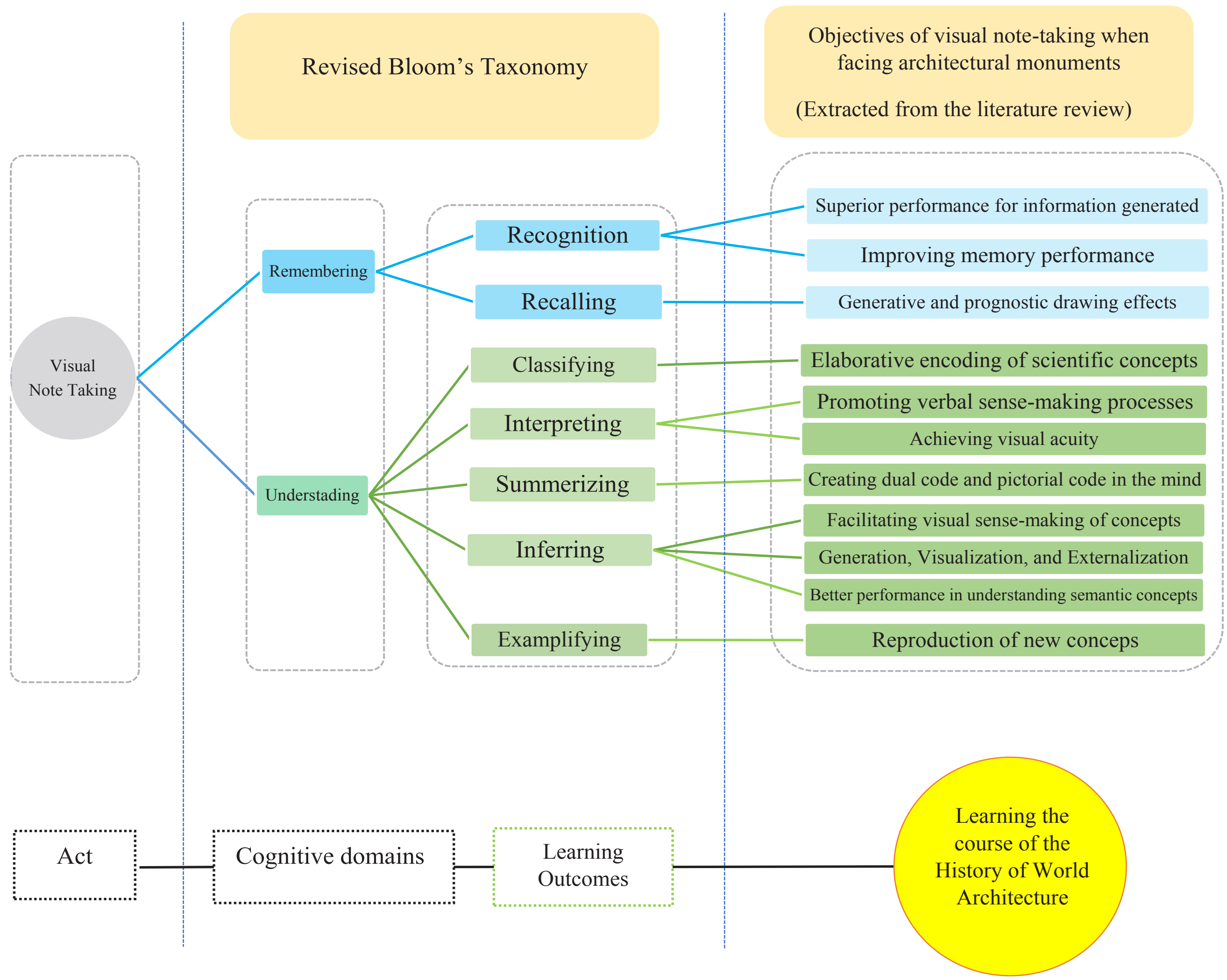

Figure 1. The theoretical framework of research

METHODOLOGY

The present research was conducted using a posttest design by selecting two experimental and control groups (EXT2/C-T2). In this study, the statistical population included 59 students, both male and female in the age range of 18 to 20 years, who were studying architecture at the undergraduate level at Shahid Rajaee Teacher Training University and attended the course of the HWA. The samples were clustered randomly and 39 people were allocated to the experimental group and 20 people to the control group. The environmental and temporal conditions and the contents taught were equal for both groups. However, in addition to the lecture method of teaching, in which the physical features of the architectural monuments belonging to different civilizations in different eras, how the monuments were formed and evolved, and how they affected other civilizations or were affected by them were taught, the learners in the experimental group were asked to express the physical and geometric-spatial features of the monuments by descriptive statements and take visual notes by drawing the design of each monument. In the control group, similar concepts were taught using the lecture method while drawing and visual note-taking were not used to investigate the effect of visual note-taking on the rate of learning.

The duration of this study was one semester in which class sessions were held weekly and it included a total of 32 hours of training. In each session, while teaching the course of the HWA, the features of the most important buildings belonging to various civilizations, including their plans, elevations, cross-sections, and perspectives, were explained. During the process of teaching, participants in the experimental group were asked to pay attention to the geometric features of plans, elevations, and cross-sections and take visual notes considering the main geometric-spatial elements related to architectural documents. To draw the architectural plans, the students drew the outlines and the lines indicating the geometry of the plan while observing the formal proportions to represent each of the building spaces. In the next step, the students considered more carefully the details of the physical elements of the building such as openings (doors and windows) and spatial connecting elements (stairs, corridors, porches, and partition spaces) so that their notes correctly represented the formal features of the building. Additionally, when drawing the cross-section, the students in the experimental group paid attention to the height proportions of each floor and the location of walls, windows, stairs, and skyline. It is worth mentioning that students were asked to write some of the main concepts related to each space in the form of descriptive phrases and keywords when drawing the images to better understand the architectural elements and physical and geometric-spatial features of the buildings and better engage in the learning process. Particularly, in the present study, visual note-taking stimulated the graphic memory of the students while drawing their attention to the general shape of the buildings, the formal proportions in each space, building details, and the position of the buildings relative to the cardinal directions. Thus, seeing closely the basic connections between the whole and the components of the building, the students in the experimental group experienced a better quality of remembering and understanding the architectural form and space compared to the control group. Samples of students' visual notes have been presented in figure 2.

At the end of the semester and after teaching all topics of the course, a researcher-made test with 29 questions was used in the form of a short answer test to investigate the written expression of students and their knowledge and comprehension of the contents related to the semantic and physical features of buildings. Focusing on the measurement of a wide range of contents that the students learned from the course of the HWA, this test was related to three types of buildings, including the pyramids of Egypt as monuments, the Greek theater and the Roman amphitheater as buildings with a social function, and Domus as an aristocratic house in ancient Rome. The students were asked to describe the physical, geometric-spatial, functional, and semantic features of the given buildings with short answers to measure the rate of students' knowledge and comprehension of the topics taught (Huang and He 2016). In the final session of the course, the tests were distributed among both experimental and control groups under the same conditions, and they were collected after 60 minutes. Then, the assessment and scoring of the tests were done. Students' responses to the test were independent of the final exam of the course and their participation in the test was voluntary.

Lawshe's index was used to measure the content validity of the test. Referring to the viewpoints of 15 experts, the value of CVR was obtained to be in the range of 0.6 to1, which was above the cut line.

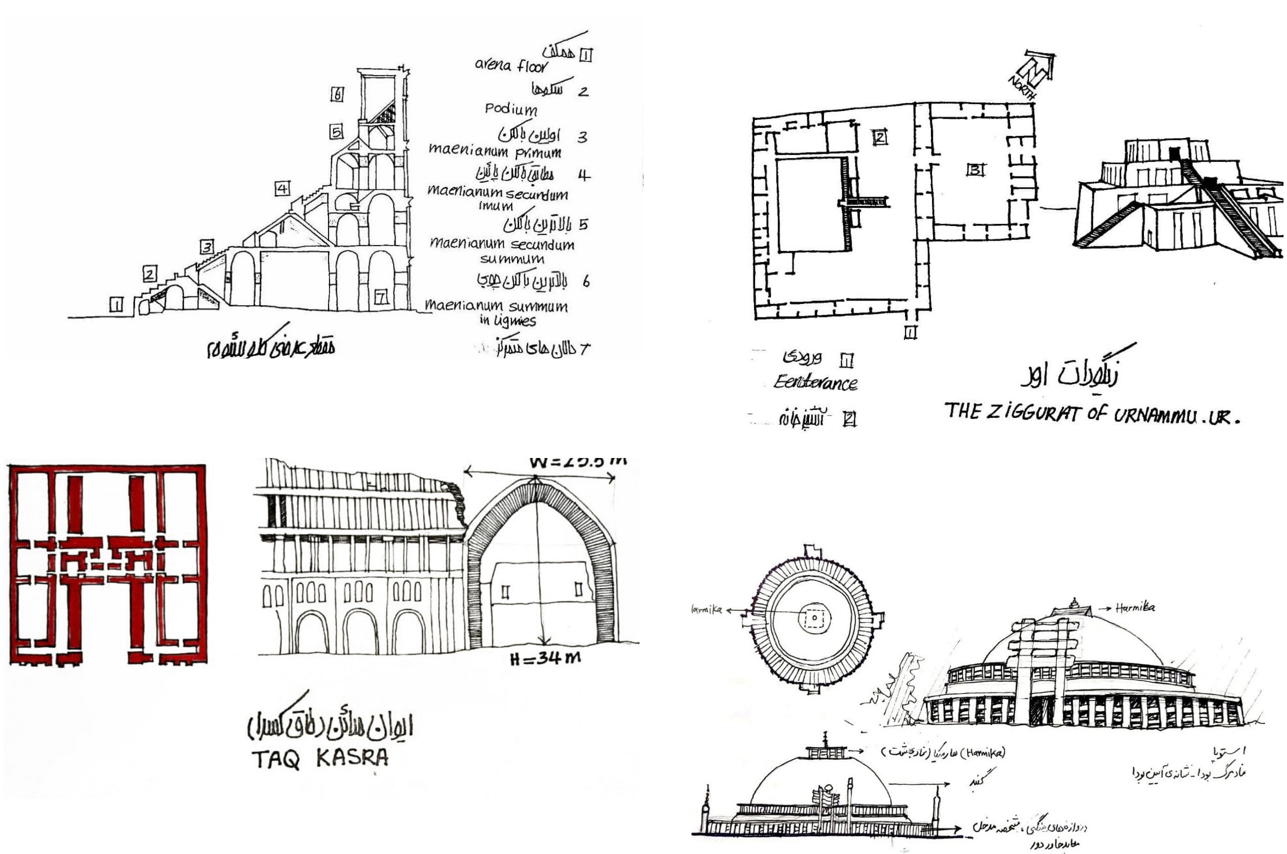

Figure 2. Samples of students' visual notes

Using Cronbach's alpha, the reliability coefficient of the questions was obtained to be 0.84, which is more than 0.7 and confirms the reliability of the test. After collecting the tests, scoring the answers to each question, and considering the overall grade of students in both groups, the results were analyzed independently using SPSS software and a parametric student's t-test. This study received ethics approval from the School of Psychology and Education, University of Tehran.

RESULTS

The following table presents descriptive statistics for the experimental and control groups, including measures such as mean, standard deviation, skewness, kurtosis, and minimum/maximum scores.

Table 2. Group statistics

Score	Group	Number	Mean	Std. Deviation	Std. Error Mean
	Experimental	39	17.64	4.625	0.741
	Control	20	7.35	1.927	0.431

The mean grades for the experimental group (39 subjects) and the control group (20 subjects) in the researcher-made test were 17.64 and 7.35, respectively. The skewness and kurtosis values fell within the range of -0.5 to +0.5, indicating a normal distribution of scores for the rate of learning variable.

Table 3. Independent samples test

		Levene's test for equality of variances		T-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference	
									Lower	Upper
Score	Equal variances assumed	11.189	0.001	9.504	57	0.000	10.291	1.083	8.123	12.459
	Equal variances not assumed			12.010	55.386	0.000	10.291	0.857	0.8574	12.0008

Based on the results from Table 3 and Leuven's test, the assumption of homogeneity of variance was not met (F=11.19, p=0.001). Comparing the experimental and control groups after Welch's correction, a significant difference was found between the two groups (t (55/38) = 12.01, p=0.000). The mean grades for the experimental group (17.64 ± 4.62) were higher than those for the control group (7.35 ± 1.93), indicating that teaching the HWA course using both the lecture method and visual note-taking was more effective in enhancing the rate of student learning compared to the lecture method alone. The Hedge's g effect size was 2.60, indicating a significant impact of the independent variable (visual note-taking) on the dependent variable (rate of learning) (McGrath and Gregory J, 2006).

DISCUSSION

The results of this study demonstrated that students who utilized visual note-taking in the HWA course exhibited improved performance in remembering and understanding instructional content, as well as effectively explaining the physical and semantic features of historic monuments. These findings align with previous studies that highlight the benefits of visual note-taking, such as those conducted by (Wammes, Melissa E. and Myra A 2017), (Schleinschok, Eitel and Scheiter 2017), and (Mayer 2020). By employing visual and verbal representations, students were able to comprehend the architectural structures of monuments from different civilizations. The process involved the use of drawings and externalization of mental images for learning purposes (Ainsworth 2006). The experimental group, through visual note-taking, not only explored the details of each monument's form but also gained a better understanding of circulation systems, hierarchical elements, construction logic, and architectural structure compared to the control group. Visual note-taking in the HWA course enhanced students' visual thinking abilities, aiding in the organization and categorization of data related to each monument, and facilitating visualization of their key physical features.

Visual note-taking and drawings contribute to the creation of internal dual codes for learning content, leading to improved memory performance and durable learning through deep cognitive processing of architectural elements. When combined with keywords relevant to each architectural part, the encoding of information and concepts is strengthened. These findings align with previous research conducted by (Wammes, Melissa E. and Myra A 2017) , (Mayer 2020), and Paivio (1986).

The brain has a natural inclination towards processing visual information over verbal and abstract forms. Visual note-taking serves as a bridge between the external world of scattered information and the internal visual world within the mind, facilitating the processing and storage of information in long-term memory. Drawing, as a robust encoding strategy, has been shown to significantly enhance memory performance (Fernandes, Jeffrey D and Melissa E 2018).

Visual note-taking is an observational, recording, perceptive, connecting, analytical, and encoding process that can be employed in various settings, including classrooms, leisure reading, and research presentations. Sometimes referred to as sketch noting, it encompasses components such as lettering, flow, order, icons, and color (Dimeo 2016). In the context of architectural auditing, visual note-taking enhances perceptual abilities, leading to increased speed and accuracy in processing semantic concepts related to architectural structures. Additionally, it enables the exploration of multiple layers of architectural values embedded in the work through intelligent repetition in the visual note-taking process (Crowe and Laseau 1986).

CONCLUSION

This research aimed to investigate the impact of visual note-taking on the learning outcomes of the HWA, a theoretical course in the field of architecture. A posttest-only control group design was employed, and data were collected through a researcher-made test. The findings of this study revealed a significant positive effect of visual note-taking on students' ability to remember and comprehend the concepts taught in the HWA classes. Students who utilized visual note-taking exhibited higher levels of knowledge and understanding due to effective encoding of information, enhanced recall, and cognitive processing of the subject matter.

Future research in the field of architecture should explore the effects of visual note-taking on other courses, such as Contemporary Architecture and Islamic Architecture, while also considering different levels of Bloom's taxonomy. Moreover, it is recommended to revise the duration of the HWA course within the academic education system in Iran, allowing for the integration of visual note-taking as a teaching method.

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