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A Review of Microlearning in Architectural Education

Ruwan A. Fernando[a]; Sylvie Chell[ab] and Ruby N, Michael[ab]
School of Engineering and Built Environment, Griffith University Queensland 4111[a]
Green Infrastructure Research Labs (GIRLS), Queensland 4111[b]
Corresponding Author Email: r.fernando@griffith.edu.au

ABSTRACT

CONTEXT

Microlearning strategies which capitalize on the gamification of language acquisition are becoming increasingly popular. Microlearning presents users with a multitude of quick, interactive exercises instead of overwhelming them with extensive assignments. This approach aligns with contemporary learning theories that suggest shorter, varied tasks can enhance engagement and retention by keeping users consistently challenged and rewarded. This research starts from the premise that educators need to understand student perquisite knowledge which can in part be indicated from small scale automated methods.

PURPOSE OR GOAL

In design courses within the engineering and built environment disciplines such as Architecture, Engineering, Planning and Industrial Design, students are commonly given large design projects worth a high percentage of the overall grade. The key issues with this approach, is that there is limited feedback on how the student is progressing and grades are not revealed till the end and there is anxiety in the build-up of assessments towards the end of the learning term. The aim of this research is to review methods that give quick feedback within a framework that also has a holistic vision of the program.

APPROACH OR METHODOLOGY/METHODS

This research is based on a literature review of key texts on the topic pedagogy that explore the theme of knowledge organisation over a learning journey. The issues are identified through our own experiences in course experience and curriculum design.

ACTUAL OR ANTICIPATED OUTCOMES

The observation of this study is the importance of educators having rapid and timely information on the student's knowledge and skills. The observations and review put forward pertain to how courses should be designed in ways that mix small and large tasks under the overview of a holistic narrative of the discipline.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

We conclude that there is a strong case (educational and economic) to incorporate microlearning tasks to build up student knowledge bases early in the course and throughout the learning term.

KEYWORDS

Microlearning, design studio, learning theories

Introduction

This paper began with the following observations, from the teaching of Year 2, 4 and 5, Architecture courses:

1. Educators frequently overestimate the level of ‘base’ knowledge that students have. This is particularly pronounced in institutes that have undergone rapid changes in the balance of domestic to international students or students entering later years through other pathways.
2. Architectural design courses are dominated by the ‘studio’ model where a single project is worked on for the duration of the teaching period. This is in part to make the class resemble a professional situation where a practitioner would work on a live project. These projects tend to be large in terms of expected delivery with the bulk of the workload skewed towards the tail-end of the learning term.
3. Design pedagogy tends to focus on the higher aspects of learning objectives (i.e. synthesis and creativity) and as such have less interest in development of base skills and knowledge.

In this context, base knowledge would refer to knowledge of influential works of architects and architecture, drawing, modelling, model making. Higher comprehensive skills would include composition, diagramming and abstraction. The task of even basic design is at minimum an ‘application’ task (or level 3 in Bloom’s taxonomy).

From these observations, a set of propositions are put forward for consideration in the planning of design pedagogy. The first, is the new opportunity to scaffold the core learning with digital methods outside of the main learning sessions. While digital tools (for example, online quizzes, videos, exercises) have some difficultly in supporting higher tasks such as synthesising, analysis or creating, they can be effective at smaller learning tasks such as memorising pieces of precedent knowledge. The second proposition is that we need to consider the relationship between the humanities (history and philosophy) and design, especially about the grand narratives of history. The reason being, that this becomes an ordering principle for knowledge that would otherwise be fragmented, this is expanded on in the next section on worldviews.

The advantage of digital tools, is that they can provide teaching outside of class, thereby greatly extending the amount of teaching time in a pseudo-supervised way. It is useful to design this in view of the body of literature around ‘microlearning’. The term "microlearning" emerged in the early 2000s, reflecting a pedagogical shift driven by advancements in digital technology. In part, this was driven by the need for rapid skill acquisition as industry and education moved towards technological solutions as well as the impracticability of traditional educational formats, for example needing full courses and assessment to acquire software skills for word processing or spreadsheets. Typically, a module is approximately 20 minutes long, though in some gamified scenarios, even smaller timeframes such as 5 minutes are used. The problem being solved, being that of ‘learner fatigue’.

The initial conceptualizations of microlearning can be linked to the increasing use of e-learning platforms that capitalized on the capability of digital media to deliver concise, targeted learning modules. According to Hug (2005), microlearning can be defined as a way of delivering content in small, specific bursts designed to meet the immediate needs of the learner. Miller (1956) popularised the idea of chunking in cognitive load management. The APA Dictionary of Psychology defines ‘chunking’ as "the process by which the mind divides large pieces of information into smaller units (chunks) that are easier to retain in short-term memory (APA, 2023) . The adaptability and flexibility of microlearning align with the cognitive principles of chunking and spaced repetition, which have been shown to enhance retention and engagement (Thalheimer, 2006).

In this research, we will make use of Bloom’s taxonomy, a hierarchical model of educational learning objectives (Bloom et al, 1964). The original taxonomy divided learning tasks into knowledge, comprehension, application, analysis, synthesis and evaluation. An update to Bloom’s taxonomy, was given by Anderson and Krathwohl (2001), who arranged it as actions for the learner into the categories of ‘remember’, ‘understand’, ‘apply’, ‘analyse’, ‘evaluate’ and

‘create’. We put forward the view, that the microlearning and gamification are well-suited for the lower tier of the hierarchy, which adds to the knowledge base that students can draw from to perform higher tasks.

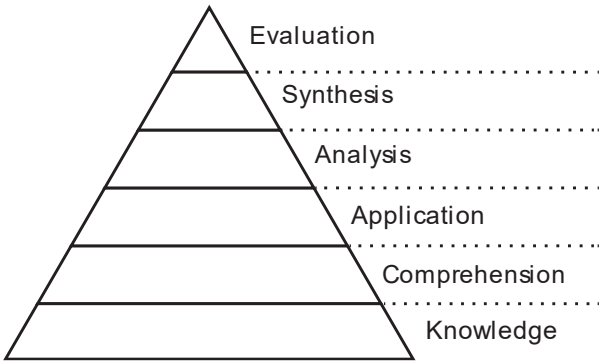

Figure 1: Bloom’s taxonomy of learning.

By leveraging microlearning and gamification, we aim to enhance architecture students' comprehension and application of a worldview, integrating these methodologies within the updated Bloom’s taxonomy framework. Gamification engages students in higher-order thinking by incorporating game elements such as challenges, feedback, and rewards, which encourage the application, analysis, evaluation, and creation of knowledge (Deterding et al., 2011). This dual approach ensures that foundational knowledge is solidified before progressing to complex cognitive tasks, fostering a comprehensive and integrated understanding of architectural principles and their cultural contexts. By structuring learning activities to gradually build from basic knowledge to advanced application and creation, this research aims to support the design of a holistic architectural education that is both engaging and pedagogically sound.

Perspectives and World-View

Our research into the topic began with a simple test we conducted every year for four years with the 4th year architecture students. In the test, students were shown twenty well-known examples of architecture and asked to identify either the name of the building, architect or location (city). Typically, students would score approximately 3 out of 20 (15%). While this showed a general lack of knowledge about world architecture, it should be noted that after being the same test one year later, students would score more than 50% with the top quartile scoring over 80%. This indicates that knowledge retention is generally good even without the incentive for grading or any further learning activities.

Continuing an activity series performed separately in two classes (all in their 4rth year of study), where students pinned events to a timeline, it was clear that most of the students had very limited knowledge of world history even in broad strokes. It was, for example, not known to students of the order of events even millennia apart (the classical age and the Renaissance). We put forward the analysis of this activity through the lens of schema theory, which offers a robust framework for developing a comprehensive worldview in design students. According to schema theory, mental structures known as schemas help individuals organize and interpret information based on prior knowledge and experiences (Bartlett, 1932; Anderson, 1977). The initial low scores observed in our test may reflect the students' underdeveloped schemas related to architectural history. By integrating historical narratives into design education, educators can facilitate the development of rich, interconnected schemas that encompass cultural, social, and technological contexts. This approach enables students to understand the evolution of design principles and practices through time, fostering a deeper appreciation of the influences that have shaped contemporary design. More importantly, it gives students ‘containers’ into which they can file away knowledge as it is gained into an appropriate mental space.

An advantage of the modern classroom is that learning assets such as simple quizzes can be created and re-used (and expanded) and can also act as supplementary learning activities for outside of the main class activities. Gamification (such as leader boards and other scoring) can be used to provide extrinsic motivation for the students investing time into the activity. Digitally, this activity scales well to large class sizes.

There is value in making the relationship between the learning objectives explicit into learning activities. Michael et al (2019) give the example of learning objectives being embedded into an online workbook through the *'PebblePad'* platform. In this case, the student reflection was made into an explicit task, with prompted questions for students to understand their own worldview transformation through the course activities.

The importance of a worldview as well as corresponding knowledge of history is important for fields that are inherently multidisciplinary. Architectural design synthesizes elements of art, science, making a well-rounded perspective important for informed design decisions (Lawson, 2004; Crysler, 2012). By cultivating a global perspective, architecture students can appreciate the diverse influences that have shaped architectural practices across different regions and epochs, allowing them to draw on a richer palette of design strategies (Ching, 2014). This broad understanding also prepares students to respond to contemporary challenges such as globalization, sustainability, and cultural identity in design, ensuring that their work is both innovative and sensitive to the needs of varied communities (Nesbitt, 1996; Frampton, 1983).

Literature

In this section, we look at the literature for surrounding the question of the design rationale for incorporating knowledge tasks into architecture courses. In the context of architectural education, understanding how students acquire, process, and apply knowledge is critical for developing effective pedagogical strategies that provide a clear and scalable path. This literature review explores key theories that inform current educational practices, particularly in relation to developing a comprehensive worldview among architecture students. The theories discussed include Vygotsky's Zone of Proximal Development (ZPD), Cognitive Load Theory and Schema Theory.

Lev Vygotsky's Zone of Proximal Development (ZPD) emphasizes social interaction and scaffolding in learning, highlighting the gap between independent ability and guided achievement (Vygotsky, 1978). Cognitive Load Theory (CLT), developed by John Sweller, addresses working memory limitations and the need to design instructional materials that optimize cognitive processing (Sweller, 1988). In architectural education, CLT advocates breaking down complex tasks and using scaffolding, chunking, and visual aids to manage cognitive load.

Constructivist learning theories, influenced by Jean Piaget and Jerome Bruner, emphasize hands-on, project-based learning where students actively construct knowledge through real-world experiences (Piaget, 1954; Bruner, 1960). Schema Theory provides a framework for understanding how students organize knowledge and encourages educators to create structured schemas for effective learning. These theories have been summarised in Table 1.

Table 1. A summary of the literature related to pedagogical design.

Theory/Schema	Author(s)	Year	Description
Zone of Proximal Development (ZPD) Role of Language in Thought and Learning	Lev Vygotsky	1930s	Describes the difference between what a learner can do without help and what they can achieve with guidance, emphasizing the role of language in learning.
Cognitive Load Theory	John Sweller	1980s	Differentiates between intrinsic, extraneous, and germane cognitive load, highlighting how a limited vocabulary increases cognitive load.
Bloom's Taxonomy	Benjamin Bloom	1956	Categorizes educational goals into a hierarchy of cognitive skills, suggesting that foundational skills must be developed before higher-order thinking.
Growth Mindset Theory	Carol Dweck	2006	Proposes that believing abilities can be developed through effort enhances persistence and confidence, facilitating higher-order thinking and creativity.
Constructivist Learning Theories	Jean Piaget, Jerome Bruner	1930s-1960s	Suggests that learners build new knowledge by connecting it to existing cognitive structures, with vocabulary playing a crucial role in this process.
Schema Theory	Frederic Bartlett, Richard Anderson	1932 (Bartlett), 1970s (Anderson)	Posits that knowledge is organized into schemas, which are mental structures influenced by the breadth and depth of an individual's vocabulary.

Discussion

In this research, we put forward an argument for the inclusion of knowledge-based tasks delivered through microlearning strategies into the architecture design curriculum. The integration of microlearning strategies into the architecture design curriculum offers a promising solution to the challenges identified in our research, particularly the observed gaps in foundational knowledge among students. Our findings suggest that while students initially exhibit limited knowledge of significant architectural works and their contexts, they show significant improvement in retention over time, even without formal incentives. By incorporating microlearning into the curriculum, educators can address the lower levels of Bloom's taxonomy—such as remembering and understanding—more effectively. Microlearning allows for the delivery of small, targeted learning modules that students can engage with outside of traditional classroom settings, thus extending the learning process beyond the confines of the studio model.

This approach aligns with Cognitive Load Theory, which emphasizes the importance of managing cognitive load to enhance learning efficiency (Sweller, 1988). By breaking down complex

information into manageable chunks, microlearning supports students in building a robust base of architectural knowledge without overwhelming their cognitive capacities.

Moreover, the use of gamification elements within microlearning can further enhance student engagement and motivation. Gamification, through the introduction of challenges, rewards, and leaderboards, taps into students' intrinsic and extrinsic motivation, encouraging them to invest time in foundational learning tasks. This approach not only promotes knowledge retention but also aligns with Growth Mindset Theory, which posits that students who perceive learning as an iterative, effort-driven process are more likely to embrace challenges and persist in their studies (Dweck, 2006).

The incorporation of historical narratives and precedents into design education, as discussed through Schema Theory, further underscores the importance of developing a comprehensive worldview in architecture students. A well-developed worldview enables students to draw from a richer palette of design strategies and respond more effectively to contemporary challenges such as globalization, sustainability, and cultural identity. This multidisciplinary approach is supported by Constructivist Learning Theories, which advocate for hands-on, project-based learning where students actively construct knowledge through real-world experiences (Piaget, 1954; Bruner, 1960).

Considering these findings, we propose that architecture educators adopt a more structured approach to integrating foundational knowledge tasks into the curriculum, using digital tools and microlearning strategies to supplement traditional studio-based learning. This approach not only addresses the cognitive and motivational needs of students but also prepares them to engage more deeply with the complex, multidisciplinary nature of architectural design. By doing so, we can ensure that architecture students are equipped with the necessary knowledge and skills to innovate within the field while remaining grounded in the rich historical and cultural contexts that shape architectural practice.

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