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# REVIEW OF THE EXPLORING SPATIAL VISUALISATION AND GENDER AMONG 3D COMPUTER ANIMATION UNDERGRADUATES

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**Abstract**
The performance of multimedia undergraduates in 3D computer animation may be impacted by their deficiencies in spatial visualisation. It is possible to see spatial visualisation as a distinct intelligence that differentiates it from other types, such as verbal and reasoning abilities. Creating a 3D animation required complex visualisation work, which most students found challenging. Students who cannot finish the task due to inadequate spatial visualisation skills will not be able to pass the 3D computer animation course. This study investigates the relationship between undergraduates' performance in 3D computer animation, gender, and spatial visualisation. The first stage of the research was to examine the literature related to spatial visualisation, gender differences and computer animation skills among undergraduate students.
**Keywords**: Computer Animation, Spatial Visualisation, Multimedia, 3D Animation

## INTRODUCTION

The growth of the animation sector in Malaysia has created several professional prospects for 3D animators, resulting in a more discerning approach by recruiters throughout the hiring process. Additionally, gender has emerged as a criterion for employment. This study examines spatial visualisation, focusing on students' proficiency in multimedia courses through literature that explicitly investigates the potential correlation between spatial visualisation skills and performance in 3D computer animation among male and female students

The expansion of Malaysia's animation sector has significantly increased professional opportunities for 3D animators, leading to more stringent and selective recruitment processes. Gender, as a demographic factor, has increasingly influenced employment criteria within the industry Furthermore, the research examines demographic variables, highlighting the critical influence of gender on students' achievements and industry readiness. According to statistics, the field of 3D animation is predominantly male, both globally and in Malaysia. In Malaysia, approximately 66.7% of animators are male, while 33.3% are female. Globally, the gender gap is more pronounced. For instance, in the United States, women held only 20% of creative roles in animation as of 2019. Despite women comprising over 70% of animation and art school students, they occupy just 34% of creative jobs in the industry (Ugap, et. al., 2023).

By exploring the male-dominated nature of the animation field, this study aims to identify the underlying factors affecting career trajectories for 3D animators in Malaysia and to propose strategies for promoting greater inclusivity within the profession.

### *Spatial Visualisation Among Multimedia Undergraduates and Gender Differences*

An individual engaged in design, particularly in the 3D discipline, must possess creativity and innovation to convey visual elements effectively. Additionally, they should have a vivid imagination to translate 2D items into their 3D counterparts and vice versa. Lohman (1988) defined spatial visualisation as the cognitive capacity to understand and mentally manipulate objects and movements within a three-dimensional space. Lowrie (2002) argues that modern civilisation progressively depends on visual stimuli as technological advancements blur the distinction between real-life settings and two-dimensional representations of three-dimensional space.

In addition, as Gutierrez (1996) stated, 3D animation students need perceptual constancy. This data refers to their ability to acknowledge that specific characteristics of an object, such as size, colour,

texture, or position, remain consistent regardless of orientation changes. They must maintain clarity and avoid confusion when perceiving things or images from different angles. Imagination is crucial in the process of creating and designing a 3D model. Dynamic visualisation, as defined by Presmeg (1986), refers to the cognitive ability to analyse and comprehend the fundamental characteristics of figures that are in motion, shrinking, or rotating, whether they are displayed on a screen or imagined mentally (Harel & Sowder, 1998; Presmeg, 1986). Workman and Lee (2004) argue that employing suitable strategies can successfully enhance students' problem-solving skills in design and foster their spatial visualisation abilities. By utilising 3D software, students can improve their spatial visualisation abilities. In addition, Sorby and Baartmans (2003) noted that including multimedia in the workbook benefited the student's development and improved their three-dimensional spatial skills.

Previous studies indicate differences in spatial ability between boys and girls (Battista, 1990; Ben-Chaim, Lappan, & Houang, 1988; McGuinness, 1993; Voyer et al., 1995). This phenomenon is evident in spatial visualisation (Mayer & Massa, 2003). Various explanatory factors have been proposed to account for the disparity in spatial ability between boys and girls, acknowledging the influence of learner-related factors (cognitive variables) and environmental factors (such as the activities in which boys and girls participate in their daily lives). Regarding characteristics associated with learners, much emphasis has been placed on how boys and girls encode and process information, known as cognitive style (Arnup, et al., 2013; Kozhevnikov, 2007; Mayer & Massa, 2003).

Michael T. Battista (1990) proposed that while males and females had discrepancies in spatial visualisation and their performance in high school geometry, they did not display differences in logical reasoning aptitude or their utilisation of geometric problem-solving approaches. The disparities in spatial skill levels between males and females can be attributed to either the influence of a male sex hormone (Hier & Crowley, 1982) or the predominant role of environmental factors (Fennema & Sherman, 1977). This is because males typically seek a technique or approach involving spatial awareness and directional strategies, while females rely on signs and route directions (Lawton, 1994; Geary, 1998). The results of this study align with the findings of Koenig et al., (1990), which suggest that women tend to excel in perceiving the exact location of objects. Still, men are proficient in understanding the distance and direction between objects.

## MATERIAL AND METHOD

This study employs content analysis to systematically investigate the literature on spatial visualisation, gender disparities, and proficiency in 3D computer animation among undergraduate students. Content analysis offers a rigorous framework for identifying, categorising, and quantifying thematic patterns within the selected body of literature, enabling a structured examination of prevailing trends and gaps (Stinson, 2021). The analytical process was grounded in a pre-established thematic framework derived from an initial scoping review of key studies, encompassing themes such as levels of spatial visualisation aptitude, gender-based performance differences, and their implications for academic and practical outcomes in 3D computer animation. The data coding process involved assigning numerical values to recurring patterns, enabling statistical evaluation of the frequency and distribution of themes across the selected works.

To ensure a comprehensive and multidisciplinary perspective, the literature search was conducted across five prominent academic databases: Google Scholar, Elsevier, PubMed, IEEE Xplore, and Springer. A systematic search strategy was employed using predefined keywords and Boolean operators, including "spatial visualisation," "gender disparities," "3D computer animation," "undergraduate students," and "performance analysis." The inclusion criteria required that studies be peer-reviewed, published between 2010 and 2023, and explicitly address at least one of the primary themes. Exclusion criteria included non-scholarly publications, studies unrelated to multimedia education or animation, and works lacking empirical evidence.

A multistep screening process was implemented to ensure methodological rigour. Initially, duplicate entries were removed to avoid redundancy. Abstracts of the remaining articles were screened for relevance to the research themes, followed by a full-text review of studies meeting the inclusion criteria. Furthermore, methodological approaches and reported outcomes were systematically categorised to provide insights into the research landscape.

This approach ensures a robust and systematic literature evaluation, offering valuable insights into the relationship between spatial visualisation, gender disparities, and academic performance in 3D

computer animation. By employing a transparent and replicable methodology, the study aims to contribute a nuanced understanding of the factors influencing proficiency in this field while identifying areas for future research.

## RESULTS AND DISCUSSION

A comprehensive literature review establishes a strong correlation between spatial aptitude and academic performance in 3D computer animation courses. Students with advanced spatial visualisation skills consistently demonstrate superior proficiency in mastering the complex cognitive tasks associated with 3D animation, such as spatial transformations, object manipulation, and scene composition. Conversely, a considerable proportion of multimedia undergraduates face challenges in executing these advanced spatial tasks, underscoring the need for pedagogical strategies tailored to varying levels of spatial proficiency.

Integrating spatial ability assessments alongside gender-based analyses offers educators an evidence-based approach to designing targeted instructional interventions. For example, developing specialised training modules or supplementary materials could enhance spatial visualisation capabilities among students with lower aptitude, thereby bridging performance gaps. While gender differences in performance have been observed, the mechanisms driving these disparities remain ambiguous, necessitating further investigation to inform more inclusive educational practices. This study underscores the importance of embedding cognitive and demographic considerations into the design of multimedia curricula to enhance academic outcomes. The findings are constrained by the need for larger, more diverse samples and further exploration of the longitudinal development of spatial skills through targeted training.

## CONCLUSION

Results revealed that students with high spatial aptitude will probably outperform those with low spatial talent in the 3D computer animation course. With spatial visualisation, students could find it much easier to understand the many activities required for a 3D computer animation performance. Few undergraduates studying multimedia have the skills to tackle the complex visualisation tasks involved in 3D computer animation, a demanding course that includes spatial tasks. Teachers can use spatial ability, gender, and 3D computer animation performance as predictors to help them create the best instructional materials for pupils with varying degrees of spatial visualisation proficiency. Future research should also focus on translating these insights into practical applications within industry settings to foster inclusivity and support the equitable development of 3D animation talent.

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