Original Article
ISSN (Online): 2582-7472

ShodhKosh: Journal of Visual and Performing Arts
International Conference on Emerging Trends in Design and Arts
May 2024 5(ICETDA24), 110–116

AR/VR TECHNOLOGICAL INTERVENTION IN DESIGN EDUCATION FOR PRODUCT VISUALIZATION

Mukesh Malviya[1], Neeraj Setpal[2], Kapil Sharma[3]

[1, 2, 3]Avantika University, Ujjain

DOI
10.29121/shodhkosh.v5.iICETDA24.2024.1271

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

It is essential to study the inevitable impact of technology on teaching in design education, specifically the methods of concept visualization. The new AR/VR technologies may have the potential to revolutionize the way product visualization is taught in Design Schools. In Industrial designing, Sketching and manual color renderings have been considered the standard practice for initial concept generation for developing tangible three-dimensional products. For three-dimensional visualization, the CAD model of a selected few ideas are generated at later stages of product development. That may give a very close-to-real view of the product on a computer screen but with constraints that can be overcome only with an actual physical prototype. Incorporating AR and VR techniques with traditional sketching methods and prevailing CAD tools may leverage an individual's learning experience of realizing ideas for products. The immersive experience of AR/VR tools may bring better engagement and a higher attention span to students. With a three-dimensional workspace, students can overcome the limitations of two-dimensional concept visualization. Interactive aspects of such technological tools bring better control benefits of color, orientation, size, and fast iteration in representing ideas. Live product experience will give students a closer view of their ideas with the final product at the early development stage. This paper investigates the benefits and challenges of adopting an AR/VR tool along with teaching conventional sketching methods for building the visualization skills of students. This study is an outcome of an elective course on Product visualization conducted as part of the Master of Design program at Avantika University.

Keywords: Product visualization, design education, augmented reality, virtual reality, immersive learning, pedagogy, creativity, Gravity Sketch, and collaboration

1. INTRODUCTION

To prepare students for professions in industries like industrial design, product design, architecture, and user experience (UX) design, design education always requires continuous updates. The development of good visualization abilities is essential to this education because it allows pupils to convert abstract concepts into tangible forms and functions. To teach these skills, design educators have traditionally used a combination of manual drawing, CAD modeling, and physical prototyping. Although these approaches have shown to be successful in some situations, they frequently need more immersive and interactive elements for students to understand the intricacies of three-dimensional design.

With the development of AR and VR technology, there is a rare chance to enhance traditional design pedagogy with hands-on, interactive, and immersive learning opportunities. Students can now explore design concepts in unthinkable ways in advance. Recent AR/VR tools have the power to simulate real-world locations and visualize surfaces/materials, and interactions. With an emphasis on product visualization, we investigate the transformative potential of AR and VR technological interventions in design education in this study (Chandrasekera and Yoon 1-13).

One objective of this paper is to understand how adopting new AR/VR technological methods for teaching will alleviate all the above dimensions with respect to individual Cognitive ability, Individual personality, physiological, psychological state, and internal emotional strength.

2. AR AND VR IN DESIGN EDUCATION

Technologies such as virtual reality (VR) and augmented reality (AR) provide new possibilities for experiential learning in design education. With AR/VR tools, students may handle virtual items in three-dimensional space and interact with them, unlike traditional teaching approaches that mostly rely on two-dimensional representations. In addition to improving students' spatial reasoning skills, this experiential learning method helps them develop a deeper comprehension of form, scale, proportion, and materiality.

When it comes to product visualization, AR/VR technologies let students examine virtual versions of their designs in a variety of settings, with varying lighting, and from different angles. Before committing to prototypes, students can find design problems, try different configurations, and make educated decisions by immersing themselves in these virtual settings.

Moreover, AR/VR technologies support cooperative design methods by letting students collaborate in real time on the creation of virtual prototypes. Students may easily communicate using AR/VR tools, whether they are in the same physical place or connected remotely over the internet. This fosters a culture of shared ownership, communication, and teamwork.

3. LEARNING METHODS

Each student has a unique learning style, and their response also varies for any lesson offered, but teaching materials play an important role in making learning effective. Good learning not only depends on students' learning style, but also depends on teaching materials used (Alan Pritchard). There is much research and many models proposed on learning styles. VARK learning style by Fleming (Drago and Wagner 1–13) focuses on Visual, Aural, Read or Write and Kinesthetic aspects of learning. In design education, Reading, writing, and auditory lessons help students to understand the background of assignment/need/idea, for which concepts to be generated. While generating ideation concepts or finding problem solutions, visual cue precedes over to visualize. Hand muscle movement and motor controls help translate visualization on paper in conventional sketching. With AR/VR tools, students can experience a completely new paradigm of immersive learning where visual and kinesthetic aspects are leveraged. Almost complete body movement get involve, giving high Kinesthetic experience.

In a study undertaken, four general dimensions of learning styles are identified (Drago and Wagner 1–13):

A. Cognitive
B. Affective
C. Physiological
D. Psychological

These four dimensions will be considered while assessing students' learning. Adopting new AR/VR teaching technology will improve individual motivation and higher physiological and psychological involvement.

4. AR/VR INTERVENTIONS' ADVANTAGES FOR DESIGN EDUCATION

There are numerous advantages for both instructors and students when AR/VR technology is used in design instruction. During our classroom experiments with AR/VR assignments, we observed several benefits among the students which are as follows:

a) **Enhanced Visualization Skills** Students' spatial reasoning and visualization skills are enhanced when they can see intricate design concepts in three dimensions. One can move the objects/products in a 3D virtual space to get a real-life user experience. It is not only expanding their imaginative thinking but also strengthening their form of understanding more rationally.
b) **Instant feedback** on design iterations is provided by AR/VR environments, enabling students to promptly see and resolve possible problems before they get out of hand. Rectifying the curves/surfaces/ forms is much quicker and easier and can be achieved with desired intentions with a great emotive jolt.
c) **Immersion Learning**: Students can study design principles in ways that are not possible with traditional teaching methods by immersing themselves in virtual worlds. This improves their comprehension and memory of the course material.

d) **Interdisciplinary Collaboration:** By enabling students from various disciplines to collaborate on common creative projects, AR/VR technologies foster interdisciplinary collaboration by encouraging the exchange of ideas and viewpoints. In our daily studio interactions, students were from Industrial design, Transportation design.

e) **Resource Optimization**: AR/VR technologies help to streamline the design process by eliminating the need for physical prototypes and travel expenses, which helps to save money and time for educators and students alike.

f) **Access to Remote Learning Opportunities**: Students in underserved or remote locations now have greater access to high-quality education thanks to AR/VR technologies, which allow them to take part in immersive learning experiences from anywhere in the world.

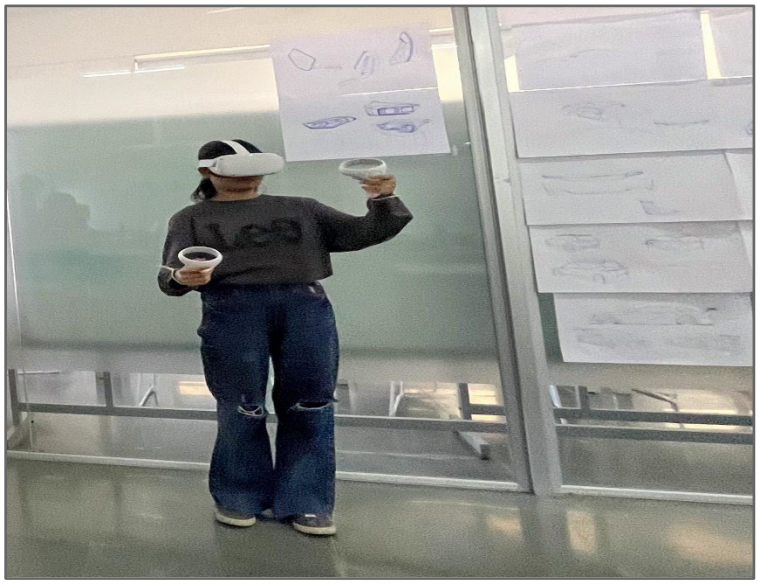

Fig. 1. Students wearing AR/VR 'Meta Quest' headset performing sketching.

Fig. 2. Students wearing AR/VR 'Meta Quest' headset work reflecting on screen.

COURSE DELIVERY - As part of a course on Product visualization, students were given a brief introduction to AR/VR tools in addition to conventional sketching methods. A module was developed for a class of seven students, to understand the comparative benefits of this technology in a better way and give a holistic virtual classroom experience to our design students. A total of five students participated in the course.

HARDWARE/SOFTWARE REQUIREMENTS

Meta quest-2 and Meta Quest Pro Headsets with pairing hardware such as large display for review and a latest computer system.

ASSIGNMENT

COLLABORATIVE DESIGN PROJECTS: All students were given the task of creating concepts of any product of their choice. Together they collaborate to develop concepts initially on paper and later iterate similar ideas using Gravity Sketch, an AR/VR tool. While students engaged in visualization and developing ideas, emphasis was also given to idea communication and collaboration.

Presentation: Students will practice presenting their design concepts in virtual environments, focusing on storytelling, visual communication, and the ability to articulate design rationale.

ASSESSMENT CRITERIA:

a) Creativity and Innovation: Assessing the originality and novelty of design concepts.
b) Technical Proficiency: Evaluating students' mastery of AR/VR tools and techniques.
c) Design Process: Assessing students' ability to iterate on designs, incorporate feedback, and refine their concepts.
d) Presentation Skills: Evaluating students' ability to effectively communicate their design ideas in virtual environments.
e) Collaboration and Teamwork: Assessing students' ability to collaborate with peers and contribute effectively to group projects.

These modules and assignments aim to provide students with a comprehensive understanding of AR/VR sketching and visualization techniques while equipping them with the skills necessary for successful careers in industrial and transportation design.

5. CHALLENGES AND CONSIDERATIONS

Although there is no denying the advantages of AR/VR interventions in design education, their successful adoption will depend on several factors, including:

a) **TECHNICAL COMPLEXITY:** At present, implementation of AR/VR technologies for teaching can be resource intensive, necessitating specialized training, hardware, software, and technical know-how. With time these would become more affordable and easily adoptable.
b) **FINANCIAL CONSTRAINTS**: Many educational institutions continue to face the financial problem of providing all students, regardless of socioeconomic level or geographic location, with equitable access to AR/VR technologies.
c) **PEDAGOGICAL INTEGRATION:** To ensure alignment with learning objectives in integrating AR/VR tools into current curriculum utmost care requires. Reviewing assessment techniques, instructional practices, careful planning, and collaboration must be considered before implementation.
d) **ETHICAL AND PRIVACY CONCERNS:** The use of AR and VR technology raises significant ethical and privacy issues about permission, data security, and surveillance. Data storage happens in cloud-based platforms with prevailed safety concerns. These issues need to be addressed with explicit regulations and guidelines.
e) **TRAINING AND PROFESSIONAL DEVELOPMENT**: To get familiar with AR/VR technology and create successful teaching practices, educators may need to take advantage of possibilities for training and professional development.

The potential advantages of AR/VR interventions in design education are too great to be disregarded, notwithstanding these difficulties. Through the integration of cutting-edge technologies and inventive teaching strategies, educators in the field of design can enable students to develop into imaginative, analytical, and socially conscious designers capable of addressing the intricate problems facing the 21st century.

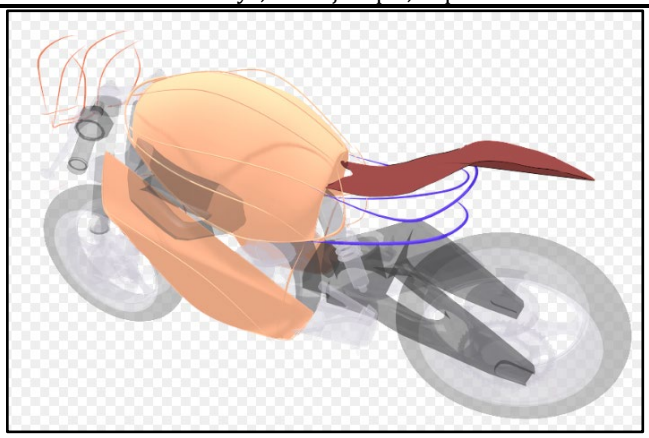

Fig. 3. Neeraj Setpal (Instruction sketch of Motorcycle)

STUDENTS WORKS:

Following images shows comparison of outcome though manual sketching vs AR/VR tool Gravity Sketch

MANUAL SKETCHES VS GRAVITY SKETCH

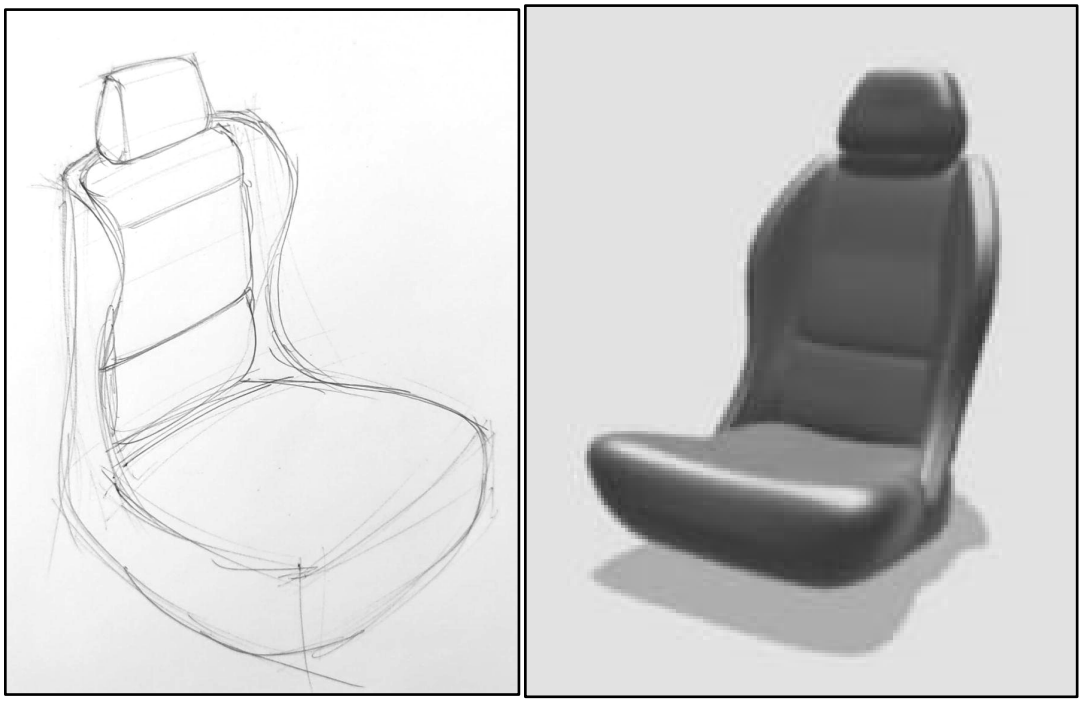

Fig. 4. Rohan Paradkar (Car seat)

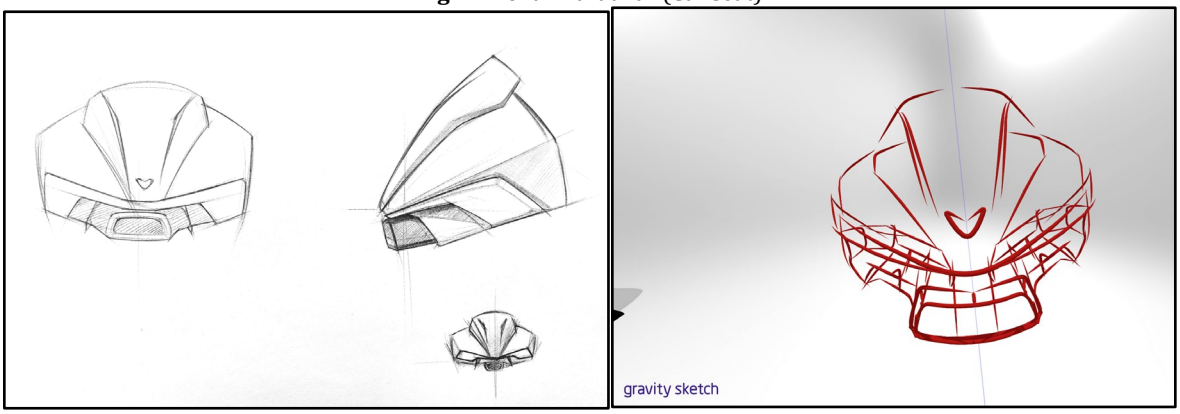

Fig. 5. Satyajit Shubhankar (Motorcycle headlamp)

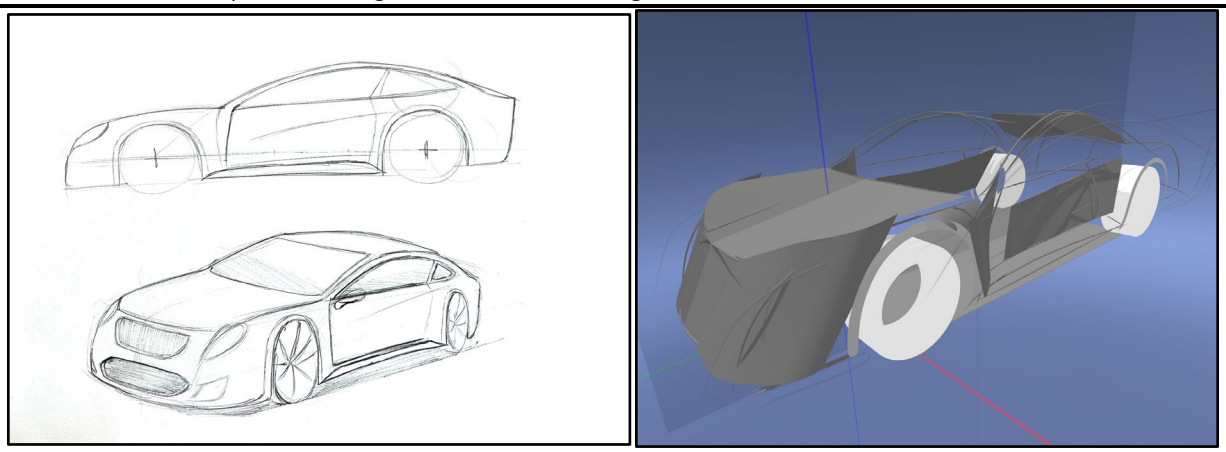

Fig. 6. Bhishmak Taunk (Sedan Car)

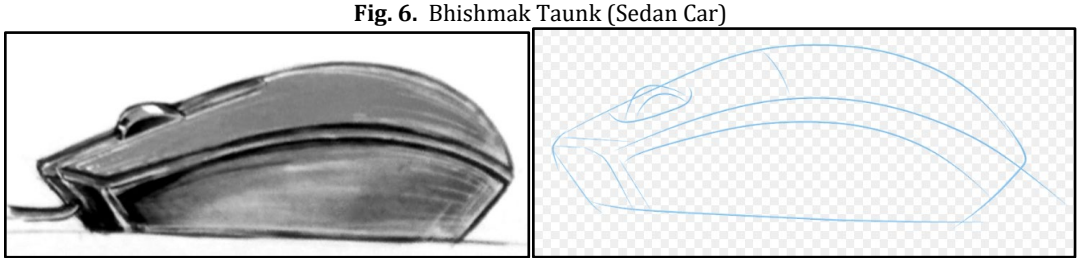

Fig. 7. Tanvi Singh (Sport Car)

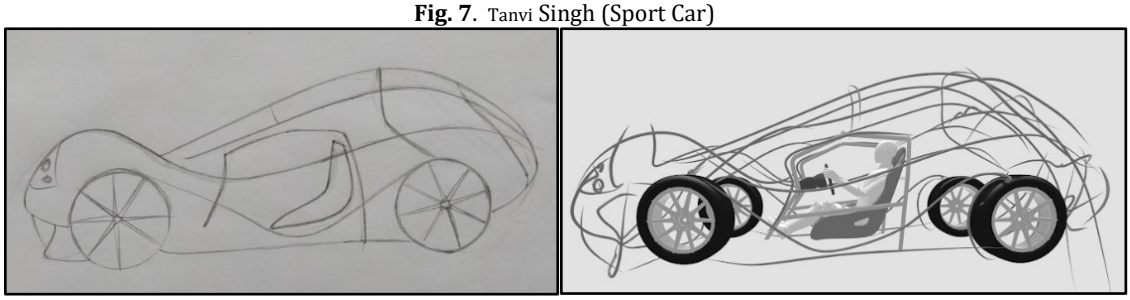

Fig. 8. Ankit Singh (Sport Car)

FEW COLLECTIVE FEEDBACK BY THE PARTICIPANTS ON MAKING A DESIGN CONCEPT WITH VR/AR METHODS ARE AS FOLLOWS:

1. Visualizing and making the product or any 3d model can be easy while using VR because one can see their products or models in an environment while looking at it at the same time.
2. Conventional processes need 3d modeling and rendering for visualizing. It can be an easy way to model or make a 3d model if someone is not that good at drawing or sketching. But on the other hand, good sketching can help one to make the model even better than conventional methods.
3. Using Gravity Sketch was totally a new and innovative experience to create and see ideas directly in a 3D space. The silhouette which is used to draw on a 2D surface - paper or digital, was possible to draw in 3D giving it the required depth with the stroke of my hand movement only. There was no requirement now to shade or give highlights to show the depth and curvature of a surface.
4. Giving initial volumes was a bit challenging to learn to do in a new atmosphere, while it also kept the constant interest to do better in this atmosphere. Provided ability to zoom, pan and rotate a 3D sketch with hand gesture movements, allowing anyone to understand the depth of curvature of line strokes and surfaces.
5. Surfacing, which takes a lot of hardship in CAD software was so much simpler to understand in Gravity Sketch - just draw two lines and using both the hands apply a surface between the two lines which feels like using sheet metal and applying it by hand. The curvature of the surface didn't even need a guide rail through its center to define the curvature as needed in CAD software. It was possible to just move our wrist in the angle of which the curvature is needed.
6. The templates given in the application for bikes and automobiles are helpful in designing their components over a pre-made chassis of the vehicle.

7. It is to believe that this application holds a great potential for designers in the industries. Be it product design or transportation design - this application gives a lot of freedom to give its users the accessibility to explore their ideas in a quick and effective manner. Gravity Sketch will save the time required in designing a form or product and will also provide a useful output required to show one's skills and ideas at the industrial level.

6. CONCLUSION

In conclusion, by giving students immersive, interactive, and experiential learning opportunities, AR/VR technologies have the potential to completely transform the field of design education. Design educators may improve students' visualization abilities, encourage interdisciplinary cooperation, and get them ready for professions in design and innovation by utilizing these tools.

Student feedback and observations as per VARK learning methods clearly indicate a longer attention span with higher kinesthetics involvement.

The revolutionary potential of AR/VR interventions in design education is evident, despite the remaining limitations. Educators, legislators, and industry stakeholders must collaborate to fully utilize AR/VR technology to build a more egalitarian, inclusive, and sustainable future for design education.

CONFLICT OF INTERESTS

None

ACKNOWLEDGMENTS

None

REFERENCE

Pritchard, Alan. Ways of Learning: Learning Theories for the Classroom. Routledge, 2018.

Drago, William A., and Richard J. Wagner. "Vark Preferred Learning Styles and Online Education." Management Research News, vol. 27, no. 7, 1 July 2004, pp. 1–13, doi:10.1108/01409170410784211.

Chandrasekera, Tilanka, and So-Yeon Yoon. "The Effect of Augmented and Virtual Reality Interfaces in the Creative Design Process." International Journal of Virtual and Augmented Reality, vol. 2, no. 1, Jan. 2018, pp. 1–13, doi:10.4018/ijvar.2018010101.