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Effectiveness of a 3ds Max Training Programme: A Pre-test and Post-test Study

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ABSTRACT

The increasing integration of computer-aided design (CAD) technologies in higher education has created a growing need for structured training in three-dimensional (3D) modelling and visualization software. However, empirical evidence regarding the effectiveness of Autodesk 3ds Max training among Community Science students remains limited. The present study evaluated the effectiveness of a 21-day Autodesk 3ds Max training programme conducted for undergraduate and postgraduate students of the Department of Resource Management and Consumer Science, I.C College of Community Science, CCS Haryana Agricultural University, Hisar. A one-group pretest–posttest research design was employed involving 30 participants (18 undergraduate and 12 postgraduate students). Participants' knowledge was assessed using a validated 30-item objective test administered before and after the training programme through Google Forms. Descriptive statistics and a paired-samples *t*-test were used to analyse the data. The findings demonstrated a substantial improvement in participants' knowledge following the training programme. The mean test score increased from 2.1 to 25.0 out of 30, while the average percentage score improved from 7.0% to 84.2%, representing an overall learning gain of 77.2%. Prior to the intervention, all participants were classified in the very low performance category, whereas after training the majority achieved high performance scores. The paired-samples *t*-test indicated a highly significant improvement in knowledge following the intervention ($t = 18.36$, $p < 0.001$), confirming the effectiveness of the structured training programme. The study concludes that hands-on training in Autodesk 3ds Max significantly enhances students' knowledge and digital design competencies in 3D modelling and interior visualization. Integrating professional CAD software training into Resource Management and Consumer Science curricula can strengthen students' practical skills, improve digital competencies, and enhance their employability in design-related professions.

Keywords: Autodesk 3ds Max, Computer-aided design, CAD training, Interior visualization, Pretest–posttest

INTRODUCTION

The rapid advancement of information and communication technologies has transformed the teaching-learning process across higher education. In design-oriented disciplines, computer-aided design (CAD) software has become an indispensable tool for developing visualization, modelling, and presentation skills. The integration of digital technologies into educational programmes enables students to acquire practical competencies that meet the evolving demands of industry and professional practice (Dalton, 2016; McConnell and Waxman, 1999).

Among the various CAD applications, Autodesk 3ds Max is widely recognized for its powerful capabilities in three-dimensional modelling, rendering, animation, lighting, and interior visualization. The software is extensively used in architecture, interior design, product design, gaming, and multimedia industries because it allows users to create realistic virtual environments and simulate design concepts before implementation (Autodesk, 2025). Consequently, proficiency in 3ds Max has become an important employability skill for students pursuing design-related programmes.

Within the discipline of Resource Management and Consumer Science, visualization plays a significant role

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in interior space planning, furniture layout, ergonomic design, and residential environment planning. Traditionally, students relied on manual drawings and two-dimensional representations to communicate design ideas. However, these methods often fail to provide a realistic understanding of spatial relationships and design aesthetics. Three-dimensional visualization software bridges this gap by enabling students to transform conceptual ideas into interactive digital models, thereby enhancing creativity, problem-solving ability, and decision-making skills (Waxman and Zhang, 1995). Skill-oriented training programmes have increasingly been adopted in higher education to improve students' practical competencies and digital literacy. Hands-on learning approaches provide opportunities for students to actively engage with software applications through demonstrations, guided practice, and project-based assignments. Such experiential learning methods have been reported to improve conceptual understanding, learner motivation, confidence, and long-term retention of technical skills (Dalton, 2016).

Several studies have demonstrated the educational benefits of integrating 3D modelling software into university curricula. Li, Songsiengchai, and Mascarinas (2025) reported that structured training in 3ds Max significantly enhanced students' technical competence, creative thinking, and software proficiency in art education. Similarly, research on theatre design education found that students receiving 3ds Max-based instruction performed significantly better than those taught through conventional methods, highlighting the effectiveness of computer-assisted learning in developing professional design skills (Hassan and Ali, 2018). Previous research has demonstrated that hands-on and problem-based instructional approaches are more effective than traditional lecture-based methods in teaching computer-aided design (CAD), as they promote greater student engagement, creative thinking, and problem-solving skills (Kurt, 2015).

Research has also shown that the application of CAD and 3D modelling software contributes positively to the development of spatial visualization abilities and design performance. Students who participate in structured CAD-based learning environments demonstrate improved understanding of three-dimensional concepts, greater accuracy in design visualization, and enhanced confidence in solving practical design problems (McConnell and Waxman, 1999). Furthermore, CAD-supported instruction encourages independent learning by allowing learners to experiment with different design alternatives and receive immediate visual feedback.

Despite the increasing importance of digital design technologies, formal training in advanced visualization software remains limited in many Community Science and Resource Management programmes in India. Students often possess only basic computer literacy and have limited exposure to professional 3D modelling applications. Consequently, there is a need for structured training programmes that can develop both conceptual understanding and practical skills required for contemporary interior planning and visualization.

Evaluation of training programmes is essential to determine whether learning objectives have been achieved. Among educational research designs, the pretest–posttest approach is widely employed to assess changes in participants' knowledge and competencies before and after an intervention. Comparing pre-training and post-training performance provides objective evidence regarding the effectiveness of instructional programmes and facilitates data-driven improvements in curriculum design.

Considering the growing relevance of digital visualization technologies and the limited availability of structured training opportunities for Community Science students, the present study was undertaken to evaluate the effectiveness of a 21-day 3ds Max training programme conducted for undergraduate and postgraduate students of the Department of Resource Management and Consumer Science, College of Community Science, CCS Haryana Agricultural University, Hisar. The study specifically examined participants' profile, changes in knowledge level, performance distribution, and overall effectiveness of the training through a pretest–posttest evaluation design

Objectives

1. To study the profile of the participants.
2. To assess students' knowledge of 3ds Max before and after training.
3. To analyze students' performance levels before and after training.
4. To evaluate the effectiveness of the 3ds Max training programme**.**

Reviews of literature

Computer-Aided Design (CAD) in Design

Education

Computer-aided design (CAD) has become an essential component of design education, enabling students to develop visualization, technical drawing, and problem-solving skills that are required in professional practice. The integration of CAD software into academic curricula has transformed conventional teaching methods by providing interactive digital environments in which students can conceptualize, modify, and visualize design ideas with greater accuracy. McConnell and Waxman (1999) emphasized that three-dimensional CAD enhances students' visualization abilities and presentation skills, thereby improving both academic performance and professional preparedness. Similarly, Waxman and Zhang (1995) reported that systematic CAD instruction strengthens technical competence by allowing students to apply theoretical knowledge in practical design situations.

Autodesk 3ds Max and Digital Design Competencies

Among the various CAD applications available today, Autodesk 3ds Max is widely recognized for its advanced capabilities in three-dimensional modelling, rendering, animation, lighting, and interior visualization. Its extensive application in architecture, interior design, product visualization, gaming, and multimedia industries has increased the demand for graduates who possess professional-level software skills. Li *et al.* (2025) demonstrated that structured training in Autodesk 3ds Max significantly improved students' technical competence, creative thinking, and software proficiency in art education. Their findings suggest that practical exposure to professional visualization software enables learners to translate conceptual ideas into realistic digital models while improving design creativity and technical confidence.

Similarly, research conducted in theatre design education reported that students who received instruction through Autodesk 3ds Max achieved significantly better design performance than those taught using conventional instructional methods. The study concluded that computer-assisted visualization enhances students' ability to understand spatial relationships, create realistic environments, and communicate design concepts more effectively (The Effect of 3DS Max in Developing the Skill of Designing Theatrical Decoration among the Students of the Department of Art Education, 2018).

Effectiveness of Practical and Technology-Supported Learning

Recent educational research consistently demonstrates that experiential and practice-oriented learning approaches produce better learning outcomes than traditional lecture-based instruction. Kurt (2015) found that collaborative and problem-based instructional strategies significantly improved students' learning outcomes in CAD education because learners actively engaged in solving practical design problems rather than passively receiving information. Likewise, Woo and Lam (2020) reported that structured three-dimensional CAD instruction substantially enhanced students' modelling competence, design accuracy, and overall learning performance.

Technology-supported learning environments also facilitate independent learning by providing immediate visual feedback and opportunities for continuous experimentation. Liu *et al.* (2023) observed that self-directed learning supported by three-dimensional modelling technologies significantly improved students' motivation, learning achievement, and digital competencies. Gill *et al.* (2006).These findings indicate that combining instructor guidance with practical assignments promotes deeper conceptual understanding and long-term retention of technical skills.

Digital Technologies and Creativity in Design Education

Recent advances in digital technologies have expanded the scope of design education beyond conventional CAD applications. Immersive technologies, visualization tools, and digital feedback systems have been shown to enhance creativity, collaborative learning, and student engagement. Huang and Wang (2022) reported that digital design instruction significantly improved students' creativity, spatial visualization, and learning motivation by providing opportunities to experiment with design alternatives in virtual environments. Similarly, Çoruh (2025) concluded that immersive digital creation environments foster collaborative learning and creative thinking while increasing learners' engagement throughout the design process.

The integration of virtual reality and digital visualization technologies has also demonstrated positive effects on students' understanding of interior spaces. Wu *et al.* (2025) found that visualization technologies improved students' spatial understanding, visual

communication skills, and overall learning experiences in interior design education. Furthermore, Yoon *et al.* (2025) reported that structured CAD instruction supported by continuous technology-enabled feedback significantly improved modelling accuracy, learning efficiency, and academic performance.

Research Gap

The reviewed literature clearly demonstrates that CAD software and digital visualization technologies contribute significantly to students' technical competence, creativity, visualization skills, and learning achievement. However, most previous studies have been conducted in architecture, engineering, art, and interior design programmes. Empirical evidence regarding the effectiveness of structured Autodesk 3ds Max training within Resource Management and Consumer Science education remains limited, particularly in the Indian higher education context. In addition, relatively few studies have evaluated short-duration skill-development programmes using a one-group pretest–posttest design to measure changes in students' knowledge following structured software training.

Therefore, the present study addresses this gap by evaluating the effectiveness of a 21-day Autodesk 3ds Max training programme conducted for undergraduate and postgraduate students of the Department of Resource Management and Consumer Science, I.C. College of Community Science, CCS Haryana Agricultural University, Hisar. The study provides empirical evidence regarding the impact of structured hands-on training on students' knowledge and digital competencies, thereby contributing to the growing body of literature on technology-enhanced learning in Community Science education.

METHODOLOGY

Participants

The study was conducted on a total of 30 students from the Department of Resource Management and Consumer Science, College of Community Science, CCS Haryana Agricultural University, Hisar. The participants included both undergraduate (UG) and postgraduate (PG) students, of which 18 were UG students and 12 were PG students. All participants were enrolled in a 21-day training programme on 3ds Max, conducted from 05 February 2026 to 07 March 2026 at the Departmental Computer Laboratory. The training sessions were held daily from 12:00 noon to 2:00 p.m. The participants were selected based on their interest in the training programme and their basic knowledge of computer applications.

Training Design

The training programme was designed to provide a balanced combination of theoretical instruction and practical exposure to Autodesk 3ds Max. A hands-on, practice-oriented approach was adopted, with each session comprising instructor demonstrations followed by guided practical exercises. The programme was conducted over 21 days and focused on developing participants' knowledge and practical skills in 3D modelling, rendering, and interior visualization.

The training content was organized into the following modules:

- Introduction to the interface and navigation (viewports, tools, and command panel)
- 3D modelling techniques (primitives, editable poly, and modifiers)
- Object management (grouping, layers, hierarchies, and linking)
- Materials and texturing (Material Editor, UVW mapping, and texture application)
- Lighting techniques (standard and photometric lighting)
- Camera setup and composition
- Rendering techniques using built-in and advanced renderers
- Interior visualization and scene creation
- Basic animation concepts and post-processing techniques

To reinforce learning outcomes, participants completed practical exercises and project-based assignments related to each training module, including the creation of 3D models and interior scenes. Students were required to submit their assignments for evaluation, allowing continuous assessment of their progress throughout the programme. Constructive feedback was provided after each assignment to improve participants' modelling, texturing, lighting, rendering, and visualization skills. This continuous practice-and-feedback approach promoted independent learning, creativity, problem-solving ability, and the practical application of Autodesk 3ds Max in design-related tasks.

Data Collection

To evaluate the effectiveness of the Autodesk 3ds

Max training programme, a one-group pre-test–post-test assessment was conducted using Google Forms. On the first day of the training programme, participants completed the registration process and received a registration kit containing the training schedule, a writing notepad, and a pen. The registration kit was provided to facilitate active participation and note-taking throughout the training programme. Following registration, the participants completed a pre-test comprising 30 objective-type questions designed to assess their baseline knowledge of Autodesk 3ds Max. After the successful completion of the 21-day training programme, the same questionnaire was administered as a post-test to evaluate the knowledge gained through the intervention. The responses were automatically recorded through Google Forms and exported for statistical analysis.

Data Analysis

The collected data were analyzed using descriptive and inferential statistical methods.

- Descriptive statistics such as mean scores and percentages were calculated to summarize the data.
- A paired t-test was applied to examine the statistical significance of the difference between pre-test and post-test scores.

All analyses were performed to evaluate the effectiveness of the training programme in enhancing students' knowledge and skills.

Plate 1 : Glimpses of the Training Programme

RESULTS AND DISCUSSION

The effectiveness of the 21-day Autodesk 3ds Max training programme was evaluated by comparing participants' knowledge before and after the intervention using descriptive statistics and a paired-samples *t*-test. The findings are presented below.

Participant Profile

A total of 30 students participated in the training programme, comprising 18 undergraduate (60%) and 12 postgraduate (40%) students. The participation of both academic levels provided an opportunity to evaluate the effectiveness of the training programme among students with different educational backgrounds. The distribution indicates that the programme successfully attracted learners from both undergraduate and postgraduate programmes, thereby enhancing its applicability across different academic levels (Table 1 and Fig. 1).

Table 1 : Distribution of Participants

Category	Frequency	Percentage (%)
Undergraduate students	18	60.0
Postgraduate students	12	40.0
Total	30	100.0

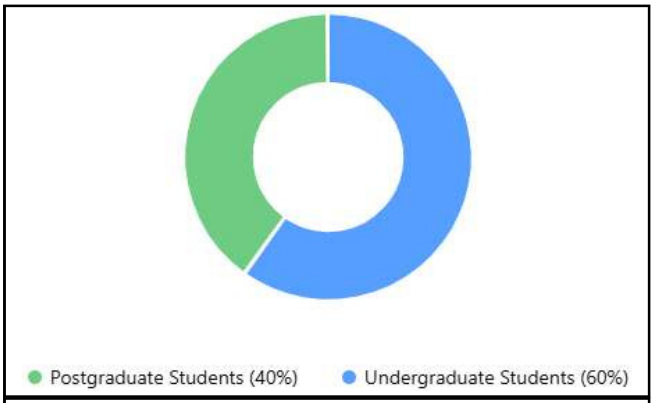

Fig. 1 : Distribution of Participants

The results indicate that undergraduate students constituted the majority of participants, although postgraduate students also represented a substantial proportion of the sample.

Comparison of Pre-test and Post-test Performance

The participants' knowledge of Autodesk 3ds Max was assessed before and after completion of the training programme. A considerable improvement was observed in the post-test scores (Table 2).

Table 2 : Comparison of Pre-test and Post-test Performance

Parameter	Pre-test	Post-test
Number of participants	30	30
Maximum score	30	30
Total correct responses	63	758
Mean score	2.1	25.0
Mean percentage	7.0%	84.2%
Overall improvement	—	77.2%

The findings demonstrate a remarkable increase in students' knowledge following the training programme. The average score increased from 2.1 to 25.0 out of a maximum of 30 marks, while the average percentage score improved from 7.0% to 84.2%. The total number of correct responses increased from 63 during the pre-test to 758 during the post-test, indicating a substantial improvement in conceptual understanding and software knowledge. The overall learning gain of 77.2% clearly demonstrates the effectiveness of the structured hands-on training programme.

Distribution of Students According to Performance Level

Students' performance was further analysed by classifying their scores into four performance categories (Table 3).

Table 3 : Distribution of Students According to Performance Level

Score Range (Out of 30)	Pre-Training (N=30)	Post-Training (N=30)
0 – 5 (Very Low)	30	2
6 – 10 (Low)	0	5
11 – 20 (Average)	0	5
21 – 30 (High)	0	18

The distribution of students' performance clearly demonstrates the positive impact of the training programme. Before the intervention, all participants were classified within the very low performance category, indicating limited prior knowledge of Autodesk 3ds Max. Following the training, most participants achieved scores within the high-performance category, reflecting substantial improvement in conceptual understanding and practical knowledge. This shift from the lowest to the highest performance category illustrates the effectiveness of the structured instructional approach adopted during the programme.

Statistical Analysis of Learning Outcomes

To determine whether the observed improvement in knowledge was statistically significant, a paired-samples *t*-test was conducted (Table 4).

Table 4 : Paired-Samples *t*-test Results

Parameter	Value
Mean pre-test score	2.1
Mean post-test score	25.0
t-value	18.36
p-value	<0.001

The paired-samples *t*-test revealed a highly significant difference between the pre-test and post-test scores ($t = 18.36$, $p < .001$), indicating that the improvement in students' knowledge was statistically significant. Therefore, the null hypothesis of no difference between pre-test and post-test scores was rejected, confirming that participation in the 21-day Autodesk 3ds Max training programme significantly enhanced students' knowledge and understanding of three-dimensional modelling and interior visualization.

Overall Learning Gain

The magnitude of improvement achieved through the training programme was assessed by comparing the average pre-test and post-test scores (Table 5).

Table 5 : Overall Learning Gain

Indicator	Value
Mean score increase	2.1 → 25.0
Percentage increase	7.0% → 84.2%
Overall learning gain	77.2%

The overall learning gain demonstrates that the training programme produced a substantial improvement in students' knowledge and technical competence. The increase in mean scores and percentage achievement indicates that the structured combination of demonstrations, guided practice, and hands-on assignments effectively facilitated knowledge acquisition and skill development. These findings suggest that integrating professional CAD software training into Community Science education can significantly strengthen students' digital competencies and better prepare them for academic and professional applications in interior design and visualization.

The present study demonstrated that the 21-day structured 3ds Max training programme significantly

improved the knowledge and performance of undergraduate and postgraduate students. The substantial increase in mean scores from 2.1 before training to 25.0 after training, together with an overall improvement of 77.2%, indicates that the programme effectively enhanced participants' understanding of 3D modelling and interior visualization concepts. Furthermore, the statistically significant difference between pre-test and post-test scores ($t = 18.36$; $p < 0.001$) confirms that the observed improvement was attributable to the training intervention rather than chance.

The findings are consistent with Li *et al.* (2025), who reported that structured 3DS Max training significantly improved students' technical skills, creative abilities, and software proficiency in art education. Both studies demonstrate that systematic instruction combined with practical exercises effectively enhances students' competence in professional 3D modelling software.

The shift in students' performance levels further supports the effectiveness of the training programme. Prior to training, all participants scored within the very low performance category, indicating minimal prior exposure to 3ds Max. Following the training, the majority achieved high performance scores, reflecting considerable improvement in conceptual understanding and practical application of the software. This transition suggests that a structured learning environment supported by demonstrations, guided practice, and hands-on assignments facilitates meaningful skill acquisition.

These findings corroborate those of Kurt (2015), who concluded that practical, problem-based, and collaborative instructional approaches are more effective than conventional lecture-based methods in improving CAD learning outcomes. Similarly, Woo and Lam (2020) found that structured CAD instruction significantly enhanced students' modelling competence and learning performance, emphasizing the value of experiential learning in design education.

The improvement observed in the present study may also be attributed to the practical nature of the training programme. Participants were actively engaged in creating three-dimensional objects, applying materials and textures, setting up lighting, rendering scenes, and developing interior visualizations throughout the 21-day programme. Such activity-based learning likely promoted deeper understanding and retention of software concepts while increasing learners' confidence in applying newly acquired skills (Fig. 2).

Fig. 2 : Practical assignments completed by students during the 3ds Max training programme

The present findings are also supported by McConnell and Waxman (1999), who emphasized that three-dimensional CAD has become an essential component of interior design education because it enhances visualization, communication, and presentation skills. Likewise, Waxman and Zhang (1995) highlighted that systematic CAD training strengthens students' technical competence and professional preparedness by providing opportunities to apply theoretical knowledge in practical design contexts.

Recent studies further reinforce these observations. Liu *et al.* (2023) reported that self-directed learning supported by three-dimensional modelling technologies improves students' motivation, learning achievement, and digital competencies. Although the present training programme was instructor-guided, the continuous practical assignments encouraged independent exploration of software tools and problem-solving, which may have contributed to the substantial learning gains.

Similarly, Yoon *et al.* (2025) demonstrated that

structured 3D CAD instruction supported by continuous feedback significantly improved students' modelling accuracy and academic performance. Although automated feedback was not incorporated into the present programme, instructor guidance and regular practice sessions appear to have produced comparable improvements in learning outcomes.

Overall, the findings indicate that structured, practice-oriented training in Autodesk 3ds Max is highly effective in enhancing students' knowledge, technical competence, and confidence in digital interior visualization. Integrating such professional software training into the curriculum of Resource Management and Consumer Science can strengthen students' employability, improve digital design competencies, and better prepare them for contemporary professional practice in interior design and related fields.

Conclusion

The present study evaluated the effectiveness of a 21-day Autodesk 3ds Max training programme conducted for undergraduate and postgraduate students of the Department of Resource Management and Consumer Science, CCS Haryana Agricultural University, Hisar, using a one-group pretest–posttest research design. The findings revealed a substantial and statistically significant improvement in participants' knowledge following the training programme. The mean test score increased from 2.1 in the pre-test to 25.0 in the post-test, representing an overall learning gain of 77.2%. Furthermore, the paired-samples t-test confirmed that the improvement was highly significant ($t(29) = 18.36$, $p < .001$), demonstrating the effectiveness of the structured training intervention.

The marked shift in students' performance from the very low category before training to predominantly high performance after training indicates that systematic, hands-on instruction can effectively enhance learners' understanding of three-dimensional modelling, rendering, and interior visualization concepts. The combination of instructor demonstrations, guided practice, practical assignments, and continuous feedback created an engaging learning environment that promoted active participation, technical competence, and confidence in using professional CAD software.

The findings highlight the educational value of integrating Autodesk 3ds Max into the Resource Management and Consumer Science curriculum. Structured digital design training not only improves students' knowledge and practical skills but also strengthens digital literacy, creativity, spatial visualization, and problem-solving abilities that are essential for contemporary interior design practice. Such competencies are increasingly demanded in both academic and professional settings, making CAD-based learning an important component of higher education.

Overall, the study provides empirical evidence that structured Autodesk 3ds Max training is an effective strategy for developing digital design competencies among Community Science students. Incorporating similar technology-enabled training programmes into university curricula can enhance students' employability, support outcome-based education, and better prepare graduates to meet the evolving technological requirements of the design and built environment sectors.

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