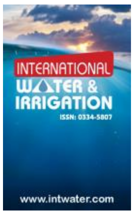

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Professional Group Construction Model of Higher Vocational Education Based on Artificial Intelligence Technology

Xiaoyan Quan[1*] and Lijuan Xu [2]

[1]Digital Marketing Industry College, Shandong Institute of Commerce and Technology, Jinan, Shandong, 250103, China
[2]Department of Academic Affairs, Shandong Institute of Commerce and Technology, Jinan, Shandong, 250103, China
xandyquan@163.com

Abstract. This research uses 120 students from automotive engineering, nursing, and IT programs - an experimental and a control group - to explore the integration of AI-driven adaptive learning systems and VR simulations in higher vocational education. Results demonstrate that the experimental group using AI and VR technologies made substantial knowledge gains and achieved better final assessment scores than the control group. The practical skills of students show a marked increase in modules trained using VR, especially with decreasing time to complete and greater accuracy. Moreover, students under training in the experimental group appear more enthusiastic and engaged. Thus, AI and VR can make vocational education a new thing by allowing students to have personal, immersive, and engaging ways of learning that are matched exactly to their educational needs.

Keywords: Artificial Intelligence (AI), Virtual Reality (VR), Adaptive Learning, Vocational Education.

1 Introduction

Blending the old pedagogy and AI will give a different twist to the teaching and learning paradigms in contemporary higher vocational training, requiring professional workers and offering a competency of both theoretical and practical skills [1, 2]. The labour market gradually changing in response to new patterns of learning with AI brought in at specific, adjustable, and experiential levels [3]. From the viewpoints of higher vocational education, it bridges between theory and practice from college and fills with the appropriate professional qualification for student pursuits in practice [4]. Thus, conventional teaching approaches are challenged by the fast-changing demands of business environments, which may conflict with the needs of the workforce and educational outputs [5]. Incidence is so widespread that institutions resort to AI-driven technologies, such as virtual reality (VR) simulations and adaptive learning systems, to make vocational education relevant, effective, and engaging [6].

The professional group construction model, the organizing framework for vocational programs is an example of creating cohesive units that are believed to encourage interdisciplinary integration and collaborative learning [7].

This model becomes even more dynamic using AI with insights from data used to drive optimizing curriculum development and customized learning experiences [8]. The paper will explore the use and influence of an AI and VR-improved professional group construction model in the context of higher vocational education and contribute towards a new approach to vocational training practices [9]. With empirical analysis, analyzing those technologies, this paper describes all the possible opportunities offered by AI and VR in restructuring vocational education's future and preparing students for a well-prepared transition to the workforce [10].

2 Related Work

The incorporation of AI in adaptive learning systems has been one of the many trendy research areas, with successful implications in offering instructional content suited to the individual needs of the students and enhancing engagement and retention in higher education [11]. Adaptive learning has been very successful in vocational education, bridging gaps in theoretical knowledge with practical skills. For instance, Lin and Hsieh pointed out that AI-based personalization in the vocational training program to master complex skills was enhanced significantly through continuous evaluation and feedback [12]. Similarly, virtual reality is effective in providing immersive learning, thereby enriching experiential learning through scenarios analogous to real events, thus effectively composing vocational training programs [13].

These studies have established that VR not only improves the retention of information but also motivates students towards active engagement, especially in high-stakes training environments [14]. Further, studies reveal that recent combinations of AI-driven personalized learning combined with VR simulations lead to enhanced knowledge about the theories as well as practical skills among the students of vocational programs such as nursing [15]. Pilot studies on automotive engineering reveal similar findings: improvements in the performance as well as the satisfaction of the students due to AI-assisted VR learning [16].

3 Methodology

The development of a professional group model at higher vocational education using AI is represented by the involvement of virtual reality and adaptive learning systems that would create a dynamic, tailored learning environment. Preparing a professional group model is initiated by a collection of data from different sources, followed up by an AI-driven analysis of trends and shortages in skills, thereby allowing the educators to start working on curricula according to the current and future needs of the labour market and the possibility of adding knowledge from other disciplines and practical skills.

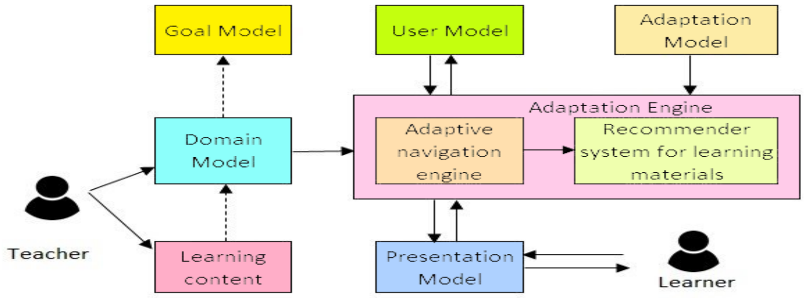

Fig. 1 Adaptive learning

AI provides tools that make curriculum mapping efficient and industry-standard-aligned. Adaptive learning technologies change the face of education, personalizing experiences for each student, tracking mistakes, flaws, or a pace that is picked up or slowly appreciated over time for every student, so that a lesson, and evaluation can be tailored to fit in maximum gains from each student's potential. Such immersive VR simulation, developed with industry experts, gives students practical experience in a safe environment and further heightens the relevance and applicability of the learning process. AI with VR produces a dynamic educational framework that actively supports the development of students.

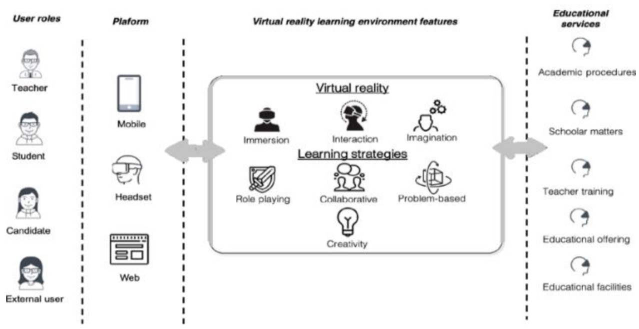

Fig. 2. Integration of Virtual Reality

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The immersive nature of VR allows students to work on problems in real-world contexts, thereby developing their skills and abilities and acquiring deep knowledge. Such VR promotes multidisciplinary collaboration by encouraging a group of students across specializations to work collaboratively to deliver virtual projects, which develops important soft skills involving communication and teamwork. Integrated assessment tools within the VR platform provide instant feedback on decision-making and technical competencies to further inform the adaptive learning process. Pilot projects are undertaken to evaluate and tailor the adoption of VR with adaptive learning as per the industry partners' and teachers' feedback. The support from an institution is also crucial for its proper integration, such as effective funding for the technology, continued maintenance, and faculty training for working within these new environments. AI systems and VR modules must be updated regularly to assimilate industry-level developments.

4 Experimental Setup

To test the model of building a professional group in high vocational education, 120 students from Automotive Engineering, Nursing, and Information Technology were used for an experiment over 16 weeks. In this context, the experimental group used AI-driven adaptive learning combined with VR, while the control group followed traditional methods.

$$A_i = \sum_{j=1} \omega_j . S_{ij} \quad (1)$$

The student who was evaluated as student (i) would have an initial evaluation grade assigned by $A_i = \sum_{j=1}$ based on weights for each question, with a weight based on how challenging the question is and how the student (i) scores on the question (j), thus providing personalized learning paths.

$$minP_i \left(\sum_{k=1}^{m} C_k . T_{ik}\right) \quad (2)$$

The learning path of the student (i) can be thought of as the cost of the learning module (k), and of course, the expected time (Tik) would then be the price that student (i) is likely to pay to master module (k) and this can be calibrated to observe the learner.

$$CA_i\,(t) = \sum_{l=1}^{p(t)} (a_1 . A_{il}(t)) \quad (3)$$

Every single assessment was weighted according to how important it was, and the score for the continuous assessment at time t, CAi(t), was calculated. For experiences related to each vocational program, simulations in VR were prepared. Student performance metrics in the experimental group were collected throughout the semester in both groups.

$$KG_i = FA_i - IA_i \quad (4)$$

Therefore, the knowledge acquired by the student was computed as the variation between the final assessment score, (FA), and the initial assessment score, (IA). It also took into account improvement in the performance metrics of accuracy, completion time, and error rates in practical tasks.

$$PSI_i = \frac{1}{q} \sum \left(PT^{(r)^q} - BT_i^{(r)} \right) \quad (5)$$

where PSIi is the practical skills improvement for students i, q is the number of tasks. Measured through surveys and engagement metrics within the learning platform.

5 Results

The experiential research was established to examine the virtual reality and artificial intelligence-based model of professional construction. In a study, an experimental group of students utilized AI and VR-based methodology in professional construction in higher vocational education, whereas their peers had to rely on traditional methods in the control group. Data on engagement, satisfaction, development of skills, and knowledge acquisition for the students were collected. The IA score of the test result from the experimental group was 62.5 (±8.3), while in the control group, it was 61.8 (±8.7) with no significant difference between them. Contrarily, the two groups manifested a significant increase in FA scores, as their average in the experimental group stood at 85.4 (±7.2), while that of the control group was 74.3 (±9.1). Knowledge gained exhibited more traits in the experimental group, given a value of 22.9, than in the control group, where the value was 12.5.

PSI was evaluated based on the real-world accomplishment of the activities. In the case of Automotive Engineering, the experimental group reduced the actual time it would take to accomplish an extensive diagnosis task in an engine from 45 minutes ±5.2 to 30 minutes ±4.1. The control group reduced from 46 minutes ±5.4 to 40 minutes ±4.8. Accuracy rates improved from 70% to 90% for the experimental group while that for the control group increased from 72% to 80%.

Table 1. Comparison of Student Performance Metrics in Experimental and Control Groups

Metric	Experimental Group	Control Group
Initial Assessment Score (IA)	62.5	61.8
Final Assessment Score (FA)	85.4	74.3
Knowledge Gain	22.9	12.5
Completion Time (Automotive)	30min	40 min
Accuracy (Automotive)	90%	80%
Error Rate (Nursing)	5%	12%
Completion Time (IT)	60 min (±6.5)	62 min (±6.8)
Accuracy (IT)	85%	75%
Engagement Level	4.7 out of 5	3.9 out of 5
Satisfaction Level	4.6 out of 5	4.0 out of 5

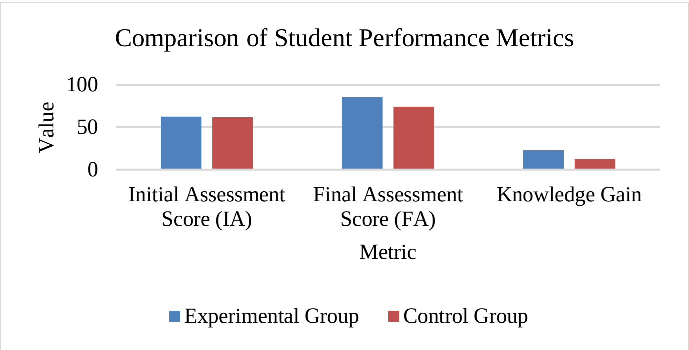

Fig.1. Comparison of Student Performance Metrics

In nursing simulations, the error rates in the experimental group dropped from 15% to 5%. This was when the control group declined their error rates from 16% to 12%. For Information Technology, an average time of 60 minutes (±6.5) worked better with the experimental group than that recorded with the control group, which worked for about 62 minutes ±6.8. An improvement accuracy rate increase from 65% to 85% was realized in the experimental group and from 67% to 75% in the control group.

The post-semester survey revealed higher levels of engagement in the experimental group with a score of 4.7 out of 5 in comparison to the control group which scored 3.9 out of 5. Satisfaction with the learning process was also

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shown to be in favour of the experimental group with a rating of 4.6 out of 5 compared to the control group with a rating of 4.0 out of 5.

6 Discussion

The above findings of the experimental study reflect the success of the integration of VR and adaptive learning systems as one form of AI in higher vocational education. The huge gain in knowledge shown by the experimental group suggests that AI-based adaptive learning aids theoretical mastery. This is by other related research studies that held adaptive learning in very high esteem, strongly arguing that adaptive learning is worthwhile only when instruction may be varied to honour the needs of different students to produce a better educational result and career preparation. Moreover, completion times were lower for the experimental group, and accuracy rates increased with VR simulation, showing strength in immersive learning. With capabilities to perform such high-stakes activities as healthcare diagnosis and engine systems safely, VR establishes an excellent platform for hands-on learning and better retention. The study is also in line with the previous studies that discuss the benefits of VR in vocational training, especially in risky practices, and thus points to some of the good collaboration.

Better student satisfaction and engagement levels in the experimental group signify positive effects of AI and VR on the learning experience. The interactive nature of the simulation across VR captured the attention of students and enhanced active participation. In addition, the system using adaptive learning ensured students received the kind of educational pathway that transformed preferences and shaped their feeling of ownership in learning. The one-semester duration may create a constraint on the impacts that can be observed, thereby warranting longitudinal studies to determine long-term effects on learning outcomes and employability due to this integration of AI and VR. The sample size and context of the study also suggest that experiments must be conducted in various strands of education and vocational training to get the results validated for the various contexts across the board.

7 Conclusions

This study demonstrates the effectiveness of the adaptation of artificial intelligence, primarily adaptive learning systems and virtual reality, in higher vocational education. AI-augmented construction of professional groups enhances students' theoretical knowledge as well as practical capabilities. Adaptations provided by the adaptive system lead to identified gains in knowledge for a given individual student.

High realistic learning experiences have proven to be one of the advantages of VR simulations in improving performance for high-stakes tasks across vocational programs. Findings show how AI and VR can shape the modern landscape of vocational training as they cater to the requirements of the contemporary workforce. Educational institutions embracing these technologies will provide dynamic and highly interactive environments that enable students to be well-prepared for careers.

The findings must be replicated in other learning settings, while the long-term implications of a curriculum that includes AI and VR for the success of the students must be considered. In a way, it has been much further forward than vocational education when it uses VR simulation, and adaptive AI-driven learning, to equip learners with basic skills for an evolving world. It allows students to operate within safe, real nursing or Information Technology the AI systems use performance analysis to provide learners with targeted feedback on how they can do things better. The two technologies together provide better engagement, knowledge retention, and modern workforce readiness while developing critical thinking, problem-solving, and teamwork skills. In the end, such integration readies a more agile workforce fit for the overarching challenge of the changing world landscape.

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