KIT FUTURELAB: INNOVATIVE LEARNING EXPERIENCES FOR ORIENTATION

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Abstract

The increasing dropout rates in higher education and within universities represent one of the most urgent challenges for educational systems globally, particularly in Europe. Although numerous initiatives focus on supporting students, there is a growing awareness of a lack of meaningful, engaging, and experiential learning experiences in earlier stages of education.

This contribution argues that to effectively address the dropout problem, it is necessary to rethink how knowledge is introduced and experienced during the entire educational journey. In particular, it explores the potential of laboratory-based learning, grounded in direct experience, as a key strategy to increase engagement, motivation, and conceptual understanding. Constructivist learning theories (Piaget, 1954; Vygotsky, 1978), which emphasize the importance of active knowledge construction, advocate for the creation of experiential environments where students can explore, experiment, and reflect autonomously.

Recent studies (Hattie, 2009; Freeman et al., 2014) show that active learning significantly improves both academic performance and intrinsic motivation. In this perspective, laboratory activities are not merely spaces for demonstration but dynamic, participatory contexts for the development of critical thinking, autonomy, and problem-solving skills.

However, to implement this pedagogical change, it is necessary to rethink not only the curriculum but also the teaching tools. In this sense, the discipline of design – particularly design thinking – offers a highly valuable methodological approach. Characterized by empathy, iteration, and prototyping, design thinking has already proven effective in educational innovation, yet its use in co-designing educational materials remains underexplored.

This research investigates how designers and educators can collaborate to create didactic and technological kits for laboratory contexts. The study adopts an exploratory design-based research approach, focusing on conceptual development and early prototyping rather than on empirical validation through implemented interventions. These kits are designed to support inquiry-based learning, promote creativity, and make the learning experience more tangible and engaging. Far from being mere aids, these tools are configured as interactive platforms, adaptable to various disciplines and educational levels, capable of supporting student-centered teaching practices even in resource-limited contexts.

An innovative aspect of the proposed kits is the integration of advanced technologies such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR). AI-based approaches are envisioned as tools to support personalized learning experiences by analyzing student interaction data and adapting content and pacing.This approach allows for the creation of highly personalized learning paths that respond to each student's individual needs, stimulating motivation and interest.

Moreover, the use of augmented and virtual reality in the kits is intended to enable students to explore complex concepts through immersive environments and teaches them to use these technologies as tools. For example, with VR headsets, students can explore simulations of real or abstract scenarios, going beyond traditional lectures, while AR can enrich the physical world with digital information, creating more engaging and interactive learning experiences.

The kits will be used in orientation activities for high school students and in ongoing and exit orientation for university students, in collaboration with local businesses and organizations.

Keywords: Education, Artificial Intelligence (AI), Active Learning, Orientation, Design Thinking.

1 INTRODUCTION

School dropout is a global phenomenon that affects millions of students every year, with devastating consequences not only at the individual level but also socially and economically. According to the Organization for Economic Co-operation and Development (OECD), dropout rates are strongly correlated

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with the level of education and the professional skills acquired. Students who drop out of school are less likely to access stable, well-paid jobs, directly affecting their income and social mobility. This phenomenon amplifies social inequalities, creating a vicious cycle that primarily affects disadvantaged classes, which, lacking access to quality education, see their economic prospects further diminished.

In addition to individual impacts, school dropout also has macroeconomic consequences. National economies suffer a loss of human capital, as young people who drop out of school are less prepared to face the challenges of an increasingly competitive and technologically advanced labor market. As a result, societies see a reduction in their capacity for innovation and productivity, widening the gap between developed and developing countries. The economic impact is not limited to the loss of talent and resources, but also extends to social costs related to unemployment, social assistance, and healthcare services, which grow exponentially when a significant portion of the young population is excluded from both the educational and labor systems.

The problem of school dropout is multifactorial, determined by a range of factors including personal and familial difficulties, issues related to the social and economic context, and challenges within the educational system itself. Among the factors that frequently emerge in the literature are a lack of intrinsic motivation, disinterest in academic subjects, and the perception that formal education does not provide concrete tools for facing the challenges of everyday life (Eccles & Wigfield, 2002). This issue is further exacerbated by the traditional educational model, which relies primarily on the passive transmission of knowledge through frontal teaching methods, where students are seen as mere recipients of information rather than active participants in the construction of knowledge.

The passivity of traditional learning not only fails to stimulate students' curiosity but also contributes to increasing the risk of disengagement. The lack of learning experiences that are relevant and meaningful to students feeds into a vicious cycle of low motivation and disconnection from school dynamics. The need for a paradigm shift is therefore clear. According to learning theorists such as Piaget (1954) and Vygotsky (1978), education should aim to stimulate active learning, in which students are involved in practical experiences that promote autonomous knowledge construction.

Laboratory-based learning emerges as one of the most promising approaches to addressing the problem of school dropout. This type of learning, based on direct experience and active student involvement, may be particularly effective in supporting engagement, conceptual understanding, and intrinsic motivation. Unlike traditional frontal teaching, which often sees students as passive recipients of information, laboratory-based learning stimulates interaction, curiosity, and inquiry, transforming the school environment into a dynamic and participatory context.

Constructivist learning theories, such as those advanced by Piaget (1954) and Vygotsky (1978), provide the theoretical framework that justifies the effectiveness of laboratory-based learning. Piaget argued that learning is an active process, where students build knowledge autonomously through interaction with their environment and problem-solving. Vygotsky, on the other hand, emphasized the importance of social interactions and the cultural context in the learning process, highlighting that knowledge is constructed through dialogue and collaboration with others.

In the context of laboratory-based learning, students are invited to explore concepts in a practical manner, experiment with solutions, and reflect on the results obtained, developing essential transversal skills such as problem-solving, critical thinking, and creativity. These skills are recognized as crucial not only for academic success but also for students' future professional lives. In this sense, laboratory-based learning goes beyond the transmission of theoretical knowledge, preparing students to be active participants in their learning process and in their professional life.

Recent studies, such as those conducted by Hattie (2009) and Freeman et al. (2014), have shown that active learning, particularly laboratory-based learning, has a significant impact on improving academic performance and enhancing students' intrinsic motivation. Hattie's (2009) meta-study, which analyzed thousands of research studies on the factors that influence learning, highlighted that active teaching strategies such as cooperative learning, problem-based learning, and laboratory-based learning are among the most effective in improving students' learning. Similarly, Freeman et al. (2014) found that active learning can lead to a significant increase in students' performance compared to traditional methods, particularly in terms of conceptual understanding and application.

For example, in Freeman et al.'s (2014) study, it was found that students who participated in courses based on active learning methods scored higher on tests than those who attended traditional courses, with a particularly noticeable improvement in STEM subjects (science, technology, engineering, and mathematics). This confirms the hypothesis that laboratory-based learning, through direct involvement and the practical application of concepts, is a highly effective approach to fostering a deep and lasting understanding of academic content.

In summary, the phenomenon of school dropout calls for a rethinking of traditional teaching methods, focusing on more active and participatory methodologies that can stimulate student engagement. Laboratory-based learning, supported by constructivist theories and empirical evidence, represents one of the most promising solutions to address the issue of school dropout and to improve the quality of the educational experience, preparing students to be more motivated, autonomous, and competent in their learning journey and professional life. In this context, the present study adopts a design research perspective, aiming to explore how design methodologies can inform the development of innovative educational tools. The contribution focuses on the conceptual and methodological framework rather than on the evaluation of implemented solutions.

This study contributes to the field of educational innovation in three main ways. First, it proposes a design-based framework that integrates constructivist pedagogical principles with design thinking methodologies for the development of educational tools. Second, it explores how advanced technologies such as artificial intelligence, augmented reality, and virtual reality can be conceptualized not merely as technological enhancements but as components of experiential learning ecosystems. Third, it highlights the role of interdisciplinary collaboration between design and education as a strategic approach to addressing challenges related to student engagement, orientation processes, and dropout prevention. By positioning design as both a methodological and epistemological approach within educational research, this work aims to bridge the gap between theoretical pedagogical models and tangible learning experiences.

Despite the growing interest in active learning and technology-enhanced education, limited research has explored how design methodologies can systematically inform the co-creation of modular educational tools specifically aimed at orientation processes and experiential engagement. This study addresses this gap by proposing a design-based framework that integrates pedagogical theory, stakeholder input, and emerging technologies into a structured approach for developing educational kits.

2 METHODOLOGY

The study follows an exploratory design-based research approach, combining qualitative data collection through focus groups with iterative design thinking processes aimed at informing the development of educational kits. As the research is currently positioned within a conceptual and design development phase, limitations include the absence of empirical implementation data and the need for future validation through real-world testing. The study follows an exploratory design-based research approach, combining qualitative data collection through focus groups with iterative design thinking processes aimed at informing the development of educational kits. The main objective of this research is to explore how design thinking can be applied to the design of innovative educational materials, with particular focus on kits designed to promote laboratory-based learning. Design thinking, as emphasized by Brown (2009), is a methodological approach characterized by its iterative, collaborative, and user-centered nature. In this perspective, the approach is not limited to a linear sequence of stages, but involves continuous interaction between research, design, and testing of solutions. The design thinking process includes several crucial phases: empathy, problem definition, ideation, prototyping, and testing. Each phase is driven by continuous feedback that allows for the progressive refinement of the design solution. In educational contexts, this methodology is distinguished by its ability to highly personalize responses to students' needs, adapting to different educational settings and learning styles.

Although design thinking is widely used in product and service innovation, its application in education, particularly in the design of educational materials, is still a relatively new area of research. In education, design thinking is particularly well-suited for creating solutions that are not only functional but also capable of motivating and engaging students, thereby addressing the growing need for more interactive and engaging teaching methodologies.

In the initial phase of the research, focus groups were conducted with educators and designers to collect information about specific educational needs as well as issues related to school dropout. Participants, including teachers, trainers, pedagogists, and design experts, were involved in discussions to identify the main difficulties that students face in traditional learning and the need for innovation in teaching practices. This process helped clarify the fundamental challenges to address when designing the kits, such as the need to make learning not only more interactive and engaging but also personalized to meet students' individual needs. The purpose of the focus groups was to inform the design process and identify stakeholder needs, rather than to evaluate the effectiveness of the proposed solutions.

The critical issues raised in the focus groups highlighted that one of the main causes of school dropout is disinterest and the perception that traditional education is of little practical use. Therefore, the proposed methodological approach aimed to create tools that would not only enrich the learning experience but also encourage active participation and emotional engagement from students. The next step was to design and prototype a series of design-based educational kits. The adopted methodological approach integrated advanced technologies such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) to offer engaging and immersive learning experiences. Each kit was designed with the goal of stimulating practical learning, allowing students to explore complex concepts in an experiential and hands-on way.

Artificial intelligence was integrated into the kits to monitor students' real-time interactions with the materials, collecting data on their progress and adjusting the content and learning pace according to their responses. This approach allows for dynamic personalization of the educational path, where each student benefits from a tailor-made experience that responds to their needs and level of competence. Real-time personalization is a key aspect, as it helps avoid isolating students due to unaddressed difficulties while simultaneously boosting intrinsic motivation.

There are numerous AI applications in education that use intelligent tutoring systems. These systems are designed to adapt to each student’s pace and level of learning, ensuring that slower learners receive the necessary support without slowing down the progress of others. Studies on the effectiveness of these systems have shown significant improvements in student performance, confirming the potential of AI in optimizing personalized learning. In addition to AI, the educational kits were enhanced with immersive technologies like augmented reality (AR) and virtual reality (VR). These technologies are particularly useful for making learning more visceral and practical, allowing students to interact with concepts in a tangible way. Augmented reality, for example, enables the overlay of digital information on the physical world, creating enriched learning experiences with interactive visual elements. Students can explore 3D models of scientific, historical, or mathematical concepts, improving the understanding of complex topics that might otherwise be difficult to visualize.

Google has experimented with a series of applications for implementing AR in educational contexts. These projects have used augmented reality to enrich lessons, allowing students to explore complex concepts interactively. The use of interactive digital elements has enabled students to “see” abstract concepts in a tangible way, positively influencing their motivation and their ability to understand complex ideas. Virtual reality (VR), on the other hand, allows students to fully immerse themselves in simulated environments. For example, through VR headsets, students can visit historical sites, explore, and carry out experiments and experiences directly in the classroom. The use of advanced technologies such as AR, VR, and AI has been associated in literature with increased engagement and may support more inclusive learning environments. Interactive technologies can be used to adapt the educational experience for students with special educational needs. For example, augmented reality can be employed to provide visual support for students with cognitive or language difficulties, while virtual reality can offer a safe and controlled environment for students with social anxiety or behavioral challenges.

Recent studies on the use of assistive technology have highlighted how virtual reality can significantly improve learning for students with concentration or attention difficulties, providing them with more immersive experiences that directly involve them in the learning process. Moreover, the use of AI allows for personalized learning that considers individual strengths and challenges, offering more targeted and timely support.

The described methodological approach, which combines design thinking, advanced technologies such as AI, AR, and VR, and a focus on active student involvement, represents an innovative proposal to address the phenomenon of school dropout. The educational kits designed in this research aim to stimulate more interactive and personalized learning that meets students' diverse needs and adapts to various educational contexts. Dynamic personalization, immersive simulation, and the use of inclusive technologies can indeed contribute to improving engagement, reducing the risk of disengagement, and increasing students' academic performance, thus representing an effective solution for improving contemporary education systems.

3 EXPECTED OUTCOMES AND DESIGN IMPLICATIONS

The expected results of this research are multiple and concern various crucial aspects of the educational process, ranging from motivation and improved academic performance to inclusion and the personalization of the learning experience. Advanced technologies, such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR), have been integrated into the educational kits with the aim of promoting more dynamic, engaging, and individualized learning tailored to the students' needs.

3.1 Increasing Engagement and Motivation

One of the primary objectives of this research is to increase student engagement in learning, which also positively impacts intrinsic motivation. According to numerous studies, including that of Deci and Ryan (1985), intrinsic motivation is essential for long-term academic success, as it encourages students to actively participate in educational activities and pursue self-directed learning. The introduction of advanced technologies, such as AI and immersive reality (AR and VR), is designed to stimulate students' curiosity, creating learning experiences that go beyond traditional frontal teaching. Virtual reality, in particular, with its ability to immerse students in simulated environments, offers unique opportunities to explore complex concepts in an experiential context, increasing interest in the subject matter and reducing the risk of disengagement. Freeman et al. (2014) examined the effectiveness of active learning in various fields and highlighted how interaction with real and applicable educational content can significantly improve student engagement. The research demonstrated that students who actively participate in practical activities, such as those proposed with virtual reality, tend to develop a deeper understanding of the content and maintain greater interest in their educational path. In this sense, immersive reality serves as both an emotional and cognitive stimulus, creating a stronger connection between students and the concepts studied.

3.2 Personalizing learning

Another key goal is the personalization of learning, made possible by the integration of artificial intelligence in the educational kits. Personalization, a fundamental aspect of each student’s success, relies on the ability to adapt the educational path to individual needs. AI allows for the collection and analysis of data related to students' interactions with the learning materials, providing immediate feedback and adjusting the content in real-time to better match each individual’s level of understanding. This approach is particularly useful for students with learning difficulties, as it allows them to progress at their own pace, receiving targeted support in areas where they struggle the most.

Personalizing the learning path not only is intended to support the effectiveness of learning but also helps reduce the frustration and anxiety many students experience in traditional educational settings, where the pace and rhythm of learning are standardized. Real-time adaptation of content to students' needs not only increases comprehension but also promotes greater autonomy, encouraging students to take responsibility for their own learning.

3.3 Orientation and Reducing the Risk of School Dropout

The educational kits designed in this research are also intended to be used in educational orientation activities. Specifically, their use extends to both high school students during the entry orientation phase and university students during ongoing and exit orientation. Virtual reality may be particularly useful in orientation contexts, as it offers students the chance to explore potential career paths experientially. For example, by using VR headsets, students can "live" a typical day in a particular profession, exploring work environments and interacting with realistic scenarios that replicate professional situations. This type of immersive experience not only provides a practical understanding of careers but also helps students make more informed and conscious choices, thus reducing the risk of disengagement and school dropout.

Orientation activities based on augmented and virtual reality provide a space where students can explore concrete scenarios related to their future educational and professional paths, improving their school decisions and reducing uncertainties regarding their academic or career choices. These tools allow students to connect what they learn in class with the real world, increasing their motivation and stimulating curiosity about future opportunities.

3.4 Impact on Academic Performance and Skill Development

Previous research indicates that the integration of active learning approaches, supported by advanced technologies, may have a positive impact on students' academic performance. Studies conducted by Hattie (2009) and Freeman et al. (2014) suggest that active learning is associated with a significant improvement in academic performance, especially in science, mathematics, and technology, where students tend to achieve higher results in interactive and applied environments.

Moreover, the use of augmented and virtual reality in educational activities not only is designed to enhance the understanding of concepts but also fosters the development of transversal skills such as problem-solving, creativity, and critical thinking. These skills are essential for addressing the challenges of today’s professional and social world and are particularly valued in high-tech and innovative sectors.

3.5 Inclusivity and Accessibility

Advanced technologies not only contribute to increasing student engagement and motivation but also play an important role in promoting inclusivity and accessibility in education. The technology can remove significant barriers to learning for students with learning disabilities or disabilities. Augmented reality, for example, can be used to provide visual aids to students with cognitive or visual impairments, while virtual reality can offer a safe and stimulating environment for students with social anxiety or behavioral difficulties, allowing them to interact with scenarios and environments without the risk of feeling judged or excluded.

In summary, the adoption of advanced technologies in the educational kits aims not only to improve student engagement and performance but also offers scalable and inclusive solutions that can support all students, regardless of their abilities or difficulties. The expected outcome is an educational environment that stimulates inclusion, motivation, and performance improvement while simultaneously reducing the risk of school dropout.

4 CONCLUSIONS

In conclusion, this study investigates the potential role of laboratory-based learning and advanced technologies as promising strategies to address the complex and multifactorial phenomenon of school dropout. In this sense, the study should be interpreted as a conceptual and design-based contribution that focuses on framing and structuring an educational innovation approach, rather than on reporting validated intervention outcomes. Rather than presenting validated empirical outcomes, the research introduces a design-oriented conceptual framework grounded in constructivist learning theories (Piaget; Vygotsky) and design thinking methodologies, aimed at supporting the development of technology-enhanced educational kits for orientation and experiential learning contexts. From a research perspective, the study contributes to the emerging intersection between design-led innovation and educational research, highlighting how design methodologies can function as generative tools for pedagogical experimentation.

From a theoretical perspective, the study contributes to ongoing discussions on active learning and student engagement by proposing a model in which laboratory-based approaches are enhanced through immersive and adaptive technologies. The integration of artificial intelligence (AI), augmented reality (AR), and virtual reality (VR) is framed not merely as technological enhancement but as part of a pedagogical ecosystem designed to foster inquiry-based learning, personalization, and meaningful participation. In this sense, the research positions design as a mediating discipline capable of translating pedagogical theories into tangible educational tools.

The preliminary research phase involved focus groups with educators, designers, and pedagogical experts, enabling the identification of key challenges related to student motivation, accessibility, engagement, and the perceived gap between formal education and real-world applications. These insights informed the conceptual development and early prototyping of modular educational kits intended to support orientation processes across different educational stages. At the current stage, the kits have not yet been implemented in real educational environments; therefore, the findings should be interpreted as exploratory and design-based rather than evaluative. This clarification reflects the nature of design research, where iterative prototyping and stakeholder feedback play a central role in shaping future implementation and validation phases.

Despite the exploratory status of the project, the proposed framework suggests that combining active learning principles with immersive and adaptive technologies may create more inclusive and engaging learning environments. In particular, the integration of design thinking within educational innovation highlights the importance of user-centered processes capable of responding to diverse learner needs and supporting more flexible and responsive teaching practices.

Educationally, the proposed kits aim to enhance orientation processes by enabling students to explore disciplinary content and potential professional pathways through experiential and immersive activities. Such approaches may contribute to strengthening students’ sense of agency, self-awareness, and connection between academic learning and future career trajectories, potentially addressing some of the motivational factors associated with dropout risks.

Moreover, the interdisciplinary collaboration between design and education represents a promising direction for rethinking contemporary learning environments. By emphasizing modularity, adaptability, and scalability, the framework seeks to support the transferability of the proposed solutions across different educational contexts, including resource-limited environments. The use of advanced technologies within flexible design systems may help reduce structural barriers to innovation and facilitate broader access to experiential learning opportunities.

Future research will focus on implementing pilot studies and real-world testing phases aimed at empirically evaluating the effectiveness of the developed kits. Data-driven assessment and iterative refinement processes will be essential to validate the proposed approach and to develop evidence-based guidelines for integrating design-led innovation into educational practice. Ultimately, this research highlights the potential of combining design methodologies and educational innovation as a pathway toward more engaging, inclusive, and future-oriented learning ecosystems.

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