Investigating the role of self-determination theory and authentic learning in the integration of technology for media production education:

A design-based research

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December 2024

This thesis is submitted in partial fulfilment of the requirements

for the degree of Doctor of Philosophy

Department of Educational Research,

Lancaster University, U.K.

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Abstract

This research explores the integration of serious games in media production education, with CineSim serving as a case study. Utilizing a Design-Based Research (DBR) methodology, the study iteratively developed, implemented, and refined CineSim to address practical and pedagogical challenges in media production courses. CineSim, built on the principles of Self-Determination Theory (SDT) and Authentic Learning Theory (ALT), provides students with a realistic simulation to practice cinematography, lighting, and storyboarding. The study conducted two rounds of data collection with authentic users. In the first round of research, 80 students participated in workshops introducing CineSim, with 57 completing detailed questionnaires. A focus group of 20 participants provided in-depth group disucssions, which informed significant revisions to the software. A second round of research involved 85 participants, with 56 completing follow-up questionnaires to evaluate the improvements. Additionally, an interview with a professional practitioner in media production provided expert validation of CineSim's effectiveness and its potential applications. The research contributes to educational technology by introducing the Integrated Motivational and Authentic Learning Framework (IMAL) for serious games. The framework integrates principles of motivation and authentic learning to promote intrinsic motivation, support creative expression, and deliver authetic practice-based learning experiences. Recommendations for future developments and limitations of the study are also discussed, offering valuable insights for scholars and educators aiming to incorporate serious games in teaching practices.

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Acknowledgements

First of all, I would like to thank all teachers in my learning journey, including professors from my Bachelor and Masters' programme, and of course PhD courseworks instructors. They taught me the proper way to be a teacher.

I would also like to show my deepest gratitude to my PhD supervisor, Dr. Julie-Ann SIME. I believe that she has gone through a very tough time with me from the zero to the end of my PhD study journey. Without her patience and supervision, this thesis would not have been finished within three years.

Last but not least, I want to thank Lingnan University, the university where I am currently teaching. It has given me sufficient freedom and chances to develop CineSim so that I can embed it into PhD thesis.

Author's Declaration

Investigating the role of self-determination theory and authentic learning in the integration of technology for media production education:

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This thesis results entirely from my own work and has not been offered previously for any other degree or diploma. The word length of the thesis (48747) does not exceed the permitted maximum.

Declaration: Use of GenAI and AI-Assisted Technologies in the Manuscript's Preparation Process

During the preparation of this work, the author used AI to help reduce word count and rephrase text. This is in line with Lancaster University AI Policy, which states: "If you are using Gen AI tools as an aid to creating, checking or translating text, as part of preparing for assessment, you must always explain how you have used them and it is essential that you are demonstrably the author of the final text."

- AI-generated summaries were made on my own writing.
- I ensured that the final text reflects my own understanding and voice.
- I actively engaged in the revision process to maintain academic integrity.
- The work is my own.

Signature :

Chapter 1. Introduction

This thesis makes a contribution to the field of serious games in education, focusing on how they can enhance media production education. There are three main goals of this study. First, to evaluate the impact of embedding Serious Games in media production education, as illustrated by CineSim. CineSim is a serious game developed to address specific challenges in media production education, such as limited access to equipment, high costs, and the shift to online learning during the COVID-19 pandemic. It provides a realistic, immersive 3D simulation environment where students can apply their theoretical knowledge of cinematography, lighting, and storyboarding while receiving real-time feedback. Second, to propose a new framework (outlined in section 8.4) to guide future educators in using serious games for teaching and learning. This framework integrates elements of Self-Determination Theory (SDT) and Authentic Learning Theory (ALT) to foster motivation and provide students with authentic, practical learning experiences. Third, to evaluate the impact of CineSim on the students' learning journey.

1.1 Introduction to Media Production Education and Challenges

This section provides an introduction to the structure and content of media production (MP) courses, highlighting the integration of creative and technical skills essential for the media industry. It emphasizes the necessity of practical, hands-on experience in MP education, discussing how experiential learning bridges the gap between theoretical knowledge and real-world application. Additionally, it examines the impact of the COVID-19 pandemic on MP education, focusing on the challenges posed by the shift to online learning and the accelerated adoption of digital technologies to replicate hands-on experiences.

1.1.1 Overview of Media Production Courses and Their Practical Nature

Media Production (MP) courses typically cover a wide range of topics, including film and video production, sound design, editing, cinematography, and more. The practical nature of MP education is fundamental. As a competitive practitioner in the industry, one must combine theoretical knowledge with hands-on experience (Regan & Sheppard, 1996; Kocic, 2019). Therefore, it is critical to allow students to develop a comprehensive understanding of media creation processes.

The majority of MP education relies on an experiential learning approach. Students are often engaged in project-based learning, where they are required to conceptualize, plan, and execute media projects. This approach not only enhances their technical skills but also fosters creativity, problem-solving abilities, and teamwork, which are critical skills for success in the media industry (Kearney & Schuck, 2006).

As an overview, different universities and institutes in the world have adopted similar approaches to MP education. They mainly emphasize hands-on experience and industry-relevant skills. For instance, the School of Cinematic Arts under University of Southern California (USC) offers students access to state-of-the-art facilities and equipment, together with a curriculum designed to provide a comprehensive understanding of film and media production (*USC Cinematic Arts | Home*, n.d.). Similarly, the New York University (NYU) Tisch School of the Arts integrates rigorous coursework with hands-on workshops and studio work, allowing students to develop their artistic style while acquiring practical skills (*NYU Tisch School of the Arts*, n.d.).

In the UK, National Film and Television School (NFTS) is famous for its specialized courses in film, television, and new media. The NFTS curriculum is designed to provide students with hands-on experience in a real-world production environment.

Students at NFTS engage in practical projects that simulate professional media production settings, allowing them to develop skills in cinematography, directing, producing, and post-production. This practical training is complemented by mentorship from industry professionals. It can ensure that students are well-prepared for the demands of the media industry (*National Film and Television School*, n.d.)

Similarly, in Australia, the Australian Film, Television and Radio School (AFTRS) places a strong emphasis on the practical aspects of media production. AFTRS combines traditional classroom learning with extensive practical exercises, offering students opportunities to work on real-life projects and collaborate with industry experts. This approach ensures that students gain a deep understanding of the technical and creative aspects of media production, from concept development to final editing. The focus of AFTRS on practical skills equips students with the necessary competencies to navigate the complexities of the media industry and adapt to its evolving nature (Australian Film Television and Radio School, n.d.).

These examples illustrate that in MP education, it is a common teaching practice to provide students with chances to learn from an authentic environment aligned to industry. It also shows that tertiary institutes recognize the importance of providing students with real-world experiences and the skills necessary to survive in the rapidly changing media landscape.

1.1.2 Importance of Hands-on Experience in Media Production Education

In the landscape of MP education, hands-on experience is not just beneficial, but essential. The evolving job market increasingly demands graduates who are not only theoretically knowledgeable but also 'work-ready'. This shift states the importance of practical skills, which are crucial for students to effectively transition from academic environments to professional settings (Bridgstock, 2009). Hands-on training in MP education plays an important role in this context.

Practical experience in MP is crucial for several reasons. It allows students to apply theoretical concepts in real-world scenarios, thereby bridging the gap between classroom learning and professional practice. This experiential learning approach is aligned with Dewey's educational philosophy, which emphasizes learning should be conducted through doing and reflecting on experiences (Dewey, 1963). Moreover, Lombardi (2007) highlights the significance of authentic learning experiences in preparing students for real-world challenges. It implies that for subjects that require students to acquire practical skills, such as media production, authentic learning is potentially a promising approach. Meanwhile, especially for MP, hands-on projects in MP courses enable students to develop a portfolio of work, which is often a key factor in securing employment in the media industry after graduation. The portfolio showcases their skills and creativity to potential employers, demonstrating their ability to produce work that meets industry standards.

Furthermore, the practical training in MP can be compared to the apprenticeship system historically prevalent in the film industry. Apprenticeships provided on-the-job training that allowed junior learners to learn directly from experienced professionals. While the formal apprenticeship system may not be widespread today, its principles remain relevant. Tertiary education in MP can draw lessons from the apprenticeship model, even with the potential to enhance it to provide systematic and structured learning experiences. This approach ensures that students not only acquire technical skills but also develop a deeper understanding of storytelling, audience engagement, and the societal impact of media (Sennett, 2008).

1.1.3 Challenges Posed by the COVID-19 Pandemic and the Shift to Online Learning

The COVID-19 pandemic challenged practitioners across various industries to rapidly reconsider their operational approaches (Ivanov, 2020). This transition from traditional, in-person methods to remote and digital formats was abrupt, presenting a unique set of challenges due to the lack of prior experience in managing such a widespread and dramatic shift. Despite the difficulties, this period of adaptation inadvertently pushed global improvements in various sectors. It accelerated the adoption of digital technologies and fostered innovative problem-solving strategies, ultimately enhancing efficiency and resilience in the face of unforeseen circumstances. This transformation, although initially driven by necessity, has led to lasting changes in work and educational practices, demonstrating the potential for growth and adaptation even in challenging times (Soto-Acosta, 2020; Watermeyer et al., 2021).

For MP education, the COVID-19 pandemic created challenges, but also catalyzed significant changes. It accelerated the adoption of virtual and remote learning methodologies. The abrupt transition from traditional, hands-on learning environments to online platforms posed unprecedented challenges, particularly in a field deeply rooted in practical, collaborative experiences such as on-site film shooting and studio work. From my observation in daily teaching during COVID-19, students without practical skills training show weaker performance in their creative work.

This shift not only disrupted the conventional pedagogical approaches but also highlighted the divide in technology and equipment access. The sudden reliance on online platforms revealed disparities in access to necessary equipment among students, raising concerns about the quality and equity of learning experiences (Daniel, 2020). The pandemic underscored the urgent need for educational institutions to address these disparities to ensure all students have equal opportunities to succeed in their studies.

In order to solve these problems and provide an alternative to hands-on practice training to sustain quality teaching and learning experience in a pandemic period, innovative approaches within MP education should be considered. The challenges presented by remote learning during the pandemic in practical matters (e.g., cinematography) are serious. Unlike other theory-based subjects, online lecture by any means may help. However, practical subjects do not work the same. This situation urgently required educators to explore and integrate advanced technologies in teaching. These technologies aimed to replicate and simulate the hands-on experiences that are fundamental to MP training. For other practical based subjects, such as medical care or tree-cutting (Ta Kung Pao, 2016), there was substantial use of virtual reality (VR), augmented reality (AR), and simulation software and tools that allowed educators to create immersive, interactive environments mimicking real-world working environment. However, there were no clues that MP educators were working towards the adoption of technology in formal education.

These technological advancements not only provided a solution during the pandemic but also laid the groundwork for a more flexible and resilient approach to MP education. The integration of these technologies has the potential to enrich the learning experience, offering students new ways to engage with course material and develop practical skills. The pandemic, somehow in many ways, accelerated the digital transformation in education, pushing the boundaries of traditional teaching methods. It also pushes for a more innovative, technology-driven future in MP education.

1.2 The Need for Innovative Solutions in MP Education

MP education is not a new subject in tertiary education. Now, there are sound pedagogies that educate students well in this area. Most of them employ authentic practice and training in a formal class environment. However, due to the changes of society and emerging technologies, as well as external challenges, there is a strong need to adopt technology into MP education.

1.2.1 Limitations of Traditional and Online MP Education

MP education has traditionally relied on hands-on, experiential learning methods (Beard & Wilson, 2006). It simply means learning by doing. These methods are crucial for developing the practical skills and creative thoughts that are necessary in the media industry. However, traditional MP education often faces challenges such as limited access to equipment and facilities, which can hinder students' ability to gain comprehensive practical experience (Mumtaz, 2000; Bingimlas, 2009). Additionally, the high costs associated with film production – from equipment to location scouting – can be a great burden for many media major students, limiting the scope and frequency of practical exercises (Kearney & Schuck, 2006).

The transition to online MP education during the COVID-19 pandemic, primarily through platforms like Zoom and pre-recorded video lectures, introduced significant challenges in delivering practical training. This mode of education, while being dominant under pandemic constraints, was mainly about theory, focusing on lectures and demonstrations that students passively consumed. This approach starkly contrasts with the hands-on, experiential nature of MP education, where direct interaction with equipment and collaborative, on-site projects are integral to learning.

In a typical MP course, students learn by actively engaging with cameras, lighting, sound equipment, and editing software. This hands-on approach is crucial for developing a deep, practical understanding of media production. However, in an online setting, these experiences are often reduced to watching demonstrations and discussions about equipment and techniques. The absence of physical interaction with the tools involved means students miss out on the tactile and experiential aspects of learning, which are essential for mastering practical skills (Hodges et al., 2023).

Furthermore, the collaborative and dynamic environment of a media production set, where students learn to adapt to real-time challenges and work as a team, is difficult to replicate in a virtual online classroom (Bower, 2017). Online platforms, which only offer a limited degree of interaction, lack the immediacy and spontaneity of a physical set (Kozar, 2010). This limitation can lead to a gap in students' ability to apply theoretical knowledge in practical, real-world scenarios (Herrington et al., 2010). The hands-on experience of trying different complex tasks in a production environment fosters critical and problem-solving skills that are essential for media professional practitioners. This is also challenging for an online learning environment to achieve (Bell & Federman, 2013).

1.2.2 Challenges in Expressing Creative Ideas in Storyboarding

Storyboarding, an essential skill in MP, presents a challenge for students, particularly for those who cannot draw well. As a visual blueprint for film and video projects, storyboarding requires not only a creative vision but also the capacity to effectively communicate and express that vision. It must be emphasized that the idea delivered and the communication efficiency are key, not how the storyboard is made. Traditional storyboarding methods, which often rely on hand-drawn sketches, can be a significant barrier for students who struggle with drawing. This limitation can impede their ability to fully express their creative ideas and receive meaningful feedback, which is crucial for their development as media professionals.

To address this challenge, recent advancements in digital technology have led to the development of innovative software tools designed to facilitate the storyboarding process. Software like *Storyboarder*[1] *or CineTracer*[2] represent a significant step forward, offering digital solutions that allow users to create storyboards using 3D models and virtual cameras in personal computers. These tools enable students to visualize their concepts in a more accessible and flexible manner, and most importantly, without the need for advanced drawing skills. Before I decided to develop CineSim as a teaching tool for storyboarding, I tried these two software tools myself. I found that these digital tools can help users to create storyboards, nevertheless, they often come with steep learning curves or poor user experience design. The complexity of the software can be overwhelming for some students. Before helping students to develop storyboards, it may potentially create a new set of challenges in terms of usability and accessibility of the software itself, which may demotivate students (Dicheva et al., 2015). These tools are an important step forward in solving the limitations of traditional storyboarding methods, educators and developers must continue to refine these technologies to ensure they meet the diverse needs and creative aspirations of MP students.

1.2.3 The Gap in Current Educational Methods and the Need for Innovation

The limitations of both traditional and online MP education, along with specific challenges for students to have previsualization such as storyboard drawing, highlights a significant gap in current educational methods. There is a strong need

[1] https://wonderunit.com/storyboarder/

[2] https://www.cinetracer.com/

for innovative solutions that can bridge this gap, offering students a more holistic and effective learning experience.

Innovative solutions in MP education should aim to combine the flexibility and accessibility of online learning with the practical, hands-on experience of traditional methods. Emerging technologies such as virtual reality (VR), augmented reality (AR), and other simulation software present promising opportunities. These technologies can create immersive, interactive environments that mimic real-world settings, allowing students to practice and refine their skills in a virtual yet realistic context (Jumani et al., 2022).

The integration of innovative technologies in MP education potentially serves as a powerful solution to democratize access and address disparities related to equipment costs and geographical constraints. By adopting technology, educational institutions can offer a more inclusive and equitable learning experience, ensuring that all students, regardless of their background, have an opportunity to develop the necessary skills and creativity for the media industry.

However, it is crucial to emphasize that the role of technology in MP education is not to replace traditional hands-on training. The essence of media production lies in the actual experience of handling real equipment and creating in actual production environments. Replacing these invaluable hands-on sessions with virtual simulations would be impractical and could potentially disconnect students from the realities of the industry. Instead, the goal is to supplement and enhance traditional training methods. Technologies can prepare students for hands-on practice, making them more ready and confident when they transition to real-world scenarios. By first practicing in a simulated environment, students could develop a foundational understanding and familiarity with various aspects of media production. This preparatory phase could potentially boost their efficiency and effectiveness when they eventually engage with actual equipment and on-site production.

1.3 Introduction to CineSim

With the encouragement of my institution, and my personal quest to understand the need for an innovative pedagogy in MP education, I developed an application called CineSim to tackle what challenges we faced in MP education. It should be emphasized that this research is not to study the development of CineSim. Instead, it focuses on the educational practice of adopting CineSim into formal MP education.

1.3.1 Introduction to CineSim, Its Development, and Objectives

CineSim stands as a testament to the innovative integration of technology in MP education. As the Principal Investigator, I led the development of CineSim, and collaborated closely with a team of part-time developers and experts in various design fields. My role involved guiding the overall direction of the project, addressing technical challenges, and ensuring that CineSim met its educational objectives effectively.

One of the key decisions in the development process was the adoption of Unreal Engine 5 (UE5)[3]. It is one of the most advanced and popular game engines available. UE5 is renowned for its ability to provide highly realistic simulations, which may potentially be a crucial feature of CineSim. Its cutting-edge graphics processing capabilities allowed us to create an immersive and authentic learning environment within CineSim, one that closely mirrors real-world media production settings. This level of realism is crucial for students to gain a practical understanding of media

[3] https://www.unrealengine.com/en-US/unreal-engine-5

production processes, as it offers them a near-authentic experience of working in the industry.

The primary objective of CineSim in its initial phase was to benefit students at the institution where I teach. By providing them with access to this state-of-the-art tool, we aimed to enhance their learning experience, particularly in the areas of lighting design, cinematography, and storyboard creation. The goal was to ensure that despite limitations in physical resources or disruptions like the COVID-19 pandemic, students could continue to develop their skills effectively and in alternative ways.

CineSim is designed with scalability and broader accessibility in mind. The vision is to make CineSim available to anyone with a personal computer, breaking down barriers to high-quality MP education. This approach aligns with the growing trend of democratizing education through technology, making learning resources more accessible to a wider audience (Czerniewicz et al., 2016; Bozkurt & Sharma, 2020). The next stage of the project involves expanding CineSim's reach beyond students from a single institution, making it available to anyone interested in learning and practicing media production skills on a computer. This expansion is not just about reaching a larger audience but also about fostering a community of learners who can share, collaborate, and grow together in the field of media production.

1.3.2 The Role of CineSim in Addressing Challenges in MP Education

CineSim plays a crucial role in overcoming the challenge of limited access to equipment and resources in MP education. Traditional media production often requires extensive tangible resources, such as equipment and studio space. They may not always be readily available to students, as known by experience. Additionally, real-world media production setups often need the involvement of a group of crew members. It is challenging for students to experiment with different setups or try out experimental ideas independently. CineSim addresses this by providing a virtual environment where students can freely experiment with various media production techniques without the constraints of physical setups and human resources. This feature is invaluable for trying out innovative and risky ideas in a safe and cost-effective manner. Once students have refined their concepts in CineSim, they could confidently move the virtually tested idea to real-world setups.

Moreover, CineSim potentially tackles the students' problem in drawing storyboards. CineSim emerges as an innovative tool that addresses key challenges in MP education, as expressed in section 1.2. It empowers students to explore and experiment with media production in ways that were previously constrained by physical and skill limitations. By providing a platform for risk-free experimentation and creative expression, CineSim enhances the learning experience and prepares students for the practical realities of the media industry.

1.3.3 Overview of the Features and Capabilities of CineSim

CineSim is designed as an open-world simulation serious game. The goal is to provide an environment for users to simulate and express cinematic ideas they want in their mind. CineSim represents an innovative approach in MP education that blends advanced simulation capacity with practical learning tools. Its development and integration into the curriculum also shows a new approach to overcoming traditional educational challenges. CineSim not only enriches the learning experience but also equips students with the skills necessary for the current media industry. More details on the features of CineSim can be found in Chapter 4.

1.4 Educational Concerns and CineSim's Role

CineSim is a serious game that is particularly designed to solve some educational concerns in MP education. This section explains these concerns, how they are addressed, and the potential impact of CineSim on students.

1.4.1 Educational Concerns in MP Training

The COVID-19 pandemic has significantly disrupted traditional MP training, primarily due to the suspension of face-to-face classes and the shift to online learning. This abrupt transition to remote education has greatly diminished opportunities for practical and hands-on training, which is a cornerstone of MP education. The reliance on video lessons and virtual classrooms has limited students' chances to practice hands-on exercises. This situation underscores the need for innovative teaching methods that can adapt to such unprecedented challenges and continue to offer effective practical training remotely. The advent of remote learning also opens-up new possibilities for international collaboration and learning from professionals worldwide.

Another significant concern in MP training is the limited access to advanced equipment and facilities. Practical training in media production often requires the use of professional-grade tools, which can be expensive for many educational institutions. This limitation can hinder students' opportunities to gain hands-on experience with the tools and technologies used in industry. The challenge is to find ways to provide students with access to these essential resources, ensuring that they can develop the practical skills needed to succeed in the media industry.

A key challenge in MP training is that students often struggle to express their creative ideas through storyboards because they lack drawing skills and may have poor ability in visual communication with others. Students who struggle with drawing may find it difficult to convey their creative visions, which can lead to frustration and a decreased willingness to engage in creative work. This challenge highlights the need for alternative methods of expression that can accommodate different skill sets and encourage more students to fully participate in the creative process. Providing a platform for diverse creative expression is vital to ensure that diverse students are also able to express themselves.

1.4.2 How CineSim Addresses These Concerns

CineSim offers an innovative solution to the challenges posed by the COVID-19 pandemic, particularly in targeting to the constraints of remote learning. As traditional face-to-face classes became impractical for some occasions, CineSim's virtual training environment emerged as a viable alternative for practical MP training. This digital platform simulates real-world media production scenarios, enabling students to continue their hands-on learning remotely.

CineSim's virtual training does not operate separately but complements lectures. It serves as a practical tool for both learners and educators. Students can use it to experiment with new concepts and ideas, while teachers can utilize it to demonstrate and clarify complex concepts during their lectures. This integration of CineSim with conventional teaching methods enhances the learning experience, making abstract concepts more tangible and understandable. By bridging the gap between theoretical knowledge and practical application, CineSim maintains the continuity of practical training during periods of physical distancing.

Secondly, CineSim directly addresses the challenge of limited access to equipment and resources in MP training. By offering a realistic simulation of media production environments, CineSim enables students to virtually experiment with various equipment and setups on their PCs. This feature is particularly beneficial for institutions facing budgetary constraints, as it provides a cost-effective alternative to expensive physical resources.

It is important to emphasize that CineSim's role is to provide an additional preparatory step in the learning process. Before students work with actual equipment, they can use CineSim to familiarize themselves with different aspects of media production, such as lighting and cinematography. This preparatory phase allows students to gain a better understanding and feel more confident when they transition to using real equipment. By doing so, CineSim democratizes access to high-quality MP training and ensures a smoother transition for students from theoretical learning to hands-on practice.

Last by not least, CineSim plays a key role in empowering students to express their creative ideas effectively, regardless of their drawing skills. The software's intuitive storyboard creation tools enable students to visualize their concepts in a 3D environment, bypassing the limitations of traditional drawing-based methods. This approach ensures that all students, irrespective of their artistic abilities, can effectively communicate their creative visions.

1.4.3 The Potential Impact of CineSim on Students' Learning Journey

One significant impact of CineSim in MP training is its role in enhancing students' competence and effectiveness through self-determined learning. As a serious game, CineSim is designed to motivate students to engage actively with the learning material. The comprehensive training and numerous practice opportunities provided by CineSim encourage students to take control of their own learning journey. By experimenting with different media production techniques such as camera angles, lighting setups, and editing processes, and receiving immediate feedback, students can explore and develop their skills at their own pace. This self-directed approach fosters a deeper engagement with the learning topics, making students more willing to learn and improving their overall competence.

1.5 Research Methodology and Design-Based Research (DBR)

As an exploratory research study, with the involvement of design and evaluation of teaching, a Design-Based Research (DBR) methodology was adopted.

1.5.1 Introduction of the DBR Methodology

Design-Based Research (DBR) is an innovative approach in educational research, with special focus on practical issues and an iterative nature. Unlike traditional research methods that may prioritize theoretical understanding, DBR is deeply rooted in addressing real-world educational challenges and testing solutions in authentic settings (Bakker, 2018; McKenney & Reeves, 2018). At the same time, because the researcher in DBR usually engages in the research actively, DBR can be enhanced by an autoethnographic (designer's) account (Bowers et al., 2021). Here, it shows why DBR is suitable for this research study.

a. *Real-World Relevance*: DBR's focus on addressing actual educational challenges aligns with the objectives of CineSim. MP education faces specific, practical challenges, such as the need for hands-on experience, which makes simple online lectures inapplicable. DBR provides an opportunity to develop, and test CineSim. The whole study can also be conducted in the environment where it will be used, ensuring that it meets the real needs of students and educators (Bakker, 2018).

b. *Iterative Development*: The iterative nature of DBR is ideal for technology-based educational tools like CineSim. As a complex software tool, CineSim benefits from continuous testing, feedback, and refinement. DBR's cyclical process of design, implementation, analysis, and redesign ensures that CineSim evolves and is refined based on user experience and pedagogical effectiveness (McKenney & Reeves, 2018).

c. *Integration of Theory and Practice*: DBR bridges the gap between theoretical concepts and practical application. For this study, evaluating CineSim in MP education, it blends several educational theories together, such as Self-Determination Theory and Authentic Learning Theory. They are translated into software design. This integration ensures that CineSim is not only technologically advanced but also pedagogically sound.

d. Collaboration and Feedback: A key strength of DBR is its collaborative nature, involving educators, students, and developers in the research process. This collaboration is crucial for CineSim, as it ensures that the software is developed with direct input and comments from its end users. The feedback loop in DBR provides ongoing insights into how CineSim is used in educational settings, allowing for adjustments that enhance its effectiveness and user experience.

e. Adaptability and Responsiveness: DBR's flexible framework allows the design of CineSim in formal MP education to respond to authentic users' (i.e. student) feedback. After collecting feedback, the design of CineSim can be modified and prepared for further tests and applications. This adaptability ensures that CineSim remains effective and relevant as the media industry and educational technologies continue to evolve.

For more information, see Chapter 4.

1.5.2 The Process of Integrating CineSim into MP Training

The integration of CineSim into MP training follows the DBR methodology, beginning with the identification of key educational challenges and objectives. This initial stage is taken for understanding the specific needs of MP students and the educational context. The development of CineSim is then informed by these insights, combining theoretical underpinnings with practical requirements.

Once finished development, CineSim is integrated into the MP curriculum, marking a crucial phase where its impact on the learning journey and student engagement is assessed in authentic educational settings. This stage involves practical application and observation, where the impact of CineSim on student learning outcomes and engagement is closely monitored, ensuring that CineSim is not only pedagogically sound but also aligns with the practical realities of MP training.

1.5.3 The Feedback Loop Between the Researcher and Users

A key component of the DBR approach in this research is the continuous feedback loop involving the researcher, the users (students and educators), and the CineSim development team. This feedback loop is essential for the iterative improvement of CineSim. User experiences and needs drive the ongoing development and refinement of the tool, ensuring its relevance and effectiveness in the MP training context.

Feedback from students and educators is collected and analyzed, providing valuable insights into the usability and impact of CineSim. The feedback is considered and reflected in the further development. This process of continual feedback and adaptation ensures that CineSim evolves to meet the changing needs of MP education and remains a cutting-edge tool for practical learning.

1.6 Theoretical foundation of the Research

The theories underlying this research are rooted in the intersection of serious games (Krath et al., 2021), Self-Determination Theory (SDT) (Ryan & Deci, 2000; Deci & Ryan, 2000), and Authentic Learning Theory (ALT) (Herrington & Oliver, 2000). These frameworks collectively provide a comprehensive understanding of the dynamics involved in using serious games as an educational tool for MP education.

Serious games, as a form of educational technology, have been gaining recognition for their effectiveness in enhancing teaching and learning experience. These games are designed not just for entertainment but to serve specific educational purposes, engaging learners in an immersive environment that simulates real-world scenarios. The use of serious games in education is supported by various theoretical frameworks. According to Krath et al.'s (2021) systematic review of gamification and serious games research, numerous theories underpin the use of serious games in learning contexts. Out of those common theories that explains the usefulness and theoretical background of serious games, two of the most commonly applied theories, Self-Determination Theory (Ryan & Deci, 2000; Deci & Ryan., 2000), and Authentic Learning Theory (Herrington & Oliver, 2000) are particularly selected to support this study.

1.6.1 Overview of Serious Games and Their Impact on Learning

Serious games are digital or non-digital games designed primarily for purposes other than pure entertainment (Marsh, 2011; Breuer & Bente, 2010; Wilkinson, 2016). These games are used in various fields of training, like education, driving, health care, and public policy for their potential to engage and motivate learners while imparting knowledge or skills. The impact of serious games on learning is well-recognized, with studies showing that they can enhance cognitive learning outcomes, increase motivation, and improve problem-solving skills (Michael & Chen, 2006; Wouters et al., 2013).

In educational settings, serious games offer an interactive and immersive learning experience, making complex or abstract concepts more accessible and engaging for students (Gee, 2003; Squire, 2006; Wouters et al., 2013). By incorporating elements of game design such as storytelling, challenges, and rewards (Deterding et al., 2011; Kapp, 2012; Hamari et al., 2014), serious games can create a compelling learning environment that encourages active participation and deepens understanding. CineSim, as a serious game, is designed to achieve specific educational objectives within the realm of media production. It provides a digital platform where students can practice essential media production-related skills and express their creativity in a simulated environment that closely mirrors real-world scenarios.

CineSim stands out by offering a photorealistic 3D environment where students can experiment with lighting design, cinematography, and storyboard creation. This hands-on approach in a virtual setting allows students who may not have access to physical resources or equipment to develop their skills effectively. The game-like elements in CineSim, such as opening world settings, avatars and receiving immediate feedback, contribute to a more engaging and motivating learning experience. These aspects align with the principles of serious games, which are designed not just for entertainment but for educational purposes (Lin & Sahagun, 2023).

While CineSim is a serious game, in order not to confuse with other similar terms, it is important to briefly mention related concepts like gamification and game-based learning (GBL). Gamification involves applying game-like elements in non-game contexts, such as education, to increase engagement and motivation. Game-based learning, on the other hand, refers to the use of games (whether designed for education or not) as a tool to support learning (Deterding et al., 2011; Tselovanskyi, 2023). Both gamification and GBL share common features with serious games, like embedding game elements in educational contexts, but serious games like CineSim are distinct in their focus on achieving specific educational goals through immersive and interactive gameplay (Dicheva et al., 2015).

1.6.2 Self-Determination Theory (SDT) for Motivation

Self-Determination Theory (SDT), developed by Deci and Ryan, focuses on the motivation behind the choices people make without external influence and interference (Ryan & Deci, 2000; Deci & Ryan, 2000). This theory is crucial in understanding the motivational aspects of learning in serious games. SDT posits that motivational quality is more important than quantity, and it categorizes motivation into different types, from intrinsic to extrinsic. In the context of CineSim, SDT helps explain how the game's design can enhance learners' intrinsic motivation by fulfilling their basic psychological needs for autonomy, competence, and relatedness.

SDT plays a vital role in shaping the learning experience by addressing these three fundamental psychological needs of humans (Deci & Ryan, 2000; Liu et al., 2023). Autonomy, in other words, freedom, is particularly emphasized through the interactive design in CineSim. It allows students to explore and make decisions within the game environment. The freedom to choose and control various aspects inside the simulated environment allows students to gain a sense of personal investment and engagement in their learning journey.

Competence, means the need for individuals to feel effective and capable in their interactions with the environment (Ryan & Deci, 2000; Wang et. al, 2022). CineSim is structured to provide immediate feedback. It is essential for skill development and mastery. This aspect of the game aligns with SDT's emphasis on the competence aspect. As students navigate through CineSim, they can perform various tasks in different scenarios that require them to apply their knowledge and skills, thereby enhancing their sense of accomplishment and proficiency.

The last psychological need under SDT is relatedness. Although it is not strongly emphasized in CineSim compared with the other two, it is still addressed through CineSim's collaborative features. CineSim, as an educational game, encourages students to have interaction and teamwork for projects (Ryan & Deci, 2000). It allows students to connect with their peers in a shared learning environment, enhancing user engagement and satisfaction through motivational affordances

(Zhang, 2008). This social aspect of the game not only enriches the learning experience but also fosters a sense of belonging and community among learners (Reeves & Read, 2009), which is crucial for maintaining motivation and engagement in educational settings (Nicholson, 2012). Furthermore, the importance of social interaction and community in learning, as highlighted by Gee (2003), aligns with the concept of relatedness in SDT, underscoring the significance of fostering a sense of belonging among learners.

1.6.3 Overview of Authentic Learning Theory (ALT) and its Application in CineSim

After concerning about how to encourage learners to start learning through CineSim with the emphasis on SDT, it is still crucial to understand how learning happens. Authentic Learning Theory (ALT) emphasizes the importance of providing learning experiences that are deeply rooted in real-world relevance and practicality (Herrington & Oliver, 2000). ALT emphasizes learning through real-life, meaningful activities. It is rooted in the constructivist approach, where learners construct knowledge through experiences that are relevant to their lives (Herrington & Oliver, 2000). It also advocates for educational experiences that mirror the complexities and contexts of professional practice, making learning more meaningful and applicable. In the case of CineSim, ALT provides a framework for understanding how the game's realistic simulation environment and task-based learning approach can facilitate the acquisition of practical skills and knowledge in media production.

CineSim, as a serious game that particularly aims to provide realistic simulation, is designed on the basis of ALT. It integrates key principles of ALT by simulating real-world media production scenarios. First, it offers students contextualized, practical experiences that are directly relevant to the topic of media production. Second, it demonstrates the concept of active learning. By actively engaging students in problem-solving and decision-making processes, mirroring the complexities and dynamic nature of actual media production, students will be more ready for the future complex working world. Lastly, CineSim fosters an environment for reflection and collaboration, encouraging students to critically evaluate their work and engage with peers. This can further enhance the depth and quality of their learning experience.

To conclude, designed as a Serious Game, and supported by SDT, and ALT, CineSim represents a comprehensive and promising approach to enhance media production education. Serious games provide an engaging platform, SDT offers insights into motivating learners, and ALT ensures that learning is authentic and relevant. This combination of sound theories promises to significantly improve the learning experience and outcomes for students in media production.

1.7 Other Contributions

This research seeks to bridge the gap between academic theory and practical application in media production training. Academic research often faces criticism for its disconnect with real-world practices (Bridgman et al., 2016; Pfeffer & Fong, 2002; Rynes et al., 2001). This study addresses this issue by demonstrating how theoretical models, like ALT and SDT, can be practically applied in curriculum design, particularly in MP education. The development and integration of CineSim, a serious game, into media production education serves as a contemporary example of the practical application of academic theories.

This research encourages policymakers and educational leaders to reconsider their approach to media production education. The COVID-19 pandemic has shown that alternative work and learning methods can be effective. For instance, the shift to remote working has been found to be efficient in many cases, challenging traditional workplace norms (Morikawa, 202). Similarly, in media production education, the over-reliance on physical equipment and resources should be re-evaluated.

CineSim offers an alternative for practical skill development, suggesting a two-stage learning process where students first practice in a simulated environment before transitioning to real equipment. This approach could provide a smoother learning experience and alleviate the pressure on equipment availability.

CineSim also has the potential to engage the broader public in media production. The gaming market trends show the popularity of sandbox and simulation games, categories into which CineSim fits. With the features from these game genres, CineSim can be accessible and enjoyable for individuals without professional training in the world. This approach not only democratizes the process of creating media content but also provides an educational experience in media production skills through gameplay.

This research contributes to the theoretical understanding of Self-Determination Theory (SDT) in the context of serious game simulations, particularly in MP education. While SDT has been applied in serious games to explain learner motivation, its specific application in MP education is less explored. This study aims to investigate how the three psychological needs of SDT (autonomy, competence, and relatedness) are influenced by serious games like CineSim. The findings will not only advance the theoretical understanding of SDT but also offer practical insights for educators and instructional designers on integrating serious games more effectively in educational contexts. Additionally, this research has the potential to broaden the application of SDT to include digital media and professional skills development, expanding its relevance in technology-enhanced learning.

Last by not least, a new framework combining SDT and four components of ALT to design serious games has been developed for others to consider how to make serious games for specific education purposes. For more details of the Integrated Motivational and Authentic Learning (IMAL) Framework, see section 8.4.

1.8 Research Questions

The integration of CineSim into MP education represents an innovative approach to enhance the learning experience and outcomes for students in the field. This research aims to explore the impact of CineSim on various aspects of student learning and development within a formal lesson environment. Employing a DBR methodology, this study is flexible and iterative.

This research is guided by the following questions:

RQ1: How does the integration of CineSim into media production education affect the way that students express their creative thought within a university context?

This question seeks to understand the influence of CineSim on students' ability to conceptualize and express their creative ideas. It explores the ways in how CineSim can facilitate expression of creativity.

RQ2: How does the integration of CineSim into media production education affect student self-determined learning in a university context?

Under the umbrella of RQ2, the study further investigates the impact of CineSim on the components of Self-Determination Theory (SDT) — autonomy and competence — to assess how the software influences students' motivation and engagement with the learning material.

RQ2.1: How does the integration of CineSim into media production education affect student autonomy in a university context?

RQ2.2: How does the integration of CineSim into media production education affect student competence in a university context?

The study examines how CineSim fosters autonomy by giving students control over their learning process, enabling them to make decisions and engage in self-directed learning. Additionally, it explores how CineSim's realistic simulations and immediate feedback mechanisms contribute to students' sense of competence, building their confidence and deepening their understanding of media production techniques. By assessing these elements, the research evaluates the overall effectiveness of CineSim in enhancing student motivation and engagement. Relatedness is not discussed in detail, as it is considered less significant for the scope of this study.

RQ3: What are the major challenges in integrating CineSim into media production education within a university context?

The final research question addresses the practicalities of implementing CineSim in an educational setting, identifying potential obstacles and challenges faced by educators and students. It aims to provide insights into the logistical, technical, and pedagogical considerations necessary for the successful adoption of CineSim in media production courses.

Through these research questions, the study contributes to the understanding of how serious games like CineSim can be effectively integrated into media production education to enhance the expression of creativity, foster self-determined learning, and address the practical challenges of modern educational environments.

1.9 An Overview of Thesis Structure

This thesis is structured to provide a comprehensive exploration of integrating CineSim into media production education, addressing the challenges, methodologies, and impacts of this integration. The structure is designed to guide the reader through the research process, from the initial introduction to the final conclusions and discussions. Below is an overview of the thesis structure:

Chapter 1: Introduction

This opening chapter sets the stage for the research by introducing the context of media production education and the challenges it faces. It outlines the motivation behind the development of CineSim, its objectives, and its potential role in addressing educational concerns within media production training. The chapter concludes with the research questions that guide the study.

Chapter 2: Literature Review

The literature review provides a critical examination of existing research related to Serious Games, Self-Determination Theory (SDT), Authentic Learning Theory (ALT), and their applications in educational settings.

Chapter 3: Theoretical Framework

This chapter establishes the theoretical foundation for the study, highlighting the relevance of these theories to the development and integration of CineSim in media production education.

Chapter 4: Research Design

This chapter details the Design-Based Research (DBR) methodology adopted for this study, explaining why it is particularly suitable to explore the integration of CineSim into media production education. DBR has an iterative process of design, implementation, analysis, and redesign, emphasizing the role of feedback in refining CineSim. Besides DBR, as I am also the inventor of CineSim, and the teacher of relevant subjects, an autoethnographic narrative is also adopted to provide data from a first-hand perspective. Also, this chapter provides an overview of the participants of this study, and how the quantitative and qualitative data were collected and analyzed.

Chapter 5: Preliminary Stage of Data Collection for Software Design

CineSim is an educational software I developed to facilitate the learning of media production. In this chapter, I cover the features of CineSim, and provide a mapping on how those features correspond to different theoretical frameworks that support CineSim as an educational software.

Chapter 6: First Round of Data Collection Results and Analysis

The results from the first batch of the data collection phase are presented. The first round of data collection includes how the software can embed learning topics into the gaming environment and how participants responded after they used it. Participant responses provide insights into how an early version of CineSim was perceived by students and educators, highlighting its impact on enriching their learning experiences and facilitating engagement. This chapter also goes deep into the analysis of the first batch of data collected. It examines how users feel towards the design of CineSim, how CineSim influences students' creative expression, and the development of practical skills in media production. Also, it suggests how CineSim can improve to better serve the learning process.

Chapter 7: Second Round of Data Collection Results

After the first round of data was analyzed, and concluded with directions to improve CineSim, CineSim was improved accordingly, and was ready for the second batch of data collection from participants. As with the first batch of data collection, both qualitative and quantitative data were collected for analysis.

Chapter 8: Discussion

This chapter synthesizes the research findings, discussing their significance in the context of media production education and technology-enhanced learning. It reflects on the challenges encountered during the integration of CineSim, including technical and pedagogical issues, and how these were addressed through iterative improvements. The chapter also explores the impact of CineSim on student motivation and learning outcomes, framed by the principles of Self-Determination Theory and Authentic Learning Theory. Furthermore, this chapter proposes a new Framework called the Integrated Motivational and Authentic Learning (IMAL) Framework, a learning design framework that synthesizes principles of Self-Determination Theory (SDT) and Authentic Learning Theory (ALT). IMAL provides a theoretical framework for designing serious games, emphasizing intrinsic motivation through autonomy, competence, and relatedness, as well as authentic, real-world tasks that foster active and reflective engagement. Its application in CineSIm offers a valuable example of how it can guide the creation of educational tools that promote engagement and authentic learning experiences.

Chapter 9: Conclusion

The conclusion highlights the contributions of the study to the field of educational technology and media production training, outlining the potential pathways for further exploration.

Chapter 2. Literature Review

Extensive research has demonstrated that serious games have a positive impact on learning (Michael & Chen, 2006; Dicheva et al., 2015). As a serious game, CineSim is expected to motivate, and help students to learn. This research seeks to comprehensively explore how CineSim impacts the learning journey, enhancing motivation and overall engagement. According to the systematic review on gamification and serious games research by Karth et al. (2021), there are approximately 120 different theories that support these areas. In this thesis, studying the effect of integrating CineSim in formal education, I use Self-Determination Theory (SDT) to explain how students' motivations are enhanced (Ryan & Deci, 2000; Deci & Ryan, 2000), and authentic learning theory (ALT) to explain how they can construct knowledge (Herrington & Oliver, 2000). The most commonly used theory to explain knowledge construction, as proposed by Krath et al. (2021), is experiential learning theory. However, this theory is not adopted in this context because of its significant oversight of the impact of social contexts on learning (Fenwick, 2000). Clearly, cinematic language is deeply rooted in societal and cultural contexts. This makes experiential learning theory a less suitable theoretical framework for this study. Meanwhile, ALT focuses on applying knowledge in practical and real-world situations, which is the centre of media production education. In overview, SDT is employed to explain how students are motivated to learn, while ALT is used to explain how knowledge is constructed when they learn.

This chapter reviews the state of research on serious games in education and positions CineSim within that landscape. Section 2.1 begins by identifying a significant research gap in the current literature. Although research suggests that serious games are effective in disciplines such as medicine (Graafland et al., 2012; Wayne et al., 2005), no study could be found that examined a serious game intervention that targets professional film making, including cinematography and lighting competencies in film education.

The chapter then digs into the concept of serious games in section 2.2. It covers their characteristics, the motivation and engagement they foster, evaluation frameworks, their adoption in practical education scenarios, and their theoretical foundations. This section also explores the relationship between serious games and CineSim, highlighting how CineSim embodies the principles of serious games to enhance learning in media production.

Although CineSim is placed into a unique position in the field, there are some other existing tools about film production, see Section 2.3 for a comparison with CineSim. Together, these sections demonstrate where the literature is established and where gaps remain, thereby justifying the need for this study.

The theoretical basis of CineSim, which is expected to motivate and support learning, is further examined in detail in Chapter 3 Theoretical Framework.

2.1 The Research Gap in Current Research

This study addresses a clear research gap: there is a dire shortage of empirical work exploring the use of educational technology—particularly serious-game simulations—to support professional training in media production. Although other disciplines (e.g., medicine, engineering) have extensively leveraged technology-enhanced learning (Callaghan et al., 2012; Graafland et al., 2012; Wayne et al., 2005), the film-production domain lacks comparable evidence-based guidance for educators.

The field of media encompasses a wide range of forms, including photography, films, drawings, music, and even virtual reality. In this research, the focus is specifically on film-related media. In this theme, scholars often overlook, and underestimate the importance of practical training for professional media production. I tried to search in university library with the keywords: “media”, “film”, “movies”, and “photography”. The result shows that the top 100 research articles in a university library database reveals a significant inclination towards cultural studies, with very little attention given to the practical skills and qualities necessary for professionals in the field of media production. A clear trend in existing literature is observed that scholars prefer to study cultural interpretations of media. There are some studies focusing on production training, for example, Hobbs (2011). However, they primarily treat media production as a means of developing generic skills rather than targeting industry-specific expertise. This study has the potential to make a unique contribution to this area

This research bridges this gap by specifically focusing on professional training in media production. The adoption of a design-based research methodology (DBR), coupled with an autoethnographic narrative, offers a unique perspective on integrating CineSim into the media production curriculum. This approach differs significantly from Herrington and Parker's (2013) research, which concentrated on digital media literacy and emerging technologies. While their study provided insights into digital media literacy and software proficiency, this research shifts the focus to media literacy and the integration of technology to enhance the learning experience in media production education.

Because media-production instructors traditionally favour hands-on teaching in real studio settings, the educational potential of digital technology has been largely overlooked. A systematic search revealed no studies that evaluate a technology-enhanced simulation comparable to CineSim for film-production training. The rapid technological advancements in recent years present a valuable opportunity to explore innovative methods that can augment traditional learning experiences in media production. This research seeks to fill this gap by examining how technology, such as CineSim, can complement conventional practical training, and therefore offer a more effective and comprehensive learning journey for students.

The primary objective of this research is not to replace hands-on practical training but to explore how technology can be integrated with practical training in media production education. By utilizing the benefits of technology, this study aims to enhance the learning experiences of students in media production, and thus equip them with the necessary skills and knowledge for their future careers in the media industry. This integration is expected to provide a more holistic educational experience, combining the theoretical and practical aspects of media production in a way that traditional methods alone may not achieve.

2.2 Serious Games

Serious games represent a unique category within the broader spectrum of digital and non-digital games. They are distinguished by their primary focus on education, training, or other purpose rather than just entertainment. These games combine engaging gameplay with meaningful learning or training content that aim to create an immersive and educational experience (Michael & Chen, 2006). Over the years, the integration of serious games in educational settings has gained more recognition from scholars, with numerous studies showing their ability to significantly boost learning outcomes and enhance student motivation (Sailer et al., 2017).

In addition to serious games, other game-related educational strategies such as gamification and game-based learning (GBL) have also gained attention. Gamification refers to the application of game-like elements, such as points, badges, and leaderboards, in non-game contexts to boost engagement and motivation (Deterding et al., 2011). Unlike serious games, which offer comprehensive game experiences with educational objectives, gamification integrates specific game mechanics into existing educational or training activities.

Based on the systematic literature review by Krath et al. (2021), a few basic principles can be derived to help explain the distinction between Game-Based Learning (GBL) and serious games. GBL is characterized by the design of interactive learning activities that convey concepts and guide students towards an end goal, promoting a student-centred learning environment where students' well-being and soft skills are developed in a playful manner. Serious games, however, are designed with a primary purpose other than pure entertainment, such as education, training, health improvement, or social change, and often involve simulation of real-world events or processes in an engaging and effective way (Krath et al., 2021). In short, GBL adapts existing games or game mechanics to make learning more engaging, whereas serious games are purpose-built as learning or training tools whose gameplay itself embodies the instructional objectives.

CineSim, as an innovative and interactive tool in media production education, exemplifies the application of serious games in an educational context. It provides a digital platform that allows students to practice and test their media production skills. It also blends the immersive nature of serious games with practical learning experiences.

This section delves into the defining characteristics of serious games, examining their impact on motivation and engagement within educational contexts. It discusses frameworks for evaluating their effectiveness and considers the practical application of serious games across various educational scenarios. Additionally, it articulates the theoretical underpinnings supporting their use in learning environments. Finally, the section explores how CineSim embodies serious games principles to facilitate learning in media production, aligning with Self-

Determination Theory (SDT) and Authentic Learning Theory (ALT) to enhance the educational experience.

2.2.1 Characteristics of Serious Games

Serious games stand out due to their unique characteristics, which differentiates them from both traditional educational tools and games designed purely for entertainment. In other words, a serious game acts as pedagogical tool that allows students to learn in a game. Below are some of the keys defining characteristics of serious games.

a. Focused Learning Objectives

Serious games are designed with clear and focused educational goals. Here, CineSim is designed to help students learn how to use visuals to tell story. They provide learners with a structured environment that aligns with specific learning outcomes. It can ensure that the gameplay directly contributes to the acquisition of knowledge and skills (Garris et al., 2002).

b. Immersive and Interactive Environment

These games offer an immersive experience and draw learners into a virtual world where they can interact with various elements and scenarios. This interactivity fosters a sense of presence and engagement that make the learning process more enjoyable and effective (Gee, 2003).

c. Safe and Controlled Learning Environment

Learners can experiment, take risks, and learn from their mistakes in a safe and controlled virtual environment. This aspect of serious games reduces the fear of failure and encourages learners to explore different topics in a risk-free condition (Gee, 2003).

d. Feedback and Assessment

Serious games are able to provide immediate feedback to learners. It helps them to understand the result of their actions and decisions. This continuous feedback loop plays an important role in the learning process, enabling learners to reflect on their performance and make necessary adjustments (Ventura et al., 2013).

e. Realistic and Contextualized Scenarios

Many serious games are designed to simulate real-world scenarios that provide learners with a contextualized learning experience. This realistic simulation feature helps learners to see the relevance of the skills and knowledge they are acquiring, enhancing the transferability of these skills to real-world situations (Squire, 2006).

f. Encouragement of Critical Thinking and Problem-Solving skills

Through challenging gameplay and complex scenarios that do not exist in real world frequently, serious games encourage learners to develop critical thinking and problem-solving skills. Learners are often required to make strategic decisions, analyze situations, and solve problems. All of these contribute to learner’s cognitive development (Van Eck, 2006).

g. Facilitation of Self-Directed Learning

Serious games empower learners to take control of their own learning journey. They can explore the game at their own pace, make decisions based on their own judgments, and take responsibility for their learning outcomes (Gee, 2003).

h. Incorporation of Authentic Challenges

Serious games integrate authentic challenges that replicate the complexities and dilemmas faced in real-world scenarios. This approach ensures that learners are not merely engaging in abstract exercises but are solving problems and making decisions that mirror those in professional and everyday contexts. This characteristic is crucial in preparing students for the demands of the workforce and equipping them with the competencies needed to navigate the complexities of the modern world (Herrington & Parker, 2013).

With all these characteristics, serious games act as a powerful educational tool that engages students, enhances their motivation, and facilitates the way that they acquire valuable skills and knowledge.

2.2.2 Increased Motivation and Engagement through Serious Games

Motivating and engaging learners to enjoy the learning process is one of the most significant advantages of serious games (Ryan et al., 2006; Hamari et al., 2014). The enjoyment and satisfaction generated from gameplay can increase levels of learning focus and engagement, ultimately allowing students to feel accomplishment and develop good command of particular skills (Hamari et al., 2016; Jabbar & Felicia, 2015). The integration of game design elements such as challenges, immediate feedback, and rewards plays a crucial role in enhancing motivation, encouraging learners to engage deeply with the content and remain determined with challenges (Ryan et al., 2006; Sailer et al., 2017). This motivational framework aligns seamlessly with the principles of Self-Determination Theory, which emphasizes the importance of autonomy, competence, and relatedness in fostering intrinsic motivation and engagement (Deci & Ryan, 2000).

2.2.3 Frameworks and Standards for Serious Games Evaluation

The development and evaluation of serious games requires a structured approach to guarantee educational efficacy. Various frameworks and standards have been established to guide the design, implementation, and assessment of serious games. It can ensure that the serious game design aligns with educational objectives and provides meaningful learning experiences.

A popular framework, the Serious Games Design Assessment (SGDA) Framework, proposed by Mitgutsch and Alvarado (2012) offers a comprehensive set of criteria for evaluating the educational effectiveness of serious games. It emphasizes the integration of game mechanics with learning objectives to ensure that the gameplay experience directly contributes to educational goals. The framework covers various dimensions, including the game's context, content, and structure, as well as the players' experience and learning outcomes. By evaluating these dimensions, the SGDA framework helps designers and educators to assess whether the serious game effectively facilitates learning and engagement (Mitgutsch & Alvarado, 2012).

Another popular framework is called Learning-Game Mechanics Framework (LM-GM). Developed by Arnab et al. (2015), the LM-GM provides a holistic approach to assess the educational effectiveness of serious games. It considers a wide range of factors, including the game's design, the learning context, the learners' characteristics, and the intended learning outcomes. The LM-GM emphasizes the importance of aligning the game's mechanics and narrative with educational content to ensure that the gameplay experience is closely linked to the learning objectives. Additionally, the model advocates for the consideration of the learners' experience and the assessment of learning outcomes to provide a comprehensive evaluation of the game's impact on education (Arnab et al., 2015).

While both the SGDA framework and the LM-GM aim to evaluate the educational effectiveness of serious games, their focus and approach are different. The SGDA framework provides a more detailed set of criteria for assessing various dimensions of serious games. It offers a comprehensive view of the game's design and its alignment with learning objectives. On the other hand, the LM-GM takes a holistic approach, considering the broader context of the learning environment and the learners' characteristics in addition to the game's design.

Despite their differences, both frameworks share a common goal of ensuring that serious games are not only engaging and enjoyable but also effective in achieving educational objectives. They emphasize the importance of aligning game mechanics with learning content and assessing the impact of the game on learning outcomes.

For the evaluation of the effectiveness and educational impact of CineSim, SGDA will be adopted. It is because SGDA has a more comprehensive approach to assessment, which aligns well with the multifaceted nature of CineSim. The SGDA framework is particularly suitable to evaluate CineSim as it provides a detailed and clear set of criteria that can assess the game's context, content, structure, player experience, and learning outcomes (Ma et al, 2019; Mitgutsch & Alvarado, 2012). These criteria are essential for CineSim, which aims to offer a realistic simulation environment for media production education.

The SGDA framework's emphasis on the integration of game mechanics with learning objectives is another reason for its selection. CineSim's design incorporates various game mechanics that are intended to facilitate learning in lighting design, cinematography, and storyboard design. The SGDA framework enables the evaluation of how well these mechanics support the educational goals of CineSim.

2.2.4 Adoption of Serious Games in Practical Education Scenarios

The adoption of serious games in practical education scenarios represents an important shift from traditional one-way teaching methods to more interactive and student-centred learning approaches. In disciplines that require hands-on experience, such as media production, healthcare, engineering, and other technical fields, serious games potentially offer an innovative solution to help learners acquire practical skills.

Serious games in practical training allow students to engage in simulated environments that closely replicate real-world scenarios. This immersive experience is valuable for students who may not have immediate access to physical resources or equipment due to logistical, financial, or safety constraints (Graafland et al., 2012). In healthcare education, for example, serious games have been used to train medical professionals in a variety of skills, from surgical operations to patient communication. Meta-analytic evidence shows that repeated gameplay shortens time-to-competence and reduces error rates on first live procedures, largely because the simulations provide unlimited practice opportunities with no risk to patients (Graafland et al., 2012). By simulating medical scenarios, students can practice and develop skills in a controlled, risk-free environment; the immediate feedback and iterative cycles embedded in these games reinforce psychomotor routines and clinical decision-making, leading to improved performance and higher self-confidence in real clinical settings (Graafland et al., 2012; Wayne et al., 2005; Nassar et al., 2016). Very similarly to CineSim, a serious game called Play Your Way Into Production (PYWIP) developed by the University of York is designed to encourage users to probe and store simulations that they can later apply to real-world situations requiring familiarity, confidence, agency, and choice-making (Brereton et al., 2024). Early evaluations of PYWIP highlight the importance of authentic task sequences—such as scheduling shots or balancing lighting budgets—for transferring in-game learning to on-set practice, a finding that further underpins the rationale for CineSim's design.

For engineering education, the effectiveness of serious games is exemplified by the development of Circuit Warz. The game is designed to increase student engagement and retention by teaching the theoretical and practical principles of electronic engineering in an immersive, problem-centred manner. Callaghan et al. (2012) applied the *Learning Mechanics–Game Mechanics* (LM–GM) framework to analyse Circuit Warz, demonstrating how carefully aligned mechanics can transform engineering education by providing highly engaging learning experiences that are both educational and enjoyable. The game offers several escalating levels—ranging from series-parallel resistor networks to oscillator design. It requires learners to diagnose faults and rebuild circuits against a countdown timer. This structure delivers three documented advantages: (i) unlimited, low-risk repetition, enabling beginners to consolidate abstract circuit laws before touching real hardware; (ii) embedded formative assessment, because every correct repair updates a live score and unlocks the next scenario, thereby giving instantaneous feedback on misconceptions; and (iii) competitive-collaborative play, where students can work in teams or race peers online, a format shown to boost time-on-task and deepen peer explanation during laboratory follow-ups (Callaghan et al., 2012). Together, these features have been linked to higher module-completion rates and improved examination performance in introductory electronics courses, underscoring the potential of genre-specific serious games to bridge theory and hands-on practice.

Further, being real is also a key to serious games. Aligning in-game activities with real-world practices is crucial for maximizing educational outcomes. Reeve (2009) takes Axon as an example to emphasize that when game exercises closely mirror actual scientific experiments, the skills acquired become more transferable to real-world contexts. Subsequent empirical work supports this claim. Surgical trainees who rehearsed laparoscopic steps in the high-fidelity game Touch Surgery performed significantly faster and with fewer errors during their first live procedures (Kowalewski et al., 2017), while engineering students using the VR welding simulator Soldamatic retained psychomotor accuracy for at least two weeks after training (Liu et al., 2023). Similarly, in the cybersecurity domain, a detective-themed serious game called SherLOCKED demonstrates how embedding realistic challenges can improve learners' problem-solving skills and engagement, with participants reporting stronger confidence in applying cybersecurity concepts to practical threat scenarios (Jaffray et al., 2021). This alignment ensures that players are not merely engaging with abstract concepts but are practicing procedures and problem-solving strategies directly applicable outside the game environment. Such realism not only enhances the learning experiences but also increases the likelihood of skill retention and successful transfer to professional practice.

The integration of serious games into practical education training is not without challenges. It requires careful consideration of game design to ensure that educational objectives are met and that the game mechanics align with the desired learning outcomes. Additionally, the assessment of learning in game-based environments must be thoughtfully developed to accurately measure the acquisition of skills and knowledge (Arnab et al., 2015).

2.2.5 Theoretical Foundations of Serious Games in Education

Serious games serve as powerful educational tools, and their effectiveness can be understood through various learning theories. Two major theories that explain the design and application of serious games in educational settings are Self-Determination Theory (SDT) (Deci and Ryan, 2000) and Authentic Learning Theory (ALT) (Herrington & Oliver, 2000). To put it simply, SDT explains one's motivation to join the learning journey, while ALT explains how learning happens.

Self-Determination Theory (SDT), proposed by Deci and Ryan (2000), emphasizes the importance of autonomy, competence, and relatedness in fostering internal motivation. In the context of serious games, SDT helps explain how these digital environments can be designed to satisfy learners' psychological needs, and therefore enhance their motivation to engage with the content and persevere in the learning process. For instance, serious games that provide players with choice and a sense of control (autonomy), clear goals and feedback (competence), and opportunities for interaction and collaboration (relatedness) are more likely to result in a motivated and engaged learner (Ryan & Deci, 2017).

Authentic Learning Theory (ALT), on the other hand, focuses on creating learning environments that mirror real-world contexts. It allows learners to engage in complex, meaningful tasks that have relevance to their lives and future careers (Herrington & Oliver, 2000). Serious games designed with ALT principles provide immersive, realistic scenarios where learners can apply their knowledge and skills obtained in lessons, in authentic contexts. It fosters the transferability of learning from classroom to problems in real-world settings.

2.2.6 Relationship between Serious Games and CineSim

CineSim's design is mainly based on the principles of SDT and ALT. This approach makes it a standout example of serious games in media production education. The game's interface and mechanics are carefully designed to grant users a high degree of autonomy, which is a fundamental aspect of SDT. This is achieved by enabling users to navigate through the game, make choices about their projects, and control the pace of their learning. All of these align with Deci and Ryan's (2000) emphasis on volition and self-endorsement in one's activities.

Besides, CineSim's design thoughtfully addresses the psychological need for competence. Instead of presenting traditional challenges, the game focuses on providing immediate feedback and responses to user actions. This feature is crucial as it allows learners to see the result of their actions in real-time. It can reinforce their sense of competence and effectiveness (Ryan & Deci, 2017). Such immediate feedback loops are essential for fostering intrinsic motivation, as they enable learners to quickly understand the impact of their actions and adjust their strategies accordingly. The game's interactive nature ensures that users are constantly engaged in a cycle of action, feedback, and learning, which sustains their interest and promotes a deeper understanding of the subject matter (Kolb, 1984).

From the perspective of ALT, realistic simulation of media production environments in CineSim offers an authentic context for learning. As suggested by Herrington and Oliver (2000), it is essential to allow learners to explore and test in simulated environments that reflect real-world practices. Only then, meaningful learning can be created. Authenticity is further enhanced by including real-world professional settings and practices in simulated environment, allowing students to apply their knowledge in a context that closely resembles professional media production settings (Lombardi, 2007).

2.3 Comparison of existing applications with CineSim

CineSim occupies a distinctive position in media-production education. While several other applications—Storyboarder, CineTracer, Previz Pro, and Play Your Way into Production (PYWIP)—offer elements of film simulation or pre-visualisation, none address the full pedagogical gap identified in this study. The following comparison (Table 1) is not intended to rank these tools, but to highlight how CineSim's feature set aligns uniquely with higher-education learning objectives and therefore underpins the contribution of this research.

Feature	CineSim	Storyboarder	CineTracer	Previz Pro	Play Your Way into Production (PYWIP)
Purpose	Formal HE training; DBR aligned learning objectives	Preparing storyboard for production	Pre-visualization for professionals	Simple pre-visualization	On-job experience
Pedagogical Design	SDT + ALT, in-game prompts	N/A	N/A	N/A	Authentic Learning, role based exploration
Asset Library	15 maps, 2000+ props	Less than 20	Limited Studio presets	~200 props	1 Map
Accessibility	Runs on mid-spec PCs	PCs and Mac	High-end PCs and Mac	iPads and iPhones and Mac	PCs
Others	Easy UI, different customized and import function	Minimal design, drawing function	Realistic rendering, many online resources	Minimal design	Situation based, player makes choices based on different scenario

Table 1. Comparison Table on different tools

Table 1 shows that only CineSim was conceived from the outset as a pedagogically driven training platform: its activities are mapped to Self-Determination Theory and Authentic Learning Theory, and its prompts align with DBR-derived learning objectives. The other tools each cover a single niche—Storyboarder offers quick sketch panels, Cinetracer targets high-end pre-visualisation for professionals, Previz Pro provides lightweight mobile pre-visualisation, and PYWIP delivers a role-play taster of industry life—but none combine a substantial asset library, curriculum-aligned feedback, and mid-specification PC accessibility. CineSim's 15 photorealistic maps and 2000+ props let students rehearse full lighting and camera workflows that previously required expensive studio time, while its easy-to-customise interface and import function allow lecturers to build tasks that mirror their own course briefs. It provides great autonomy to the user. By uniting authentic production tasks with a theoretically grounded learning architecture, CineSim fills the gap for a serious game that can deliver repeatable, classroom-ready practice in film and media-production education.

Chapter 3. Theoretical Framework

In this chapter, the theories underpinning this study, including Self-Determination Theory (SDT) and Authentic Learning (ALT) are covered, as well as how this study applied those theories.

This study adopts SDT and ALT because together they cover the two dimensions of the research gap in media-production education. SDT explains how CineSim can sustain motivation. Its game mechanics are designed to satisfy learners' needs for autonomy and competence. ALT complements this by specifying what the learning tasks should look like. They must replicate real studio workflows to maximise potential skill transfer to industry. Similar frameworks were considered, for example, Flow Theory and Experiential Learning. Yet, they do not address both motivational quality and real-world fidelity as comprehensively. The SDT-ALT pairing therefore offers the most suitable framework for designing CineSim to motivate students and deliver industry-relevant skill acquisition, their limitations are acknowledged later in this chapter.

3.1 Self-Determination Theory (SDT)

Self-Determination Theory (SDT), a seminal theory developed by Deci and Ryan in the 1980s, has significantly influenced our understanding of human motivation, particularly within educational contexts (Deci & Ryan, 1985; Ryan & Deci, 2000). This comprehensive framework posits that individuals possess innate psychological needs, and the fulfillment of these needs is paramount for optimal functioning, well-being, and enhanced learning outcomes (Deci et al., 1991; Niemiec & Ryan, 2009). The following sections provide a detailed exploration of SDT, explaining its key components, applications in education, empirical evidence underscoring its validity, and its pertinence in contemporary educational settings.

3.1.1 Key Components of Self-Determination Theory

Self-Determination Theory (SDT), formulated by Deci and Ryan, serves as a robust framework for understanding the complexities of human motivation and behavior, shedding light on the driving forces behind individual actions (Deci & Ryan, 1985; Ryan & Deci, 2000). Central to SDT are three essential psychological needs deemed universal and crucial for optimal human functioning and well-being, they are autonomy, competence, and relatedness (Deci & Ryan, 2000).

Autonomy in SDT is not simply allowing learners to do whatever they want nor complete independence from external input. Rather, it refers to acting with a sense of volition. It endorses one's behavior as personally meaningful, even when that behavior occurs within externally provided boundaries (Ryan & Deci, 2017). Three instructional supports operationalise autonomy:

- Choice provision – giving learners meaningful options.
- Rationale – explaining why a task or rule matters.
- Acknowledgement of perspective / non-controlling language.

When these supports are present, compliance becomes self-endorsed. A student follows the assignment not to avoid punishment or chase points but because the task aligns with personal or professional goals. Empirical studies show that such autonomy-supportive conditions lead to deeper engagement, higher creativity, and greater persistence (Amabile, 1996; Deci et al., 1991; Niemiec & Ryan, 2009). Conversely, controlling feedback like "You must do exactly like this" ruins autonomy and shifts motivation toward externally regulated forms. By dissecting autonomy into choice, rationale, and voice—and illustrating how each is embedded in CineSim—this study provides a clearer, practice-oriented analysis of the construct.

Competence involves the need to effectively interact with one's environment, experience developing ability, and utilize and enhance one's skills (Deci & Ryan, 2000). It is about feeling proficient and capable in undertaking activities, which is pivotal for fostering intrinsic motivation and engagement (Ryan & Deci, 2000). Environments that offer optimal challenges, clear objectives, and constructive feedback support the need for competence, thereby boosting motivation and performance (Vallerand & Reid, 1984; Guay et al., 2008).

Relatedness encompasses the need to establish connections with others, to give and receive care, and to experience a sense of belonging (Baumeister & Leary, 1995). It involves forming secure and supportive relationships, which is vital across various life domains, from education and work to healthcare and sports (Deci & Ryan, 2000). When individuals experience relatedness, they are more likely to take on the group's values and act on them willingly. (Ryan & Deci, 2000).

SDT also categorizes motivation along a continuum, ranging from amotivation, characterized by a lack of intentionality and purpose, to intrinsic motivation, where actions are driven by genuine interest and enjoyment. Between these extremes lie various forms of extrinsic motivation, where behavior is influenced by external rewards or pressures. For example, a student might initially engage in an activity due to external rewards (external regulation), gradually value its importance (identified regulation), and eventually integrate it into their sense of self (integrated regulation), moving toward more autonomous forms of motivation. SDT underscores the significance of the quality of motivation, advocating that autonomous motivation (intrinsic and well-internalized extrinsic motivation) is linked to more favorable outcomes than controlled motivation (external and introjected regulation) (Ryan & Deci, 2000; Deci & Ryan, 2008).

By fostering these fundamental psychological needs, various stakeholders, from educators and employers to healthcare professionals, can cultivate environments that promote autonomous motivation, culminating in enhanced performance, persistence, and well-being (Deci & Ryan, 2000; Ryan & Deci, 2017).

3.1.2 Applications of Self-Determination Theory in Education

SDT has been extensively applied in educational settings, demonstrating significant impacts on student motivation and learning outcomes. When educators align their teaching practices with the principles of SDT, they create an environment that supports students' innate psychological needs, leading to enhanced intrinsic motivation and engagement (Niemiec & Ryan, 2009).

In practical terms, this can be observed in project-based learning environments where students are given the autonomy to choose their topics and methodologies. This sense of control and ownership over their learning journey fulfills their need for autonomy, fostering intrinsic motivation and engagement (Stefanou et al., 2004). Furthermore, providing clear expectations and timely feedback addresses the need for competence, as students are able to gauge their progress and understand what is required to excel (Hattie & Timperley, 2007).

Digital learning platforms such as Khan Academy[4] and Duolingo[5] offer concrete examples of how technology can be utilized to support students' psychological needs in accordance with SDT. Khan Academy's personalized learning dashboard allows students to learn at their own pace, enhancing their sense of autonomy (Khan, 2012). Additionally, the platform's instant feedback mechanisms address students' need for competence, helping them to identify areas of strength and weakness.

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[4] https://www.khanacademy.org/

[5] https://www.duolingo.com/

Duolingo employs gamified elements to make language learning engaging, while also providing immediate feedback and tailored challenges, catering to students' needs for autonomy and competence (Vallerand, 1997).

Online forums and collaborative projects facilitated by digital platforms also contribute to fulfilling students' need for relatedness. Tools such as Google Classroom[6] and Slack[7] create virtual communities where students can collaborate, share resources, and engage in discussions, fostering a sense of belonging and connectedness (Ateş & Köroğlu, 2024).

By integrating these SDT-aligned practices and tools into educational settings, educators can create a conducive learning environment that not only supports students' psychological needs but also enhances their motivation, engagement, and academic performance.

3.1.3 Empirical Evidence Supporting Self-Determination Theory in Education

The principles of SDT are well-supported by a range of empirical evidence, particularly in educational contexts. The studies cited in this section were selected because they represent a diverse range of educational contexts, such as middle school and higher education, and from students' and teachers' perspectives. They provide robust, well-cited empirical evidence for the theory's core proposition. They consistently demonstrate that when students' basic psychological needs for autonomy, competence, and relatedness are satisfied, they experience a range of positive outcomes (Deci et al., 1991; Reeve, 2002; Niemiec & Ryan, 2009).

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[6] https://classroom.google.com/

[7] https://slack.com/intl/en-gb

Research by Taylor et al. (2014) in higher education settings found that students who perceived their learning environment as supportive of their autonomy and competence showed higher levels of intrinsic motivation and engagement. These students also reported greater overall satisfaction with their educational experience, highlighting the critical role of need satisfaction in fostering positive educational outcomes.

In a study conducted by Niemiec and Ryan (2009), middle school students who reported higher levels of autonomy and relatedness in their classes also demonstrated greater academic achievement and well-being. This study provides empirical evidence for the positive association between need satisfaction and academic performance, further validating the applicability of SDT in educational settings.

Jang et al.(2010) conducted a longitudinal study examining the impact of teacher autonomy support on student engagement and achievement. The findings revealed that students who perceived their teachers as supportive of their autonomy displayed increased engagement over time, which in turn predicted higher academic achievement.

These studies collectively underscore the importance of creating educational environments that support students' basic psychological needs. By doing so, educators can enhance students' intrinsic motivation, engagement, and academic success, ultimately contributing to their overall well-being and development.

3.1.4 Criticisms, Limitations, and Responses to Self-Determination Theory

SDT has significantly influenced our understanding of human motivation, especially in educational contexts. Despite its widespread acceptance and application, the theory still receives certain criticisms and has limitations, which have led to further discussions and refinements to enhance its applicability and validity.

a. Overemphasis on Autonomy

Critics argue that SDT may overemphasize autonomy and therefore overlook the need for structure and guidance, especially in classrooms where shared goals and teacher direction are valued (Iyengar & DeVoe, 2003). Scholars that support SDT clarify that autonomy does not mean the absence of structure. Instead, it is the experience of volition and ownership even within well-defined boundaries (Ryan & Deci, 2017). For example, a teacher can supply explicit criteria and guidance while still supporting autonomy by (a) allowing students to choose their topics, (b) explaining the personal or professional value of the task, and (c) using non-directive language that acknowledges students' decision. Such practices, often summarized as choice, rationale, and voice, show that autonomy and structured guidance are complementary rather than contradictory. Empirical studies confirm that this "autonomy-supportive structure" promotes higher engagement and deeper learning than either laissez-faire freedom or rigid control (Reeve, 2002; Vansteenkiste et al., 2012).

b. Broadness of the Theory

Some critics have argued that the broad nature of SDT, covering a wide array of human behaviors and motivations, can make it challenging to test and validate specific hypotheses (Iyengar & DeVoe, 2003). Supporters responded that this conceptual breadth is indeed a strength. It allows the integration of multiple motivational constructs (e.g., goal contents, causality orientations) within a single coherent framework and provides a common language for cross-disciplinary dialogue. They also note that more than four decades of empirical work—spanning education, work, health, and sport—reveal a consistent pattern. When autonomy, competence, and relatedness, three constructs of SDT are supported, adaptive outcomes follow (Deci et al., 1991; Ryan & Deci, 2017). This empirical evidence supports the validity of SDT. To address domain-specific concerns in the present study, CineSim's design and data collection include measures tailored to creative freedom and aesthetic decision-making, thereby testing SDT propositions in a context where evidence is still sparse.

c. Complexity in Measurement

Measuring the psychological needs and types of motivation outlined in SDT can be challenging, with potential overlap between different constructs. To address this, researchers have developed various validated scales and instruments (Sheldon & Hilpert, 2012). Despite these efforts, the complexity of measurement remains a challenge (Deci & Ryan, 2000). For instance, the Self-Determination Scale (SDS) is designed to assess the degree to which an individual feels self-determined, but distinguishing between intrinsic and extrinsic motivation can sometimes be confusing (Ryan & Deci, 2017). Recent work has introduced more fine-grained tools, such as the Basic Psychological Need Satisfaction and Frustration Scale (Chen et al., 2014) and the updated Behavioral Regulation in Exercise Questionnaire (Cid et al., 2018). Ongoing research therefore combines multiple methods—self-report inventories, behavioural traces, observational coding, and experimental manipulations—to triangulate findings and mitigate measurement complexity, thereby enhancing overall validity (Deci & Ryan, 2000; Ryan & Deci, 2017).

While SDT has encountered criticisms and limitations, continuous research and discussions in the field are addressing these issues, further solidifying the theory's foundation. The extensive empirical support and its broad application across diverse domains and cultures emphasises SDT's strong relevance and validity as a framework for understanding and fostering human motivation (Ryan & Deci, 2000; Chirkov et al., 2003; Gagné & Deci, 2005; Deci & Ryan, 2008; Niemic & Ryan, 2009).

3.1.5 Relevance of SDT to CineSim

In the innovative educational landscape, CineSim emerges as a powerful tool, intricately aligned with the principles of SDT, to foster a conducive learning environment in media production. By providing a photorealistic 3D simulation for practical skills development in lighting design, cinematography, and storyboard creation, CineSim directly addresses SDT's core component of competence. Students are not just passive recipients of knowledge. Instead, they actively engage in the learning process, experimenting and receiving immediate feedback. This real-time interaction and the sense of progression and developing ability it brings are crucial in nurturing intrinsic motivation and a strong desire to learn and improve.

Firstly, CineSim exemplifies the SDT principle of autonomy by giving learners room to create and decide. More than 2000 drag-and-drop assets and 15 pre-built sets allow students to design a very wide range of scenes. Learners have a high level of freedom when making their own creation. It is scaffolded through the three well-established autonomy-support strategies:

- Choice provision: Learners can pick the shooting genre (e.g., horror, comedy), choose between multiple lighting designs, or decide what shots are going to be taken. These choices are meaningful because they change the end product.
- Rationale: Brief lecturer guidance, and tutorial videos are available explaining how certain set ups contribute to certain results. Students know "why" but are not blindly following instructions.

- Acknowledgement of perspective (non-controlling language): During teacher-led walkthroughs and critique sessions, guidance is framed as suggestions—“You might try lowering the key light for a moodier look”—rather than commands. Students’ choices are still valued and they can try the outcome freely based on their wish.

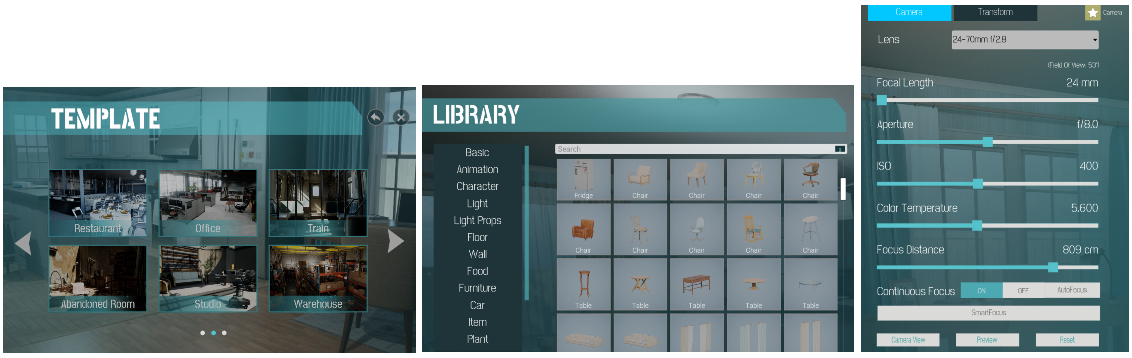

Figure 1. Map Templates, Assets Library and Virtual Camera Setting in CineSim (From left to right)

Together, these design elements ensure that autonomy in CineSim is not just lots of buttons, but a structured freedom where students’ decisions matter, their creative vision surfaces, and the reasoning behind professional standards is transparent.

Further, competence in CineSim comes from instant cause-and-effect feedback: switch on a light and the set brightens immediately; change aperture or ISO and the virtual camera instantly shows the new exposure. This real-time response lets learners see the impact of each adjustment instantly and quickly builds technical confidence.

While CineSim is primarily a single-player experience, it incorporates some elements that touch on the SDT principle of relatedness, although this aspect is less emphasized compared to competence and autonomy. Through opportunities to share their work, receive feedback, and engage in discussions, students can still experience a degree of connection within a learning community. This sense of shared experiences and collaborative engagement can enhance motivation and engagement, even if relatedness is not a primary focus of CineSim's design.

Aligning its design and functionality with the tenets of SDT, CineSim stands out as a pedagogical tool that not only enhances the acquisition of practical skills but also deeply engages and motivates students. It transforms the learning experience, and makes it more meaningful, enjoyable, and aligned with the innate psychological needs that drive human motivation and learning.

Addressing one of the criticisms of SDT - the overemphasis on autonomy - does not diminish the applicability of SDT to CineSim. In fact, CineSim provides an open-world platform that empowers students with a high degree of autonomy, allowing them to experiment with various creative settings. This autonomy is a core feature of the learning experience within CineSim. However, it is complemented by the potential for guidance from teachers, ensuring that students' creative explorations remain guided by teachers. Thus, the integration of SDT within the CineSim framework remains authentic and effective, as it balances autonomy with structured learning opportunities.

3.2 Authentic Learning Theory (ALT)

Authentic Learning Theory (ALT) suggests that learning is most effective when students are engaged in tasks that replicate the complexity and relevance of real-life situations. This pedagogical approach believes that learning should not be limited to the acquisition of knowledge. It should be further extended to the application of knowledge that reflects how it will be used in real life (Herrington & Oliver, 2000). ALT is not only about simulating real-world tasks, but it involves creating learning experiences that are inherently meaningful and engaging for the learner (Lombardi, 2007).

Making learning heavily related to real-world scenarios is the backbone of ALT. When learners see that materials are relevant to their own lives and future careers, their internal motivation is enhanced, and further leads to deeper engagement and retention of knowledge (Herrington & Oliver, 2000). This approach aligns with constructivist learning theory, which emphasizes the learner's active role in constructing knowledge through experiences (Piaget, 1973). Furthermore, ALT is deeply influenced by the educational principles of John Dewey. Dewey suggested that education should be firmly rooted in experience and practical application (Dewey, 1963).

Authenticity is one of the key features of ALT. It is not just a characteristic of the learning task, but it should also be reflected in the assessment methods, the role of the instructor, and the collaborative nature of the learning environment (Herrington et al., 2010). Authentic tasks are typically complex, and it requires a strong and continuous engagement from learners. The product or outcome should be valuable on its own, and not just as a demonstration of what learners acquire (Rule, 2006). This approach encourages learners to produce work that is meaningful and has real-world application or significance, rather than just being a token demonstration of their acquired knowledge or skills. This not only enhances the authenticity of the learning experience but also motivates learners by giving them a sense of accomplishment and purpose.

Education for the 21st century is increasingly recognizing ALT as an essential tool for preparing students for the complexities of the modern world (Herrington & Oliver, 2000; Lombardi, 2007). By engaging students in authentic tasks, educators can facilitate the development of higher-order thinking skills, such as analysis, synthesis, and evaluation, which are crucial for success in the 21st century (Lombardi, 2007).

3.2.1 Theoretical Foundations of Authentic Learning Theory (ALT)

ALT is deeply rooted in constructivist theory. It posits that learners should actively construct their own understanding and knowledge of the world through experiences and reflection (Bruner, 1966; Piaget, 1973). Piaget (1973) described the generation of knowledge as a process of "equilibration”. When the learner's existing knowledge interacts with new experiences, new knowledge is therefore generated.

Jerome Bruner (1966) expanded on the constructivist approach further, emphasizing the importance of discovery in learning. Bruner (1966) advocated for teaching methods that encourage students to inquire, explore, and evaluate their knowledge. In ALT, this translates into learning activities that are investigative and exploratory, and driven by students' curiosity rather than external forces.

John Dewey's educational philosophy also significantly influenced ALT. Dewey (1963) believed that education should be rooted in real-life situations, with learners engaging in experiences closely related to their lives. ALT embodies this principle by creating learning experiences that replicate the complexities and contexts of the real world (Herrington & Oliver, 2000). His concept is pretty straightforward, that is, “learning by doing”.

Furthermore, Vygotsky's social constructivism theory (Vygotsky, 1978) also acts as a backbone for ALT. He introduced the concept of the Zone of Proximal Development (ZPD), which helps to enhance understanding of the role of social interaction in learning. In simpler terms, the ZPD suggests that understanding of certain knowledge can be enhanced with the help of more knowledgeable peers or partners. ALT incorporates this concept by designing environments that foster collaborative problem-solving, and extends learning beyond individual capabilities (Vygotsky, 1978; Palincsar, 1998).

ALT combines these perspectives into a framework that emphasizes context, social interaction, and the learner's active role in knowledge construction. It draws from constructivism and applies these ideas in practical and real-world learning scenarios.

3.2.2 Herrington's Framework for Authentic E-Learning

Jan Herrington's framework for authentic e-learning provides a structured approach to designing e-learning experiences that are engaging, relevant, and effective for learners to acquire new knowledge. Herrington and her colleagues, Thomas C. Reeves and Ron Oliver, identified nine crucial elements that are regarded as essential components for authentic e-learning (Herrington et al., 2010). These elements serve as a guide for educators to create online learning environments that closely mimic real-world scenarios and challenges. These points are illustrated below.

a. Authentic Context

The learning environment should emulate the context in which the knowledge will be applied. This means creating scenarios that closely resemble real-life settings, making the learning experience more meaningful and helping learners understand the practical application of their knowledge.

b. Authentic Tasks

Tasks should be complex and reflect real-world challenges. Students should be required to define the tasks and sub-tasks necessary to complete the activity, promoting a deeper understanding of the subject matter and developing problem-solving skills.

c. Access to Expert Performances and Modelling of Processes

Learners should have the opportunity to observe and analyze the performances of experts. This exposure helps them understand the processes and standards of professional practice and provides a model for them to emulate.

d. Multiple Roles and Perspectives

By engaging with different viewpoints and roles, learners can approach problems from various angles. This diversity encourages critical thinking and helps students develop a multifaceted understanding of complex subjects.

e. Collaborative Construction of Knowledge

Learning is often a social process, and collaboration among peers can enhance understanding. Through discourse and shared experiences, learners can construct knowledge collectively, which mirrors the collaborative nature of professional environments.

f. Reflection

Reflective practices enable learners to consider their learning processes and outcomes critically. This not only reinforces the material learned but also promotes self-regulation and the ability to evaluate one's own understanding and skills.

g. Articulation

As learners progress, they should express their knowledge, thought processes, and decision-making. This articulation can take many forms, such as discussions, presentations, or written assignments, and is crucial for reinforcing learning and communication skills.

h. Coaching and Scaffolding by the Teacher at Critical Times

Authentic e-learning emphasizes the role of instructors as more than just providers of information. Instead, they act as mentors or coaches who guide and support learners, particularly when they face challenges or complex tasks. This approach is akin to an apprenticeship model where the mentor provides just enough assistance to help the learner progress, but not so much that it diminishes the learner's active role in problem-solving (Herrington et al., 2014; Barab & Duffy, 2012).

i. Authentic Assessment

Assessments should be integrated with the tasks and context to evaluate learners based on their performance in tasks that simulate real-world challenges. This approach ensures that assessments are not only about recalling information or memories from the lesson, but also about applying knowledge in practical situations.

This framework stands out for its focus on real-world relevance that ensure that the skills and knowledge acquired by learners are practical and transferable, which makes it a crucial aspect in motivating learners and enhancing the applicability of their learning (Herrington et al., 2010). These nine essential elements address all critical components of authentic learning, from context and tasks to assessment and reflection. It provides comprehensive guidelines for educators to design a holistic learning experience (Herrington et al., 2010). The framework's emphasis on complex tasks and problem-solving promotes the development of higher-order thinking skills, aligning well with constructivist learning principles and fostering critical thinking and creativity (Rule, 2006). Additionally, the authentic tasks and contexts provided lead to increased learner engagement and intrinsic motivation, as students find the material more relevant and interesting (Lombardi, 2007).

Project-based learning (PBL), as another approach that provides a guide for the educators to design activities, is similar to Herrington's framework. Both frameworks advocate for real-world relevance and learning by experience. However, they differ in their focus and methodological implementations, leading to the selection of Herrington's framework for this specific research context (Herrington et al., 2010; Krajcik & Shin, 2014). Here is a comparison of these two frameworks.

Comparison of Frameworks:

- Active Construction and Scaffolding: PBL emphasizes learners' active engagement in constructing knowledge, supported by scaffolding in line with Vygotsky's Zone of Proximal Development (ZPD) (Vygotsky, 1978). This principle is shared by Herrington's framework, which also values active learning but with a specific emphasis on e-learning environments (Herrington et al., 2010).

- Situated Learning and Authenticity: Both frameworks value situated learning, with PBL focusing on projects that reflect real-life challenges (Krajcik & Shin, 2014), and Herrington's framework detailing the creation of e-environments that simulate professional practices (Herrington et al., 2010).

- Social Interaction: PBL highlights the importance of collaborative learning and social interaction, drawing from the concept of communities of practice (CoP) (Wenger, 1998). While Herrington's framework also acknowledges the role of collaboration, it offers specific strategies for fostering interaction in an online context (Herrington et al., 2010).

- Use of Cognitive Tools: Krajcik and Shin (2014) discuss the role of cognitive tools in facilitating PBL, aligning with Herrington's advocacy for digital resources to support authentic e-learning tasks. Herrington's framework, however, is more explicit in how these tools can be optimized within e-learning platforms (Herrington et al., 2010).

Rationale for Framework Selection:

This research adopted Herrington's Authentic E-Learning framework over PBL with the following considerations:

- E-Learning Specificity: Herrington's framework is designed specifically for e-learning environments. It offers detailed principles for designing, implementing, and assessing online authentic learning experiences (Herrington et al., 2010). This specificity aligns closely with the research focus on enhancing media production education through digital platforms.

- Structured Approach to Authenticity: While PBL provides a broad pedagogical strategy suitable for various educational settings, Herrington's framework offers a more structured approach to ensure authenticity in tasks and assessments (Herrington et al., 2010). It explicitly addresses the challenges of simulating real-world practices in a virtual environment, which is critical for media production education.

To conclude, while PBL offers valuable insights into active learning and collaboration, Herrington's Authentic E-Learning framework is chosen for its direct applicability to e-learning environments and its structured methodology for creating authentic online learning experiences.

3.2.3 ALT Real-World Applications and Case Study in Professional Training

ALT is a useful framework in professional training contexts (Winstone & Avery, 2018; Ng & Lam, 2019). Its emphasis on real-world relevance and application is particularly suitable to different practical professions where there is often a requirement to integrate learning with their professional responsibilities and personal experiences. This section discusses the implementation of ALT in professional training scenarios, and these scenarios cover medical training and legal practice.

In the healthcare industry, ALT is applied extensively through the use of realistic simulations that replicate patient interactions and emergency response scenarios (Lateef, 2010; Graafland et al., 2012). These simulations are designed to replicate the complexities of real-life medical situations. They provide healthcare professional practitioners (e.g. Nurse, doctors) with a safe but realistic environment to practice and polish their clinical skills. The Nursing school in the Hong Kong Polytechnic University recently released a virtual reality (VR) platform to train nursing students (PolyU, 2022). The design of such simulations often includes the use of a sophisticated VR system that can mimic human responses to medical interventions, as well as enable role-playing with non-player characters (NPCs) in VR to simulate patient interactions. This immersive approach not only enhances the learning experience by allowing learners to apply theoretical knowledge in a practical setting it also improves efficiency by providing immediate feedback through debriefing sessions. As a result, healthcare professionals are better prepared for actual patient care (Lateef, 2010).

In the fields of project management and legal practice, ALT activities such as simulations of complex projects and mock trials are integrated into professional training (Savelsbergh et al., 2016; Wiggins & McTighe, 2005). These simulations are designed to present learners with real-world challenges and require them to apply theoretical principles to resolve issues effectively. For instance, in project management training, participants may engage in a simulated project where they must utilize project management methodologies to navigate obstacles and make strategic decisions. Similarly, in legal education, mock trials and negotiation simulations provide learners with the opportunity to practice litigation and negotiation strategies in a controlled, yet realistic environment. These activities not only solidify the learners' understanding of legal and project management concepts but also enhances their practical skills and self-efficacy. The success of these methods in improving the transfer of skills to the workplace shows the value of ALT in professional education (Savelsbergh et al., 2016; Wiggins & McTighe, 2005).

3.2.4 Discussion on the Effectiveness of ALT

The effectiveness of Authentic Learning Theory (ALT) in educational practice has always been the focus, and the topic of debate in academia. This section critically evaluates the efficacy of ALT, with comparison to other learning theories to provide a deep understanding of its place in educational pedagogy.

ALT's core belief is that learning is most effective when it is active, engaging, and situated within a context that replicates real-life situations. This approach has been lauded for its ability to foster higher-order thinking skills, such as analysis, synthesis, and evaluation, which are crucial in adult learning and professional development (Herrington & Oliver, 2000). Moreover, the emphasis on authentic tasks has been shown to enhance learner motivation and engagement, leading to improved learning outcomes (Lombardi, 2007).

Criticisms and response

Some critics argue that the implementation of ALT can be resource intensive. It requires significant time and effort to design and facilitate authentic learning environments (Barab, et al., 2000). There is also the challenge of ensuring that the simulated scenarios can sufficiently reflect the complexities of real-world situations, which can be difficult to achieve in a controlled educational setting.

The above criticism is true. However, the advantages may outweigh the disadvantages. Here are some responses to these criticisms that highlight the long-term value and effectiveness of ALT.

While the initial investment required to create authentic learning environments might be significant, the potential long-term benefits for learners are considerable. Accessible technologies, such as computers and affordably priced VR goggles, have made it easier for a wide audience to engage with these immersive learning experiences. Such equipment opens opportunities for a large number of learners to benefit from authentic environments. This democratization of access not only enhances the learning experience but also ensures that a broader segment of the population can enjoy the rich, interactive educational opportunities these technologies provide. Also, due to the fact that technology has rapidly developed recently, it has become easier and more cost-effective to create realistic simulations. Technologies such as Virtual Reality (VR) and Augmented Reality (AR) encompass a range of specific tools and platforms that can create immersive learning experiences closely mimicking real-world environments. For instance, Unreal Engine 5[8], a sophisticated game engine, offers powerful capabilities for developing VR and AR applications. It is freely available for non-commercial use, making it an accessible option for creating cost-effective, immersive educational simulations.

[8] https://www.unrealengine.com/en-US

Meanwhile, once the environments are developed, they can be scalable and reusable across different cohorts of students, and even across institutes. This scalability enhances the cost-effectiveness of the initial investment over time.

Comparative Analysis with Other Learning Theories

When compared to traditional learning theories, such as behaviorism, which emphasizes passive learning through repetition and reinforcement, ALT offers a more dynamic and interactive approach to learning. Unlike behaviorism, ALT encourages active learner participation and the application of knowledge in practical settings (Ertmer & Newby, 2013).

Although ALT is also rooted in constructivism, ALT places a greater emphasis on the authenticity of the learning context. While constructivism focuses on the construction of knowledge through experiences, ALT extends this by situating these experiences in a context that closely resembles real-life applications (Jonassen, 1999). In other words, ALT takes a step forward towards the experience happening in real-life scenarios.

3.2.5 ALT in CineSim

The application of ALT within the context of CineSim provides a compelling case study for examining the practical implementation of ALT principles. CineSim, a simulation serious game designed for media production studies, integrates the core elements of ALT to create a realistic learning environment for students. In Chapter 7 discussion, I analyze how CineSim applies Herrington's framework of authentic e-learning and the impact of these design elements on the learning experience.

3.3 Summary

In this chapter, I have reviewed the literature on serious games, SDT and ALT. The integration of them in this research represents a comprehensive approach to understanding and enhancing the learning experience in media production education. Each of these theories contributes a unique perspective that, when combined, offers a holistic understanding of how technology can be effectively utilized in educational settings.

Serious games provide an engaging and interactive platform for learning that offers real-world scenarios in a controlled environment. This aligns with the practical needs identified in the research gap, where there is a demand for more hands-on, skill-oriented learning experiences in media production, serious games allow students to apply theoretical knowledge in practical, simulated settings. SDT and ALT are two common theories associated with serious game that can be used to explain the underlying reasons that motivate learners to learn and explain how the learning happens.

Self-Determination Theory (SDT) focuses on the motivational aspects of learning. It emphasizes the importance of fulfilling learners' intrinsic needs for autonomy, competence, and relatedness to foster motivation and engagement (Ryan & Deci, 2000). In the context of this research evaluating the adaptation of CineSim into media production education, SDT provides a framework for understanding how students' motivation can be enhanced through interactive and autonomous learning experiences offered by serious games.

Authentic Learning Theory (ALT) helps to bridge the gap between theoretical knowledge and its application in real-world scenarios. By emphasizing authentic tasks and contexts, ALT ensures that the learning experiences are not just theoretical exercises but are deeply rooted in the actual practices and challenges of the media production industry. This alignment of educational content with real-world practices is crucial for preparing students for the demands of the professional media landscape. Incorporating ALT into media production education means that students are not merely learning about media production in an abstract sense, instead, they are actively engaging with the processes, decision-making, and creative challenges that professionals face in the industrial operation. This approach promotes a deeper understanding of the subject matter and cultivates essential skills such as critical thinking, problem-solving, and adaptability. These skills are invaluable in an industry that is constantly evolving and where professionals must be able to navigate a dynamic and often unpredictable environment.

By linking these theories, the research aims to address the identified gap in current media production education. The combination of serious games, SDT, and ALT allows for a multifaceted approach to education, where students are not only engaged and motivated but are also able to apply their learning in practical, real-world contexts. This integrated approach wishes to enhance the effectiveness of media production training and equip students with the necessary skills and knowledge for their future careers in the media industry.

Chapter 4. Research Design

4.1 Introduction to Research Design

In this study, Design-Based Research (DBR) is adopted as the primary research methodology, complemented by a mixed-methods strategy for data collection and analysis. This approach is designed to address the unique challenges and objectives associated with incorporating CineSim into media production (MP) training. The aim of this research is centred on evaluating and refining the design of the software, and its adoption in formal classroom teaching. The research process involves iterative loops of feedback and enhancements to understand deeper how to optimize learning.

4.1.1 My Role as a Researcher, Developer, and Teacher

The unique integration of my roles as a researcher, developer, and teacher enriches the DBR approach, making it particularly suitable for developing and refining CineSim within an educational setting. Each role contributes distinct insights and skills that are pivotal in navigating the iterative design process inherent in DBR, ultimately ensuring that CineSim meets both educational and practical needs effectively.

As a researcher: It allows me to incorporate robust theoretical frameworks into the design and assessment of CineSim. This foundation ensures that the learning activities not only adhere to sound pedagogical principles but are also underpinned by established theories in educational technology. This theoretical alignment is crucial for justifying the educational strategies employed and for framing the analysis of CineSim's effectiveness.

As a teacher: Working directly in the classroom provides first-hand insights into the practical challenges of media production education. This perspective is invaluable for identifying the real-world difficulties encountered by both educators and students in a formal educational setting. It also allows for immediate testing and application of CineSim in live teaching scenarios, offering a practical feedback loop that directly informs enhancements to the tool's design and functionality.

As a developer: My role as a developer bridges the gap between theoretical frameworks and practical application. This position enables me to respond swiftly to educational needs as they arise, ensuring that the development of CineSim is continuously aligned with user feedback and educational goals. Moreover, my understanding of the technical challenges - such as software integration into existing curricula and systems - allows for a more adaptive and responsive development process.

The synthesis of these roles exemplifies a key feature of the DBR methodology - its emphasis on iterative development driven by a combination of empirical evaluation and theoretical grounding. By acting simultaneously in these roles, I am able to guide CineSim's development through a cycle of refinement that is deeply informed by both the theoretical objectives and the practical realities of educational technology implementation. The ethics of this dual role of researcher and teacher are discussed in Section 4.5.

4.1.2 Rationale for Choosing this Research Design

The rationale for selecting this research design, with DBR at its core, is driven by several key factors:

1. Practical Relevance: The practice-oriented nature of DBR aligns with the study's goal of enhancing practical training in MP education through CineSim. This methodology is usually used for solving real-world problems, which is central to this study (McKenney & Reeves, 2018).

2. Iterative Development: DBR, known for its iterative process involving cycles of design, implementation, evaluation, and refinement (Cao, 2023), effectively bridges the gap between theoretical research and practical application. This approach ensures that CineSim is continuously improved based on real user experiences and feedback, making it an ideal choice for meeting the educational needs of media production students (Brown, 1992).

3. User-Centred Design: Emphasizing end-user involvement in the design process, DBR ensures that CineSim is developed in line with the specific needs and preferences of MP students (Oh & Reeves, 2010).

4. Integration of Theory and Practice: DBR allows the effective integration of theoretical concepts from serious games and learning theories with practical educational tools, which help to ground CineSim in sound educational principles (Mingfong et al., 2010).

4.2 Design-Based Research (DBR) Methodology

4.2.1 DBR and its Relevance to Educational Research

DBR is a relatively new methodology that merges empirical educational research with the theory-driven design of learning environments (Wang & Hannafin, 2005). A fundamental point of DBR is its focus not merely on exploring the potentialities of what education could be, but rather on critically evaluating and shaping what education should be to optimize learning outcomes (Bakker, 2018). This approach emphasizes the development of educational practices and interventions that are not only theoretically sound but also pragmatically effective in real-world educational settings (Anderson & Shattuck, 2012; Bakker, 2018). It stands out in the area of educational research methodologies due to its unique blending of theory and practice. Unlike conventional research methods that often emphasize either theory development or empirical testing separately, DBR integrates these elements within a real-world context (The Design-Based Research Collective, 2003). It allows researchers to develop and refine theories while simultaneously creating and testing practical interventions. This approach is particularly beneficial for exploring the integration of new technologies in education, as it facilitates the continuous improvement of these technologies based on direct feedback from end-users (Barab & Squire, 2004). DBR is characterized by its iterative nature, involving cycles of design, implementation, evaluation, and redesign. This iterative process is similar to the steps in design practice, where ideas are conceptualized, prototypes are developed, tested, and refined based on feedback (Wang & Hannafin, 2005; Edelson, 2002).

Further, in design practice, the focus is on creating solutions that are not only functional but also user-friendly and responsive to the needs of the target audience. Similarly, DBR emphasizes the involvement of end-users (educators and learners) in the research process, ensuring that the educational interventions are practical, relevant, and tailored to the specific needs of the educational context (The Design-Based Research Collective, 2003).

4.2.2 Advantages of Using DBR in Technology-Enhanced Learning

DBR excels in tailoring technological tools to meet the unique demands and challenges of different learning environments (Anderson & Shattuck, 2012). For instance, in the development of CineSim, DBR's contextual focus ensures that the software addresses the real-world needs of media production training.

Moreover, the iterative nature of DBR is a significant advantage in the realm of educational technology. The field is characterized by rapid changes and advancements in technology, which require educational tools that can adapt and evolve to provide proper response. DBR supports this need by allowing for continuous refinement and improvement of educational technologies. This iterative process ensures that tools like CineSim remain relevant and effective over time, adapting to new challenges and opportunities in MP education (Wang & Hannafin, 2005).

Additionally, DBR bridges the gap between theory and practice by grounding the development of educational technologies in robust theoretical frameworks while testing and refining them in real-world settings. As a result, the tools developed are both conceptually sound and practically effective, enhancing the learning experience (Barab & Squire, 2004). DBR also fosters a collaborative environment where educators, researchers, and technology developers work together, ensuring that the tools are technologically advanced and pedagogically sound. For example, input from media production educators is crucial in shaping CineSim's features to align with educational goals. DBR addresses the diverse needs of learners by involving a wide range of users in the design process, ensuring the technologies cater to various learning styles and preferences (Sun et al., 2023).

Finally, DBR projects often result in sustainable and scalable educational solutions. By focusing on real-world applicability and continuous improvement, tools developed through DBR are designed to be scalable across different educational settings and sustainable over time (Collins et al., 2004).

4.2.3 Challenges and Responses in DBR

Despite its strengths, DBR faces several challenges, particularly regarding its resource-intensive nature. The methodology requires significant time and resources due to its iterative cycles. This can be a substantial commitment for any educational project. However, the response to this challenge lies in strategic planning and resource allocation. By anticipating these needs and allocating resources accordingly, the impact of this challenge is minimized (Collins et al., 2004).

Another critique of DBR is its perceived lack of generalizability due to its focus on specific contexts. Critics argue that findings from DBR projects may not be easily transferable to other settings. However, this challenge is addressed by recognizing that while each DBR project is unique, the insights and principles derived can often be adapted and applied to broader contexts. The key is to extract and articulate these broader principles effectively (Barab & Squire, 2004). For example, CineSim is inspired by other research that uses virtual environment to train practical skills (Virtual Hospital, 2021).

Furthermore, concerns about the scientific rigor of DBR arise from its iterative and practitioner-involved nature. To counter this, proponents of DBR emphasize the systematic and reflective inquiry that is integral to the methodology. The use of mixed-methods approaches, combining qualitative and quantitative data, enhances the comprehensiveness and depth of the research, thereby bolstering its scientific rigor (Anderson & Shattuck, 2012).

Scalability is a challenge in DBR, especially in technology-enhanced learning where solutions need to be adaptable to various settings. Addressing scalability involves considering factors such as adaptability and user diversity from the outset of the project. Testing interventions in varied settings can provide insights into their adaptability and scalability (Wang & Hannafin, 2005).

4.2.4 The Iterative Process of DBR: Design, Implementation, Analysis, and Redesign of CineSim

DBR process is an iterative cycle comprising four main stages: Design, Implementation, Analysis, and Redesign (Wang & Hannafin, 2005). Each stage plays a crucial, but different role in developing effective educational interventions. The figure below shows how the iterative cycle works in this research.

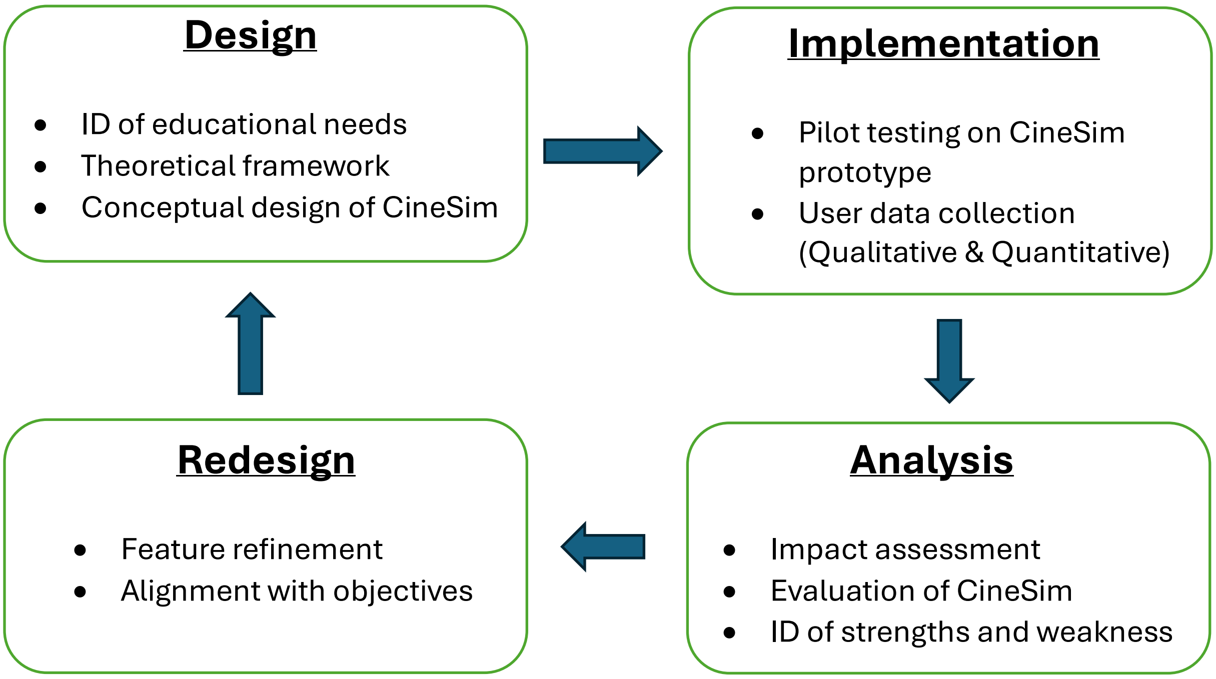

Figure 2. Iterative Process

Design: The initial design phase of CineSim tackles key educational challenges encountered in media production (MP) training. This phase pinpoints essential needs, such as the need for practical experience and the difficulty students face in expressing creative ideas. The design is shaped by these specific needs, informed by research in the field of serious gaming and other learning related theories, while also considering the realistic limitations found in MP educational settings. This stage also involves conceptualizing how CineSim could integrate features like lighting design simulation, cinematography tools, and interactive storyboarding in virtual environment to address these challenges.

Implementation: After the initial design, CineSim was implemented in a real-world educational setting, specifically in MP courses. This phase is crucial for observing how students and educators interact with CineSim and how it facilitated learning. During this stage, data on user engagement, learning outcomes, and usability are collected to evaluate CineSim's effectiveness in a practical educational context.

Analysis: The data gathered from the implementation phase is then analyzed to assess CineSim's impact on learning and teaching in MP courses. This analysis focuses on how well CineSim addresses the identified educational challenges, its usability, and its effectiveness in enhancing students' practical skills and creative expression. Feedback from students and educators is crucial in this stage to identify strengths and areas for improvement.

Redesign: Based on the insights gained from the analysis, CineSim undergoes a redesign stage to refine its features and functionalities. This involves enhancing the user interface for better usability, adding new features to support more aspects of MP training, and adjusting existing functionalities to better align with educational objectives. The redesigned version of CineSim is then implemented, and the iterative cycle of improvement continues.

Through this iterative DBR process, CineSim evolves from a concept to a functional educational tool. It is continually refined based on real-world application and feedback. This approach ensures that CineSim not only aligned with theoretical principles but also effectively meet the practical needs of MP education.

4.3 Participants

4.3.1 Description of Participant Demographics and Selection Criteria

This study engaged with university students, with a focus on both those enrolled in media production courses and those from other disciplines. This inclusive approach gathered insights from a demographic that was directly involved in media production education, as well as from students who were not specialized in media production but could potentially benefit from using CineSim to broaden their understanding in cinematic arts or just for personal interest. The selection criteria were intentionally broad to ensure that the study captured a wide range of student experiences and perspectives, thereby enriching the understanding CineSim's applicability and effectiveness. Specifically, participants were selected based on the following:

- Students taking media-production courses: Those currently enrolled in media production related courses, such as Video Art, and Storytelling and Storyboarding. They represent the primary target user group of CineSim, and their comments were particularly useful to review the tool's direct educational impact and its potential to assist and enhance formal classroom teaching.

- Students not enrolled in media production courses: They were included to assess CineSim's broader appeal and utility beyond specialized and professional training. This diverse group provided valuable insights into how CineSim could be adapted or expanded to cater to a general audience. This inclusive approach was in line with CineSim's design objectives, which were to make the tool accessible and beneficial to anyone interested in media production knowledge through the internet and online gaming platforms, even those without formal training in the field.

- Student 18 years old or over: Age was not important, however, all participants were over 18 years old to minimize ethical issues.

4.3.2 Justification for the Choice of Participants

There were several reasons to select university students to join the research. Firstly, these students represent the primary target user group of CineSim. Their insights were invaluable for assessing the tool's educational impact. The way that they joined the research was very similar to the designed learning activity of CineSim. Secondly, their varied backgrounds in media production allowed for a comprehensive evaluation of CineSim's applicability and effectiveness across different skill levels and learning needs. Lastly, focusing on this demographic enabled the research to develop a deeper understanding of how users without relevant backgrounds worked in CineSim.

As stated, students from both related and non-related disciplines were recruited to join the research. A key concern of this study was to ensure that their learning experience was not hindered by differences in their technical knowledge or operational skills. Having hands-on operation in a 3D environment is a pre-condition for smooth learning. The navigation design of CineSim takes reference from industrial 3D software, for examples, Autodesk Maya[9], and Unreal Engine[10]. Therefore, students with relevant experiences in operating in 3D software may have found it easier to learn to navigate the world in CineSim. Including participants without prior knowledge of operating 3D software was crucial to understand how users without a relevant background learned and operated CineSim, and their feedback could help to further polish CineSim to make it suitable for the public.

[9] https://www.autodesk.com/products/maya/features

[10] https://www.unrealengine.com/en-US

4.3.3 Strategies to Ensure a Diverse and Representative Sample

To achieve a diverse and representative sample, the study employed a combination of purposive and stratified random sampling techniques. This mixed-methods approach allowed for the deliberate inclusion of participants from underrepresented groups (Teddlie & Yu, 2007), while also ensuring the sample reflected the broader population of media production students.

4.4 Data Collection and Analysis

4.4.1 Role of Feedback in Refining CineSim

User feedback is a cornerstone of the DBR process, shaping and refining educational technologies through continuous, real-world input. DBR emphasizes iterative design and practical application, where feedback from educators and learners is not a one-time input but an ongoing dialogue that drives development (Anderson & Shattuck, 2012). This dynamic interaction ensures that the final product, such as CineSim, is responsive to user needs and remains relevant throughout its evolution (Barab & Squire, 2004).

The importance of feedback in educational technology development is well-established in scholarly literature (Hattie & Timperley, 2007). In the context of CineSim, this principle is grounded in theoretical frameworks that emphasize the value of user input during the design process. Specifically, user-centred design, a key component of DBR, posits that understanding users' needs, experiences, and challenges is crucial for creating effective educational tools (Norman, 1986). This philosophy is deeply embedded in the development of CineSim, where user feedback has been instrumental in guiding design choices and functionality.

From its conceptualization to implementation, user feedback significantly shaped CineSim's development. Initial feedback from users identified key features beneficial for media production training, while later input revealed usability issues and areas for enhancement. For example, feedback on the user interface led to a more intuitive design, simplifying navigation and improving the user experience.

In the early phases of user testing, it became evident that the simulations needed more realism to effectively replicate real-world media production scenarios. This feedback drove the development team to upgrade graphics and functionality, enhancing the software's immersive qualities. These changes were not merely cosmetic but aimed at boosting the educational impact of CineSim (Collins et al., 2004).

The responsiveness of the CineSim development process to user feedback underscores the adaptability inherent in DBR. As users interacted with the software, their insights and critiques provided valuable information that was used to fine-tune CineSim. This included adjustments in the user interface for better accessibility, the introduction of new features to aid in storytelling and cinematography, and improvements in the overall stability and performance of the software. Each iteration of CineSim was a response to the specific needs and preferences of its users, ensuring that the tool remained relevant and effective for media production training (Edelson, 2002).

The continuous interplay between user feedback and design decisions in CineSim's development also ensured that the tool remained aligned with its educational objectives. By actively incorporating feedback into the design process, I maintained a clear focus on the educational goals of CineSim, ensuring that each iteration contributed to a more effective learning tool. This alignment is a critical aspect of DBR, where the goal is not just to create innovative technology but to develop technology that enhances learning and teaching processes (Wang & Hannafin, 2005).

4.4.2 Features and Advantages of a Mixed-Method Approach

The mixed-methods approach in this research combines quantitative and qualitative data collection methods, offering a comprehensive understanding of CineSim's impact and effectiveness in media production education. The use of mixed methods is pivotal for achieving a comprehensive and deep understanding of the impact and effectiveness of CineSim in media production education. This approach combines the strengths of both quantitative and qualitative research methods. Quantitative data can provide a broad overview, while qualitative data adds depth and context, ensuring a more holistic understanding. Here are some of the advantages.

A. Comprehensive Analysis

The integration of quantitative and qualitative methods provides a more complete analysis than either approach alone. Quantitative data, collected through structured methods like surveys and questionnaires, offers measurable, statistical insights. It helps in quantifying changes in student learning outcomes or usage patterns of CineSim. On the other hand, qualitative data, gathered through interviews, focus groups, and observational studies, provides depth and context. It delves into the experiences, perceptions, and attitudes of users towards CineSim. This combination leads to more robust and well-rounded conclusions, as it captures both the measurable impact of CineSim and the subjective experiences of its users (Creswell & Plano Clark, 2011).

B. Triangulation

Another significant advantage of the mixed-methods approach is triangulation. By employing both qualitative and quantitative data, the research can cross-verify findings, thus enhancing the validity and reliability of the results. Triangulation allows for a more comprehensive understanding of the research problem, as it combines the objectivity of quantitative data with the rich, detailed insights provided by qualitative data. This methodological triangulation is particularly useful in educational research, where understanding the details of learning experiences and outcomes is crucial (Greene et al., 1989).

C. Flexibility

The mixed-methods approach also offers flexibility, allowing the research to adapt to emerging findings and explore different aspects of the research question. This flexibility is essential in a dynamic field like educational technology, where user needs and technological capabilities are constantly evolving. The ability to adjust research methods in response to initial findings or new developments ensures that the research remains relevant and accurately reflects the complexities of integrating technology like CineSim into educational settings (Tashakkori & Teddlie, 2003).

D. Common Approaches in Mixed-Methods Research

The mixed-methods approach in research offers various strategies, each tailored to specific research objectives and contexts. Three common approaches are the Sequential Explanatory Strategy, Sequential Exploratory Strategy, and Concurrent Triangulation Strategy (Creswell & Plano Clark, 2011). This research took the Sequential Explanatory Strategy for analysis.

Sequential Explanatory Strategy

The Sequential Explanatory Strategy is characterized by an initial collection of quantitative data, followed by qualitative data gathering. This approach is particularly useful when the researcher aims to dig deeper into the findings obtained from quantitative analysis. In this research, after quantitatively understanding user's attitude and impressions of CineSim through surveys, follow-up focus groups were conducted to explore the reasons behind these statistical outcomes. This strategy allows for a deeper understanding of the initial quantitative results, providing insights into user experiences and perceptions that numbers alone might not reveal (Ivankova et. al, 2006).

E. Balancing Objectivity and Subjectivity

In assessing the impact of CineSim on media production education, it is essential to strike a balance between objective measures of learning outcomes, such as skill acquisition and performance improvement, and subjective experiences of users, including their perceptions and satisfaction. Mixed methods facilitate this balance by combining quantitative data, which offers measurable, objective insights, with qualitative data, providing a deeper understanding of the subjective experiences of students and educators. This comprehensive approach ensures a well-rounded evaluation of CineSim's effectiveness in both tangible learning outcomes and user satisfaction (Johnson & Onwuegbuzie, 2004).

F. Informing Development

The integration of quantitative and qualitative data is invaluable in informing the ongoing development and refinement of CineSim. Quantitative data can highlight areas where the tool is effectively meeting its educational objectives, while qualitative insights can guide adjustments in design and functionality to better align with user needs and preferences. This combination ensures that CineSim evolves based on both its educational effectiveness and its usability, leading to a tool that is not only pedagogically sound but also user-friendly and engaging (Teddlie & Tashakkori, 2009).

4.4.3 Preliminary Stage: Data Collection for Software Design

In the preliminary stage of data collection for the design and development of CineSim, a comprehensive approach is adopted to ensure that the software effectively meets the educational needs of media production education. Data collected in this stage is analyzed qualitatively and proposed changes transformed into the design of CineSim.

Gathering Course Syllabi

The process begins with an in-depth analysis of existing media production course syllabi from the university I am currently teaching in. Those syllabi are collected from the school data server. As an educator, it is my job to have deep understanding on the relevant topics so that I can provide direction to the development team. This analysis is crucial to identify the key concepts, skills, and learning outcomes that CineSim should address. By examining these syllabi, the development aligns CineSim's features with the core educational objectives of media production courses. This alignment ensures that CineSim is relevant and beneficial in an academic setting, providing students with practical experiences that complement their theoretical learning.

Common Game Elements from Open World Sandbox Games and Simulations

To enhance the educational engagement of CineSim, I took onboard research on common elements from popular open-world sandbox games and simulations. This involves identifying game mechanics that promote creativity, exploration, and practical application of skills. Elements such as a high degree of freedom, realistic physics, and interactive environments are considered for integration into CineSim.

These elements are chosen to make the learning process more immersive and engaging, allowing students to experiment and learn in a virtual environment that closely mimics real-world media production settings. Data collected here is used to direct the development team to work on CineSim.

Translating Course Syllabi into Gaming Elements

The next step is to translate the educational content from the course syllabi into gaming elements within CineSim. This involves mapping out how theoretical concepts could be represented and taught through interactive simulations. For example, principles of lighting design is incorporated into the game as adjustable lighting setups that students can manipulate in real-time. Storyboarding concepts are translated into a virtual environment where students can arrange and visualize scenes using drag-and-drop functionality. This translation process ensures that the educational goals of media production courses are effectively embedded within the gameplay mechanics of CineSim. The effectiveness will be assessed in the first and second round data collection.

Initial Design of CineSim

Based on the gathered data and insights, the initial design of CineSim is developed. This phase includes creating, mock-ups, and prototypes that illustrates how the identified features and game elements will be implemented. This is the outcome of data collected in this stage. The initial design aimed primarily at ensuring the software was functional and provided core simulation capabilities. As a researcher, educator and designer, I work closely with the development team to make sure that the development of CineSim sticks closely with the design concepts and educational needs. The initial design of CineSim further undergoes continuous internal testing and refinement within the development team to ensure it meets work-ready standards for user testing.

Autoethnographic Data from a Developer and Researcher Perspective

In my roles as a developer, researcher, and educator, I experience various challenges and insights. The technical hurdles of integrating complex features into CineSim, ensuring the software aligns with educational theories, and addressing real-world classroom needs all contribute to a multifaceted development process. Additionally, implementing the software in school settings poses challenges related to school regulations and IT policies, which can affect the deployment and accessibility of CineSim. These experiences provide valuable insights that can guide other educators and developers, emphasizing the importance of flexibility, collaboration, and a user-centred approach in the development and implementation of educational technology.

4.4.4 First Stage: Data Collection for the CineSim Beta

After the preliminary data collection and design of CineSim, the software is ready for authentic user testing. In this stage, authentic users are invited to use CineSim in formal educational settings to ensure that it effectively meets the educational needs of media production training.

Educational Implementation

Students are first taught media production concepts such as cinematography and storyboarding. Following this, they are guided to use CineSim to practice and express their creative thoughts. This hands-on approach allowed students to apply theoretical knowledge in a practical, simulated environment, enhancing their learning experience.

Questionnaire Distribution and Feedback Collection

80 students are invited to join the learning activity, and 57 of them completed questionnaires (see Appendix 2) to express their views on the usability and

effectiveness of CineSim. Additionally, 20 of these participants are invited to join focus groups conducted by a third party moderator to mitigate ethical concerns related to power imbalance. This mixed-method approach ensures a robust collection of both quantitative and qualitative data.

Data Analysis

The quantitative data from the questionnaires and the qualitative data from the focus groups are analyzed using a sequential explanatory strategy. This method provides deeper insights into the usability and educational impact of CineSim. The focus group data undergoes thematic analysis to identify key patterns and themes in student feedback.

Autoethnographic Reflection on Teaching with CineSim

Using CineSim to teach in a formal classroom setting provides valuable insights and poses several challenges. As an educator, I observe firsthand how students interact with the software, which helps me understand its strengths and areas for improvement. Teaching with CineSim allows me to bridge theoretical concepts and practical application effectively.

Integration of Feedback and Iterative Refinement

The insights gained from the data analysis are then integrated into the design of CineSim. This iterative refinement process involves revising and enhancing the software features based on user feedback. The goal is to improve the usability and educational effectiveness of CineSim, preparing it for the second round of data collection and analysis.

4.4.5 Second Stage: Data Collection for a Polished CineSim

After the first round of refinement, CineSim should be more polished to erase hurdles generated by poor user experience design. In this stage, the data collection is more focused on how users feel about their learning journey and effectiveness of CineSim.

Data Collection

85 students joined the learning activity, and 56 of them completed questionnaires to provide quantitative data. Additionally, 10 students from this pool were invited to join focus groups to gather qualitative data. This mixed-method approach adopts a sequential explanatory strategy again to gain deeper insights into user experiences. The data collected focused on users' experiences, perceptions, and overall satisfaction with CineSim.

Usability and Learning Impact Analysis

For usability and learning impact analysis, the data collected from users is thoroughly examined through both quantitative and qualitative methods. During the focus groups, the convenor focuses on how users feel about the usability of CineSim and whether CineSim has any impact on their learning journey.

This mixed-method approach helps in triangulating the findings, ensuring a comprehensive understanding of both the usability and educational impact of CineSim. By integrating quantitative data with qualitative insights, the analysis identifies specific areas for improvement and assesses the overall effectiveness of CineSim in enhancing the learning experience. This approach not only helps in refining the software but also provides valuable feedback for future iterations, ensuring that CineSim continuously evolves to meet educational needs.

Identifying Further Enhancements

Based on the user feedback and analysis, potential enhancements to CineSim are identified. This involves reviewing both quantitative and qualitative data to determine areas that can be improved. The goal is to continue refining the software to better meet educational objectives and user needs.

Detailed Interview with Industry Practitioner

A detailed interview was conducted with a professional storyboard artist with over 10 years' experience. He is asked to develop a storyboard based on a script using conventional methods, and then use CineSim to develop the storyboard again. This interview provides valuable insights into the practitioner's thoughts on CineSim, including their impressions and comparative experiences with conventional methods. This perspective is crucial for understanding how professionals perceive CineSim in terms of storyboard development and visual simulation.

Autoethnographic Insights

As part of the second stage, autoethnographic data is collected to reflect on the multi-role experiences in this research. This includes insights from teaching and implementing CineSim in classroom settings. The challenges and strategies involved in balancing these roles provide valuable lessons for other educators and developers.

4.5 Ethical Considerations

This section outlines the ethical considerations relevant to this research, focusing on participant confidentiality, informed consent, and addressing potential power dynamics between the researcher and participants.

Before the research was conducted, ethical approval was sought and granted by Lancaster University's Faculty of Arts and Social Sciences and Lancaster University Management School Research Ethics Committee. After consulting relevant parties at the host institution (i.e., Lingnan University, where the research was conducted and participants were recruited), it was confirmed that no additional procedural approval was required.

To safeguard participant confidentiality, all data collected from students was anonymized, with personal identifiers removed or encrypted. For the interview with industry practitioner, Mr. Ken Au Yeung, his personal identifier is not removed after getting his consent. As a professional, exposing his background and other personal identifier may contribute to the authenticity of the research as it provides comments from the industry perspective. Besides, participants were informed about the data collection methods, the purpose of the research, and how their data would be used, stored, and disposed of after the study's completion. Informed consent was obtained from all participants, emphasizing that their participation was voluntary and that they could withdraw at any time without penalty (Mertler, 2016).

The research acknowledged the inherent power dynamics between the researcher, who is also the tool developer and a lecturer of the student participants. To mitigate any potential coercion or bias, the recruitment and consent process was conducted in a manner that ensured students understood that their participation was not linked to their academic evaluation or standing. At the same time, an external party facilitated the focus groups and data collection to further distance the researcher and reassure participants of their anonymity (Franzke et al., 2020).

4.6 Addressing Limitations and Ensuring Research Quality

This section addresses the inherent limitations of the research, discusses the advantages and disadvantages of insider research, and outlines strategies for ensuring the quality of the study. It covers the research design limitations, the generalizability of the findings, and the measures taken to ensure validity, reliability, and triangulation. Additionally, it highlights the importance of rigorous methods and reflexivity in maintaining the credibility of the research outcomes.

Limitations Inherent in the Research Design

DBR, though highly appropriate for developing educational interventions like CineSim, has limitations. DBR's iterative nature, focusing on real-world educational settings, may introduce variables that are difficult to control or predict. For instance, student engagement with CineSim could be influenced by external factors such as varying levels of prior experience with similar technologies, differing personal interests, or the novelty effect, where the initial enthusiasm may not necessarily translate into long-term educational benefits. These factors might limit our ability to attribute observed learning outcomes solely to the use of CineSim.

Generalizability of the Findings

The study's findings are contextually bound to the specific educational setting, the design features of CineSim, and the participant group, which consists of media production students in a university setting. While the insights gained contribute to improved understanding of serious games in media production education, caution must be taken when generalizing these findings to different contexts, disciplines, or educational technologies. The uniqueness of CineSim as an educational tool - designed specifically for media production courses - might limit the applicability of the study’s results to other fields or settings without similar technological and pedagogical frameworks. However, mixed methods research enhances the generalizability of the findings by providing a 'thick description' that allows readers to transfer knowledge to their own contexts (Polit & Beck, 2010). With detailed documentation of the whole research, readers can decide what they can learn from my experience.

4.6.1 Discussion on Insider Research: Advantages and Disadvantages

Conducting research as an insider offers both unique advantages and challenges that can significantly affect data interpretation and contextual understanding. As an insider, my roles as a developer, researcher, and educator involved in the design and implementation of CineSim present both benefits and limitations.

Advantages of Insider Research

- **In-depth Understanding**: Insiders have a deep understanding of the context, culture, and specific details of their research environment. This familiarity allows for more accurate and detailed data interpretation (Bonner & Tolhurst, 2002).
- **Enhanced Rapport and Trust**: Established relationships with participants can lead to greater trust and openness, resulting in richer data collection (Mercer, 2007).
- **Access to Information**: Insiders often have easier access to informal conversations, internal documents, and other sources of information that might be unavailable to external researchers (Unluer, 2012).

Disadvantages of Insider Research

- **Potential for Bias**: Insiders may face challenges with bias, as personal experiences and expectations can influence data interpretation (Bonner & Tolhurst, 2002; Mercer, 2007).

- **Role Conflict**: Balancing multiple roles can lead to role conflict, potentially affecting objectivity. The dual responsibility of developing and researching CineSim could complicate maintaining a critical perspective (Mercer, 2007).
- **Ethical Considerations**: Managing dual relationships and ensuring confidentiality can be complex. It is crucial to navigate potential power dynamics and obtain informed consent from participants (Unluer, 2012).

Strategies to Mitigate Disadvantages

To address these challenges, several strategies have been employed:

- **Reflexivity**: Continuously reflecting on biases, assumptions, and influence on the research process helped mitigate bias. Keeping a reflective journal and seeking peer feedback were useful practices (Bonner & Tolhurst, 2002). This DBR with its cyclical process of data collection and feedback, ends naturally in the redesign phase with a reflection.
- **Triangulation**: Using multiple data sources and methods enhances the validity of findings. Combining quantitative surveys with qualitative insights from focus groups provided a balanced understanding (Denzin, 1978). With such a process, different groups of data were cross checked with each other to further support the findings. If data do not align, specific reasons were found out from deeper analysis of qualitative data. As an insider researcher, I should trust data collected, but as with much self-interpretation I was also aware that it may be potentially influenced by self-bias or incorrect assumptions.
- **Peer Review and Consultation**: Regular consultations with external researchers or experts not directly involved in the study provided valuable external perspectives, helping to identify potential biases or gaps (Mercer, 2007). In this research, I continuously consulted with my PhD supervisor on the research methodology and different industrial experts, such as Ken Au

Yeung, a professional storyboard artist with more than 10-years' experience, and David Lee, a professional gaffer for a HK film award movie.

4.6.2 Ensuring the Quality of the Research

Ensuring the quality of research involves rigorous methods to establish validity, reliability, and triangulation. Using mixed methods enables triangulation, which enhances the overall validity and reliability of the research.

Validity

Validity refers to the extent to which the means of measurement accurately measure what they are intended to measure. In this study, validity is ensured by carefully designing d procedures that align with the research objectives. For example, questionnaires and interview protocols are developed to specifically address usability and learning impact aspects of CineSim. Content validity is established by aligning the development of CineSim with the course syllabi, ensuring they comprehensively cover all relevant aspects. This approach enhances the credibility of the findings by systematically covering all necessary elements, thus ensuring the instruments are both comprehensive and relevant (Golafshani, 2003).

Reliability

Reliability refers to the consistency and stability of the measurement. It is ensured through the standardization of data collection procedures and the use of reliable instruments. By using mixed methods, reliability is further enhanced as quantitative data provides measurable consistency, while qualitative data offers depth and context that support and explain quantitative findings (Creswell & Miller, 2000).

Triangulation

Triangulation involves using multiple methods, data sources, or theoretical perspectives to cross-validate findings and ensure comprehensive coverage of the research questions. In this study, triangulation is achieved by combining quantitative surveys with qualitative focus groups and interviews. This mixed-methods approach allows for a more robust analysis by integrating numerical data with rich, descriptive insights.

- **Methodological Triangulation**: The use of both quantitative and qualitative methods allowed for the validation of results through different lenses. Quantitative data provided broad patterns and trends, while qualitative data offered detailed explanations and context (Golafshani, 2003).
- **Data Triangulation**: Collecting data from various sources, such as students, educators, and industry practitioners, ensured that different perspectives are considered, enhancing the validity of the findings (Creswell & Miller, 2000).

Rigorous Use of Methods and Reflexivity

Ensuring quality also involves the rigorous application of methods and reflexivity. Reflexivity involves the continuous self-assessment and reflection on the researcher's biases, assumptions, and influence on the research process. Maintaining a reflective journal and seeking feedback from peers helps in recognizing and mitigating biases.

- **Rigorous Methods**: Design-Based Research (DBR) involves an iterative process of design, implementation, analysis, and refinement, which allows for continuous adjustments based on real-world feedback. This approach contributes to the validity of the research by ensuring that the design aligns closely with practical educational contexts and responds dynamically to observed outcomes. Regular peer review and consultation with experts further ensured that the research design and implementation were sound.

- **Reflexivity**: Engaging in reflexive practices helped in maintaining objectivity and transparency. Documenting reflections and adjustments made during the research process provided a clear audit trail, enhancing the credibility of the findings (Golafshani, 2003).

By integrating these approaches, the study ensured high-quality research outcomes that are valid, reliable, and comprehensive. The use of mixed methods and triangulation, combined with rigorous methodological practices and reflexivity, ensures that the research findings are robust and trustworthy.

4.7 Summary

This chapter explains the reasons and the advantages of adopting DBR as a methodology. Besides, it also discusses the participants involved, the relevant research methods, ethical considerations, limitations and ensuring quality of the research.

Chapter 5. Preliminary Stage: Data Collection for the Design of CineSim

5.1 Initial Idea of CineSim Before Data Research

Throughout my experience in tertiary education and industry, I have been holding a thought to develop a real-time simulation software for cinematography and pre-visualization. With a chance to get a funding from the government, as well as undertaking a PhD in technology enhanced learning at the same time, I believed that this is a prefect chance for me to kickstart this idea. Here are initial ideas of the software (CineSim) before conducting any systematic research.

Conceptual Foundation

The initial concept for CineSim emerged from my experience. I found that current training in media production is not sufficient, especially at the time of COVID. Further application of technology in formal training is desirable. Traditional classroom settings only offers limited chances to students to expose to real-world scenarios, probably with the reason of resources and real world situation. The vision for CineSim was to create an educational tool that offers a realistic and interactive environment where students can actively experiment with and practice cinematic concepts.

The primary objective of CineSim was to provide students with more hands-on learning opportunities that conventional classroom environment can only shortly offer. By leveraging the capabilities of serious game design, CineSim acted as a platform that would integrate educational goals within its gameplay, ensuring that CineSim is engaging and instructional. The immersive environment of the software was intended to help students intuitively understand media production concepts, making complex ideas more accessible and engaging through hands-on practice.

5.2 Data Collection on Relevant Course Syllabi and Overall Synthesis

The detailed analysis of the syllabi from the four relevant courses—ADA1004 Introduction to Moving Images, ADA2006 Storytelling and Storyboarding, VIS2109 Basic Videography, and VIS3006 Cinematography by Practice - provides a comprehensive understanding of the core concepts and practical skills essential for media production education. For a more comprehensive documentation of relevant course syllabi, refer to Appendix 1.

Through this analysis, I found that the course content can be categorized into two main areas: theoretical knowledge and practical skills. It is important to note that practical skills are deeply rooted in theoretical knowledge, and the reason I separate them here is to make for clarity in understanding the emphasis of each module. For instance, while all modules cover concepts in cinematography, ADA1004 focuses more on the theoretical aspects using relevant movie clips as examples, whereas VIS2109 and VIS3006 emphasize more on hands-on practice.

The following key concepts have been identified for further integration into the CineSim design:

- Mise-en-scène
- Camera Shooting
- Hands-on Skills on Video Shooting
- Storyboarding
- Lighting Design
- Visual Narratives
- Cinematography
- Camera Movement

These concepts represent a blend of theoretical understanding and practical application, which are crucial for effective media production training. By incorporating these elements into CineSim, it can provide a holistic learning experience that bridges the gap between classroom instruction and real-world application.

5.2.1 Integration of Key Concepts into CineSim

The above identified concepts are common, and critical elements of media production education. This sub section discusses how, and whether these concepts will be integrated into CineSim.

These 8 critical concepts are different from each other. Yet, some of them are similar, and they can be grouped into three categories for easier explanation and integration. The groupings are shown in Table 2:

Camera Work	**Storytelling**	**Scene Decoration and Design**
Camera Shooting	Storyboarding	Mise-en-scène
Cinematography	Visual Narratives	Lighting Design
Camera Movement		

Table 2. Critical Concepts Grouping

It is evident that topics in media production are closely intertwined with one another. For example, cinematography can never skip lighting. On the other hand, for mise-en-scène, lighting should be an integral part. As this section discusses how these topics are included in the design of CineSim, I group them from the perspective of features of CineSim. The detailed mapping is done in section 5.4.

Hands-on Skills on Video Shooting:

While CineSim does cover hands-on video shooting skills, this aspect is not heavily emphasized in the current version. Hands-on video shooting skills typically involve physically handling a camera and conducting shoots. CineSim provides some functions for students to practice these skills, such as understanding how changes in parameters affect the captured image. However, the focus is more on shoot design and the application of these skills within the virtual environment. Future possible iterations, such as CineSim VR, are planned to provide more immersive experiences that will further enhance hands-on training.

5.3 Research on Common Game Elements from Open World Sandbox Games and Simulations

CineSim is designed to be a serious game. Serious game is a type of game designed for a primary purpose other than pure entertainment (Dörner et al., 2016). Serious games combine the enjoyable aspects of gaming with educational objectives, thus making the learning process more engaging and effective.

As the term suggests, a serious game still retains the core elements of a game, despite its educational or training objectives. Therefore, researching relevant games and extract useful element is crucial because it helps identify the elements that make these games engaging and effective. By understanding what captivates players and encourages interaction, I can incorporate these mechanics into CineSim. This ensures that the learning journey is not only educational but also enjoyable. Playing games can make learning fun, and incorporating game-like elements into educational software can enhance user engagement, motivation, and retention of information (Gee, 2003).

5.3.1 Research on Popular Games

In this sub section, several games falling into sandbox and simulation categories are studied. Some features are integrated into the design of CineSim.

Game 1: Minecraft[11]

Minecraft, developed by Mojang Studios and officially released in 2011, is a sandbox game that offers players an expansive, procedurally generated 3D world to explore. It features multiple modes, including Survival, which challenges players to manage resources, health, and hunger, and Creative, which provides unlimited resources and the freedom to build and design without constraints. Minecraft's open-ended gameplay is characterized by its block-based world, where players can gather resources, construct structures, and craft items, fostering an environment of endless creativity and exploration. The game's simplistic yet versatile mechanics encourage players to use their imagination, making it not only a popular entertainment medium but also a valuable educational tool.

What can be transformed

The exploration and freedom provided by Minecraft can be mirrored in CineSim, allowing students to explore and experiment with media production techniques in a virtual environment. This promotes creativity and problem-solving skills, as students can try different approaches to media production without the constraints of a traditional classroom setting. Minecraft's Creative Mode, which allows players to build and design without limitations, can inspire CineSim's design to help students visualize and create complex media production setups. By providing a platform for free experimentation and design, students can better understand spatial relationships, set design, and the practical application of theoretical concepts in media production.

[11] https://www.minecraft.net/en-us

Game 2: Grand Theft Auto (GTA) V[12]

Developed by Rockstar Games and released in 2013, GTA V is an open world action-adventure game that provides players with an expansive and detailed virtual environment. Players can explore the fictional state of San Andreas, interact with various objects and characters, and engage in numerous activities and missions. The game is renowned for its highly interactive environments, where almost every element in the world can be manipulated, providing a realistic and immersive experience. The advanced physics engine and detailed graphics contribute to the authenticity, making GTA V to be one of the favourite games to gamers who like sandbox games.

What can be transformed

The high level of interactive environments in GTA V is truly a learning topic to CineSim. By incorporating interactive elements, CineSim allows users to set up scenes, adjust lighting, and direct actors within a virtual environment. This would create a realistic and immersive learning experience, helping students to better understand and apply media production techniques. The ability to interact with various elements in CineSim can simulate real-world media production scenarios, providing a hands-on learning experience that traditional classroom settings may not offer. This approach promotes active learning, where students can experiment with different configurations and see the immediate impact of their choices on their projects, thus deepening their understanding of media production principles.

Game 3: Kerbal Space Program[13]

Kerbal Space Program, developed by Squad and released in 2011, is a critically acclaimed space flight simulation game that allows players to design, build, and

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[12] https://www.rockstargames.com/gta-v

[13] https://www.kerbalspaceprogram.com/

manage their own space program. The game is renowned for its realistic physics engine, which accurately simulates orbital mechanics, aerodynamics, and other aspects of space travel. Players must consider a wide range of factors, such as fuel efficiency, structural integrity, and gravitational forces, to successfully launch and operate spacecraft. This level of realism not only provides an engaging gameplay experience but also serves as an educational tool, teaching players the complexities of rocket science and space exploration.

What can be transformed

Kerbal Space Program's accurate physics engine can be mirrored in CineSim to teach students about the technical aspects of media production. By incorporating realistic simulation system, CineSim can provide a hands-on understanding of different camera and lighting settings. For instance, users can learn how different camera angles and settings affect the composition of a shot. It simulates real-world conditions in a virtual environment. This approach deepen students' understanding on how different settings change the final capture in real world, just like how Kerbal Space Program educates players about the intricacies of space travel.

Game 4: Animal Crossing: New Horizons[14]

Developed and published by Nintendo in 2020, it is a life simulation game that allows players to build and customize their own island paradise. The game is celebrated for its extensive customization options, enabling players to personalize their characters, homes, and entire island environments. Players can decorate their homes with furniture and accessories, change their character's appearance, and design the landscape of their island. This high level of customization fosters a strong

[14] https://animalcrossing.nintendo.com/new-horizons/

sense of ownership and creativity, encouraging players to invest time and effort into their virtual world.

What can be transformed

The customization features of Animal Crossing can be integrated into CineSim to enhance the educational experience. By incorporating similar customization options, CineSim can allow students to personalize their media projects, which can significantly increase their engagement and investment in the learning process. For example, CineSim can offer a range of options for customizing character movements and facial expressions, enabling students to create more detailed and expressive performances in their media projects. Additionally, providing tools to design and modify sets and props can help students visualize and implement their creative ideas more effectively. These features can make the learning process more interactive and enjoyable, fostering a deeper connection to the media production tasks and enhancing the overall educational experience.

By examining these popular sandbox games and simulations, we can identify key elements that make these games engaging and educational. Incorporating these elements into CineSim will not only make the learning process more enjoyable but also ensure that students gain practical, hands-on experience in media production. This approach will help bridge the gap between theoretical knowledge and practical application, providing a comprehensive educational tool that prepares students for real-world challenges in media production.

5.4 The Design of CineSim

In this section, I cover the features of CineSim, and explain how they correspond to the concepts of serious games design and relevant theories.

5.4.1 Overview of the Features and Capabilities of CineSim

As an innovative educational software, also a serious game in MP education with wide range of capabilities, CineSim consists of the following features to enhance the learning experience in media production:

1. Open-World Environment with Extensive Asset Library: A key highlight of CineSim is its open-world environment, which offers high degree of creative freedom to users. With a large asset library of over 2000 assets, including furniture, characters, props and various items, students can craft and customize their virtual sets easily and conveniently. The simple drag-and-drop functionality makes it accessible for students to create diverse and complex scenes, fostering creativity and experimentation. This extensive range of assets ensures that students can simulate a wide variety of scenarios and settings, making their learning experience as comprehensive and realistic as possible.

2. Real-time Photorealistic Lighting Design Simulation: CineSim's advanced lighting design simulation system, powered by Unreal Engine 5[15], allows students to experiment with various lighting setups and immediately observe the impact of their choices on the mood and visual aesthetics of a scene. This real-time photorealistic simulation capability is one of CineSim's most striking features, providing students with invaluable hands-on experience in lighting design. The ability to render scenes in real-time with photorealistic quality ensures that students receive instant visual feedback, enabling them to refine their creative decisions in a realistic setting. The authenticity of this simulation depends on the computational power of the computer, with a 2019 mid-grade notebook equipped with an RTX2060 display card generally able to run all functions of CineSim smoothly.

[15] https://www.unrealengine.com/en-US

3. Cinematography Design Tools: The software gets a fully functional virtual camera that enables students to explore and experiment with camera angles, movements, and shot compositions. Basically, they can simulate every camera settings, such as depth of view, focal length and all other functions. This hands-on approach to learning cinematography allows students to grasp the details and complexities of visual storytelling.

4. Interactive Storyboard Creation: CineSim offers an intuitive platform for storyboard creation, catering especially to students who may lack traditional drawing skills. The software allows users to perform the placement of characters and cameras within a 3D environment. It enables students to visualize and plan their stories with ease and creativity. Storyboards can then be created without many constraints. Designing a shot in the virtual world is exactly the same as doing it in reality.

5. User Interface and Accessibility: The user interface of CineSim is specially designed to be intuitive and user-friendly, catering to users with varying levels of technical proficiency. The interface features streamlined navigation and easy-to-understand controls, making the learning path flat. Accessibility is a key component of CineSim, with features such as straightforward drag-and-drop functionality that ensure the software as accessible as possible to users.

6. Integration with Existing Curricula: Features of CineSim are integrated with concepts from media production curricula. It therefore serves as a useful tool for both students and educators. For teachers, CineSim provides an handy platform to demonstrate professional workflows in media production. The software's drag-and-drop functionality allows educators to easily showcase complex cinematic concepts and production techniques in a visually engaging manner. This capability makes it easier for teachers to illustrate abstract ideas and ensures that students

grasp practical skills in a context that mirrors real-world scenarios. By facilitating this dynamic teaching approach, CineSim enhances the educational experience, making complex ideas more accessible and engaging for students.

Figure 3. Three screenshots from CineSim showing: The landing page of CineSim, The in-game screen, The shot generated directly from CineSim (from left to right)

5.4.2 Mapping of CineSim Features with Course Syllabi

In this chapter, I have explored research on related games, analyzed relevant course syllabi, and detailed the features of CineSim. To build the interconnections among these three areas, this section presents a mapping of them. Specifically, it explains how CineSim is designed as a serious game by incorporating elements from popular games and how its features align with the course syllabi to meet educational objectives.

Mapping to Course Syllabi

As discussed, the identified key concepts from the course syllabi can be grouped into three categories: Camera Work, Storytelling, and Scene Decoration and Design. Each of these categories is aligned with specific features of CineSim.

Camera Work:

- Features: Cinematography Design Tools, Real-Time Photorealistic Lighting Simulation
- Description: The Cinematography Design Tools in CineSim allow students to experiment with camera angles, movements, and shot compositions. The real-time photorealistic simulation provides immediate visual feedback,

helping students understand the impact of different camera settings and techniques.

- Integration: These features support practical skills in camera shooting, cinematography, and camera movement by providing a virtual environment where students can practice and refine their techniques.

Storytelling:

- Features: Interactive Storyboard Creation
- Description: The Interactive Storyboard Creation feature allows students to place characters and cameras within a 3D environment, facilitating the visualization and planning of stories.
- Integration: This feature helps students develop storytelling skills by allowing them to visualize and plan their narratives effectively, bridging the gap between theoretical concepts and practical application.

Scene Decoration and Design:

- Features: Open-World Environment with Extensive Asset Library, Photorealistic Lighting Design Simulation
- Description: The open-world environment and extensive asset library enable students to create diverse and complex scenes, thus fostering creativity and experimentation. The advanced lighting design simulation allows students to experiment with various lighting setups, understanding how lighting choices affect the mood and aesthetics of a scene.
- Integration: These features support the practical application of mise-en-scène and lighting design concepts, providing students with a hands-on experience in creating and adjusting scenes.

Mapping to Game Design Research

CineSim is also inspired by key elements identified in the research on popular sandbox games and simulations, ensuring that the software is both educational and engaging. The exploration and freedom found in games like Minecraft are mirrored in CineSim's open-world environment, which encourages students to explore and experiment with media production techniques in a virtual space. This promotes creativity and problem-solving skills, allowing students to try different approaches without the constraints of a traditional classroom.

Similarly, the high level of interactivity seen in games like GTA V has influenced CineSim's design, allowing users to interact with various elements within the virtual world. This interaction helps create a realistic and immersive learning experience, which is crucial for understanding and applying media production techniques. The realistic physics and mechanics found in Kerbal Space Program are also reflected in CineSim, providing students with a hands-on understanding of different camera and lighting settings and how they affect the final output.

Customization and personalization, inspired by games like Animal Crossing: New Horizons, are integral to CineSim's design. By allowing students to personalize their projects and experiment with different configurations, CineSim increases student engagement and investment in their work. These elements collectively enhance the educational experience, making learning more interactive, enjoyable, and effective. Incorporating these engaging and interactive elements from successful games ensures that CineSim is not only an educational tool but also an enjoyable platform that motivates students and enhances their learning outcomes.

5.4.3 Stages of CineSim Development

The development of CineSim, guided by the Design-Based Research (DBR) methodology, followed a cyclical process encompassing several key stages: Design, Implementation, Analysis, and Redesign. This iterative approach is similar to design practice, ensures continuous improvement and adaptation of the tool to meet educational needs effectively (Wang & Hannafin, 2005; Edelson, 2002). The following stages do not solely focus on the work completed in the preliminary stage but outline the overall efforts throughout the development of CineSim.

A. Conceptualization and Initial Design

The development of CineSim commenced with a crucial conceptualization stage. This initial phase identified the existing educational gaps within media production training. It involved a thorough analysis of the current state of media production education, pinpointing areas where digital intervention could provide significant enhancements.

Also, in this stage, a plan was made to have a deeper understanding on what features for CineSim should get, and how they could be effectively integrated into the existing media production curriculum. The focus was on ensuring that CineSim not only incorporated advanced technological aspects but also aligned closely with pedagogical needs.

The process of transforming abstract concepts into a concrete design for CineSim involved discussions with educators, students, and media production professionals to gather a diverse range of perspectives. This collaborative approach ensured that the design of CineSim was informed by a comprehensive understanding of the users' needs and the practical challenges they faced in media production training.

Moreover, this phase included a critical evaluation of existing educational technologies and tools used in media production. By analyzing the strengths and limitations of these tools, the design team could identify unique features and functionalities that would set CineSim apart and address the unmet needs in media production education.

B. Technical Development and Challenges

The technical development stage of CineSim was a complex and iterative process, characterized by a series of trial-and-error experiments. This phase was crucial in transforming the conceptual designs into a functional software tool. The development team comprises a programming specialist and a designer, I acted as the team leader to oversee the development direction.

One of the primary challenges was to balance the technical constraints of software development with the desired educational outcomes. For instance, the integration of a 4x4 diffuser, a key element in media production, presents a significant technical hurdle. The initial attempts to incorporate this feature into CineSim revealed limitations in the current technology's ability to accurately simulate light passing through multiple layers. After several brainstorming sessions and technical evaluations, the team decided to increase the size of the light source in the simulation. This adjustment, while not a direct replication of the original concept, provided a viable solution that achieved a similar educational effect. Indeed, this alternative does not influence the users' learning journey as it is all about the back-end design which is hidden from the users.

Another challenge was to ensure the software's performance and stability. As CineSim grew in complexity, with the addition of various features and tools, maintaining a smooth and responsive user experience became increasingly challenging. The development team had to optimize the software continuously, ensuring that it remained user-friendly and did not overwhelm the system resources of the end-users' computers.

In this phase, my role as a media production practitioner was integral. My practical experience and knowledge of the industry's needs helped guide the technical team in making decisions that aligned with the educational goals of CineSim. This collaboration between technical expertise and industry knowledge was key to overcoming the challenges encountered during the development of CineSim and ensured that the final product was technically sound.

C. Implementation in Educational Settings

The implementation phase marked a significant transition from theoretical design to practical application. In this phase, CineSim was introduced into real teaching environments. This stage was particularly challenging due to several factors. Firstly, initial deployment often uncovers technical issues such as software bugs or design flaws that are not apparent during the development phase. These issues require prompt attention and resolution to ensure the software's functionality and reliability in a real educational setting.

Another challenge during this phase was the initial reception of CineSim by students and educators. The early versions, while innovative, sometimes did not fit with user expectations, primarily due to the unforeseen technical glitches or user interface complexities. This made users hesitate to use CineSim as users were having doubts about its effectiveness and ease of use. Convincing users to invest their time and effort in a new, untested educational tool, especially when they faced initial setbacks, was a significant hurdle.

Moreover, the implementation phase tested CineSim's real-world applicability. It was crucial to observe how students interacted with the software and how effectively it integrated into the existing curriculum. This stage provided valuable insights into the practicality of CineSim as a teaching aid and its impact on the learning process. However, the challenge lay in ensuring that CineSim complemented traditional teaching methods without overwhelming the students or disrupting established learning patterns.

The initial feedback was taken into account in refining CineSim, highlighting the areas that required improvement and provided a clear direction for further development. This phase underscored the importance of resilience and adaptability in the face of challenges and the need for continuous engagement with users to enhance the tool's effectiveness and acceptance in educational settings.

D. Analysis from User Feedback

The analysis stage was critical in understanding the effectiveness of CineSim from the user's perspective. This phase involved an examination of feedback gathered from students and educators who interacted with CineSim in real educational settings. The goal was not just to collect responses but to deeply analyze them to uncover underlying issues and areas for improvement.

For example, if students reported difficulties, such as with the control method, this initiated a detailed analysis to identify the root causes of these challenges. This process involved several steps:

1. Feedback Collection: Gathering detailed feedback through various means, including questionnaires, focus group discussions, and direct observations. This comprehensive approach ensured that a wide range of insights into user experiences were received.

2. Identifying Patterns: Looking for common themes or recurring issues in the feedback. For instance, if multiple students struggled with the same control feature, it indicated a more systemic problem rather than individual incidents.

3. Contextualizing Feedback: Understanding the context in which the feedback is given. For example, were the control issues common among beginners or experienced users? This contextual understanding helped in making solutions more effectively.

4. Technical Evaluation: Assessing whether the issues were due to design flaws, technical limitations, or user interface complexities. This step was taken to determine what action was needed, and if it required a redesign of the feature or an enhancement of the existing design.

Through this process, I led my team to transform user feedback into actual enhancement action. This stage was essential in bridging the gap between CineSim's design and its practical application in educational settings, ensuring that the software not only met technical standards but also effectively supported the learning and teaching processes.

E. Redesign and Continuous Improvement

This stage, redesign, was the final stage of the design cycle, but not the final stage of the whole design process. The development keeps going until the resources exhaust.

The redesign is based on insights gained from the analysis. This phase sees the team revisiting the entire design process, making necessary adjustments and improvements for the next iteration. This continuous cycle of redesign and re-implementation is at the heart of DBR, ensuring that each version of CineSim is more refined and better suited to the educational needs of media production students.

5.4.4 Strategies for Integrating CineSim into Media Production Education

The integration of CineSim into Media Production (MP) education is a multi-step process that involves careful consideration of pedagogical strategies, lesson planning, and the complementarity of CineSim with traditional teaching methods.

Engagement Strategies

A critical aspect of integrating CineSim is ensuring student engagement with the software. Despite its utility, the success of CineSim relies on its user-friendliness and the ability to keep learners engaged. To achieve this, CineSim incorporates elements of serious games, which are shown to successfully enhance student engagement and motivation in learning environments (Deterding et al., 2011). Designing CineSim as a serious game makes the learning experience more interactive and enjoyable.

Pedagogical Integration

In terms of pedagogical strategies, CineSim is integrated into the curriculum through a blended learning approach. Blended learning, which combines digital media with traditional classroom methods, has been found to be effective in enhancing learning outcomes (Graham, 2006). CineSim can be used as a tool for students to apply theoretical concepts learned in class in a practical, simulated environment. This approach allows for a deeper understanding of the subject matter and the development of practical skills.

Lesson Planning and Classroom Integration

In lesson planning, CineSim could be used to complement traditional teaching methods. For instance, in a cinematography class, instructors can first explain the theoretical aspects of lighting and camera angles. Subsequently, students can use

CineSim to apply these concepts in a simulated environment, allowing them to experiment and see the effects of their choices in real-time. This hands-on experience is invaluable and it promotes active participation in the learning process (Freeman et al, 2014).

5.4.5 Addressing Educational Concerns through CineSim's Features

CineSim, as an innovative educational tool, is designed to address several key educational concerns in Media Production (MP) training. By leveraging its unique features, CineSim provides practical solutions to some of the most pressing challenges in MP education.

Bridging the Practical Experience Gap

One of the primary concerns in MP training is the lack of practical experience. Traditional classroom settings often limit students' exposure to real-world scenarios, which is crucial for their professional development. CineSim addresses this gap through its realistic simulation features. By offering a virtual environment where students can experiment with different aspects of media production, CineSim provides hands-on learning opportunities that are a challenge to replicate in a conventional classroom. This promotes students' active participation and experience in the learning process (Freeman et al., 2014).

Enhancing Visualization of Creative Concepts

Another significant concern in MP education is the difficulty students face in visualizing and communicating their creative ideas, especially in storyboarding. CineSim's storyboard tools offer a solution to this challenge. The software allows students to create and manipulate scenes in a 3D environment, enabling them to visualize their ideas without the need for any drawing skills. This feature not only aids in the creative process but also ensures that all students, irrespective of their artistic abilities, can effectively communicate their visions.

Facilitating Remote and Blended Learning

The COVID-19 pandemic has underscored the need for flexible and adaptable learning methods. CineSim's virtual platform is well-suited for remote and blended learning environments, offering students the opportunity to continue their practical training irrespective of their physical location. This adaptability ensures that learning is not disrupted by external factors like pandemics or limited access to physical resources, addressing a critical concern in contemporary education (Bao, 2020).

Preparing Students for Industry Readiness

Finally, CineSim contributes to students' industry readiness by providing them with a platform to develop and refine skills that are directly applicable in the media industry. The software's emphasis on real-world scenarios and practical skills ensures that students are well-prepared to meet the demands of the modern media landscape. This alignment with industry standards is crucial in ensuring that graduates are competitive and competent in the job market (Beard & Wilson, 2006).

5.4.6 Limitations of Current Version of CineSim

CineSim breaks new ground in media-production education, but the present release still has notable limitations. First, the software runs only on Windows PCs equipped with an RTX-class graphics card. Students with PCs with non-compatible graphics cards are also unable to use CineSim outside the laboratory. Second, development is handled in-house by a single full-time programmer, so occasional bugs and stability issues exist. In its current state, then, CineSim should be regarded as a fully functional beta version: a proof-of-concept showing that photorealistic simulation can be embedded in formal instruction to enrich the learning experience, while still requiring further optimisation and cross-platform support.

5.4.7 Conclusion of CineSim

This chapter has documented the design of CineSim, emphasizing its foundation in both educational theory and practical game elements. CineSim has been designed as a serious game to bridge the gap between theoretical learning and practical application in media production education. By mapping its features to key concepts from course syllabi and integrating successful elements from popular sandbox games, CineSim aims to provide an engaging and effective learning platform.

It is important to note that this design represents the initial framework of CineSim before any testing with authentic users. As part of the DBR methodology, the design of CineSim is intended to evolve continuously (Collins et al., 2004; Juuti & Lavonen, 2006). Feedback from users will play a critical role in refining and enhancing the software. This iterative process ensures that CineSim remains responsive to the needs of students and educators, ultimately leading to a more effective and user-centred educational tool. The subsequent chapters will explore the implementation and feedback phases, which will guide the ongoing development and improvement of CineSim.

5.5 Mapping with Theories that Support Serious Games – SDT and ALT

As outlined in the literature review in Chapter 2, serious games leverage various learning theories to enhance educational outcomes. Specifically, Self-Determination Theory (SDT) is utilized for fostering motivation, emphasizing the importance of autonomy, competence, and relatedness in increasing learners' engagement (Deci & Ryan, 2000). Authentic Learning Theory (ALT) enhances the learning process by providing real-world relevance and applicability to educational tasks (Herrington et al., 2010). These theories explain the dual impact of serious games: they increase learners' willingness to engage and participate actively in the learning process and provide a context that enhances the assimilation and application of knowledge (Gee, 2003; Prensky, 2001). This section will detail the mapping between CineSim's design and functionalities and the principles of SDT and ALT, illustrating how theoretical underpinnings contribute to practical educational advancements.

5.5.1 Encouraging Motivation with SDT

Needless to say, the learning journey will not start unless you have motivation to join the learning activity. As such, studying how to better motivate students became a crucial topic in this research. I chose Self-Determination Theory (SDT) to systematically elaborate on how to motivate users (Deci and Ryan, 2000). SDT posits that motivation is enhanced when an activity supports the innate psychological needs for autonomy, competence, and relatedness. CineSim has been designed to address these needs in the following ways:

Autonomy: Choice and Decision-Making within the Simulation

In SDT, autonomy refers to the feeling of volition and self-direction that individuals experience when they are fully in control of their own behaviors and goals (Deci & Ryan, 2000). It emphasizes the importance of acting with a sense of choice and freedom, rather than feeling controlled by external pressures or demands (Ryan & Deci, 2000). This sense of autonomy is crucial for fostering intrinsic motivation, where individuals engage in an activity for the sheer pleasure and satisfaction derived from the activity itself, rather than for some separable outcome (Deci & Ryan, 1985; Vansteenkiste et al., 2004).

CineSim significantly supports the need for autonomy by providing users with the freedom to make choices and decisions that influence the outcome of the simulation. For instance, students can choose from a variety of camera angles, lighting setups, and editing techniques to create their desired visual effects. This level of control allows students to experiment and explore different aspects of media production according to their personal interests and creative styles. The open-ended nature of tasks within CineSim ensures that students can approach problems in their own way, enhancing their engagement and intrinsic motivation to learn.

Additionally, CineSim extends this freedom further by allowing users to select different scenarios or environments in which to apply their skills. For example, students can opt to work on a normal house setup, a commercial video shoot, or a Hong Kong style film scene, each requiring different approaches and techniques. This choice not only enriches the learning experience by exposing students to various aspects of media production but also empowers them to align their learning activities with their career aspirations or personal interests, further enhancing the autonomy supported by CineSim.

By providing these choices, CineSim not only supports the technical development of media production skills but also aligns with the SDT principle that enhancing autonomy boosts motivation and satisfaction in educational activities. This approach helps ensure that students are not just passive recipients of information but active participants in their learning journey, engaged and motivated by their ability to control their educational path.

Competence: Immediate Feedback and Realistic Consequences

Competence refers to an individual's need to feel effective and capable within their environment. It involves a sense of mastery and proficiency in tasks that are both challenging and attainable (Deci & Ryan, 2000). Supporting competence in educational settings typically involves providing opportunities for skill development, offering challenges that are appropriate to the learner's level, and providing feedback that is both informative and encouraging (Deci et al., 1991; Pintrich & Schunk, 2002).

CineSim excels in fostering competence by offering immediate feedback on users' actions. When students adjust lighting or camera settings, the changes are instantly visible, providing clear and direct feedback on their creative decisions. This feature not only helps students understand the impact of their choices but also facilitates a deeper learning experience by allowing them to experiment and learn from mistakes without real-world consequences. The realistic simulation of media production processes ensures that students can gain practical skills and confidence in their abilities, further increasing their motivation to engage with the tool.

For example, when a student decides to experiment with a three-point lighting setup within CineSim, they can immediately see how adjustments to key light, fill light, and back light affect the appearance of the subject. The software provides visual feedback on shadow intensity, direction, and the overall mood created by their lighting choices. This real-time feedback loop not only reinforces the learning of cinematic lighting techniques but also aligns perfectly with the concept of competence in SDT. Students feel more competent as they see the tangible results of their actions, understand the rationale behind specific setups, and master the skills needed to create desired visual effects.

Additionally, CineSim allows students to manipulate a virtual camera and receive immediate visual feedback. For instance, when a student changes the camera position or angle, they can instantly see how the composition of the shot and the perception of depth change. By experimenting with different camera positions, students can better understand concepts like framing, perspective, and focal length. This immediate feedback helps students grasp the visual impact of their decisions, reinforcing their learning and boosting their confidence in using camera techniques effectively.

These features of CineSim perfectly encapsulate the SDT principle that competence is enhanced when individuals receive timely and relevant feedback about the effectiveness of their actions, fostering an environment where students can develop mastery and self-assurance in their skills (Ryan & Deci, 2000; Hattie & Timperley, 2007).

Relatedness: Collaborative Project Features

Relatedness refers to the need to feel connected to others, experiencing a sense of belonging and involvement in a community (Ryan & Deci, 2000). This psychological need underscores the importance of social interactions and relationships in enhancing motivation and emotional well-being. In educational settings, fostering relatedness can significantly boost students' engagement and persistence by creating a supportive learning environment where students feel valued and connected to their peers and instructors.

While CineSim includes features that support collaborative projects, such as the ability to work on joint media productions or share and discuss creations, the support for relatedness is not as important as for autonomy and competence. The platform primarily focuses on individual skills and creativity, with less emphasis on building connections or fostering a sense of community among users. Although there are opportunities for interaction, these are not as deeply integrated into the core functionality of CineSim as the other two psychological needs. However, the existing features do contribute to a sense of relatedness by allowing students to share their work and receive feedback from peers, albeit this aspect could be further enhanced to better support social learning and engagement.

5.5.2 Facilitating Authentic Learning

Jan Herrington's framework for authentic e-learning outlines a structured approach to designing online learning environments that are engaging, relevant, and effective for knowledge acquisition (Herrington et al., 2010). The framework identifies nine essential components that help replicate real-world challenges within an e-learning context. For the purposes of analyzing CineSim, I focus on four key elements that are particularly integral to serious game design, ensuring that students can actively acquire and apply knowledge through gaming. These elements are:

1. Authentic Context: Ensures the learning environment emulates real-world settings.
2. Access to Expert Performances and Modelling of Processes: Provides students with access to expert knowledge and demonstrations, allowing them to observe and learn from professionals.
3. Reflection: Facilitates opportunities for learners to reflect on their learning experiences.
4. Coaching and Scaffolding by the Teacher at Critical Times: Offers guidance and support from educators when students encounter challenges, helping them to overcome obstacles and progress in their learning journey.

CineSim's design primarily incorporates these elements to enhance the educational experience, making learning not only more interactive but also more applicable to real-world media production. The following sections delve deeper into how CineSim maps these elements of Herrington's framework into its gameplay and instructional design, demonstrating its effectiveness as a serious game in educational settings.

Authentic Context

Authentic Context within Herrington's framework for authentic e-learning emphasizes the importance of creating a learning environment that closely mimics the context in which the acquired skills will be applied in the real world (Herrington et al., 2010). This is essential for ensuring that the knowledge and skills learned are relevant and directly transferable to professional settings.

CineSim excels in providing an authentic context by simulating a realistic media production environment where students can engage with the same tools and scenarios they would encounter in a professional setting. The software is designed to replicate various aspects of film and media production, including pre-production planning, on-set shooting, and post-production editing. This immersive simulation helps bridge the gap between theoretical learning and practical application, making it an ideal tool for media production education.

For example, students can work on a project that involves creating a short film from concept to final edit. They start by selecting a script and then proceed to plan the shoot, considering factors like location setup, lighting, and mise-en-scène. If a student chooses to shoot a nighttime scene, they must adjust the lighting to reflect how such a scene would be lit on an actual film set. They can experiment with different lighting setups, camera angles, and movements to see how each decision impacts the visual style and mood of the scene. The software provides realistic feedback on lighting and camera settings, giving students a real-time view of how their choices affect the output. This real-world relevance is crucial for students to understand not just the "how" but the "why" behind various production techniques.

By integrating these realistic scenarios and challenges, CineSim fulfills the criterion of providing an authentic context, thereby enhancing the educational value of the learning experiences it offers. This authentic context ensures that students gain practical skills and theoretical knowledge that are applicable and valuable in real-world media production settings, truly embodying the principles of authentic learning as outlined by Herrington's framework (Herrington & Oliver, 2000; Lombardi, 2007; Rule, 2006).

Access to Expert Performances and Modelling of Processes

This emphasizes the importance of providing students with opportunities to observe and learn from the practices of experts. This component is crucial for helping students understand professional standards and techniques, as well as for fostering the development of their own skills through guided observation and practice (Herrington & Oliver, 2000).

CineSim provides access to expert performances and models professional processes by allowing students to simulate high-level media production tasks. Unlike traditional teaching methods where students might passively watch a movie or a demonstration, CineSim actively involves them in constructing and analyzing shots, offering a hands-on learning experience. This engagement is particularly valuable in media production education, where understanding the intricacies of professional work is essential for skill development.

For instance, CineSim can simulate the setup involved in creating blockbuster movie scenes. Students are not merely passive observers; they actively participate in the creation process by selecting camera angles and adjusting lighting. This level of engagement allows them to apply theoretical knowledge in a practical setting, enhancing their understanding of cinematic techniques and workflows.

The interactive nature of CineSim means that students can experiment with different approaches and receive immediate feedback on their decisions, which is not possible in traditional classroom settings. By modelling expert processes and allowing students to replicate these techniques, CineSim can build a strong linkage between practical application and expert examples. This approach ensures that students not only learn about professional standards but also develop the skills needed to achieve them.

By integrating access to expert performances and modelling processes, CineSim enhances the educational experience, making it more interactive and applicable to real-world settings. This approach aligns with Herrington's framework, ensuring that students gain a deeper understanding of professional practices and develop the skills necessary for success in the media production industry (Herrington et al., 2010; Collins et al., 1989; Lave & Wenger, 1991).

Reflection in CineSim

Reflection emphasizes the importance of providing learners with opportunities to critically assess their learning experiences. It is a critical component of the learning process, allowing students to think about what they have learned, how they have learned it, and how they can apply this knowledge in future contexts (Herrington et al., 2010).

CineSim facilitates reflection by incorporating features that encourage students to review and analyze their work. After completing a media production task, students can save and share their projects with peers and instructors, allowing them to receive feedback on various aspects such as lighting, camera angles, and editing choices. A significant advantage of CineSim is its ability to accurately translate users' thoughts into visual form, ensuring that discussions and feedback are precisely targeted to the user's original ideas. This clarity helps eliminate misunderstandings and allows for more focused and constructive feedback. By engaging in this reflective process, students can identify strengths and areas for improvement, fostering a deeper understanding of cinematic techniques.

Additionally, reflection sessions can be integrated into classroom activities, where students share their experiences and insights with peers. This collaborative reflection not only reinforces individual learning but also builds a community of practice, enabling students to learn from each other's experiences.

By facilitating reflection, CineSim ensures that students engage in meaningful learning that promotes long-term retention and application of knowledge. This approach aligns with Herrington's framework, highlighting the importance of reflection in achieving deep, authentic learning (Killion & Todnem, 1991; Moon, 2004; Ryan, 2013).

Coaching and Scaffolding by the Teacher

Coaching and scaffolding by the teacher are essential components within Herrington's framework for authentic e-learning. These elements emphasize the importance of providing timely guidance and support from educators, particularly when students encounter challenges. Such interventions help students overcome obstacles and progress in their learning journey (Herrington et al., 2010).

In the context of CineSim, instructor guidance plays a critical role in enhancing the learning experience. The interactive nature of CineSim allows for real-time feedback and adjustments, making the coaching process more effective and aligned with the students' learning needs.

With CineSim, the alignment of ideas between students and teachers is significantly enhanced. The platform's realistic simulations enable teachers to observe students' work closely and understand their decision-making processes. This alignment allows educators to provide more accurate and constructive feedback. For instance, when a student is working on a scene in CineSim, the teacher can see exactly what the student sees, facilitating a clearer understanding of the student's approach and challenges.

This precise alignment of perspectives enables teachers to offer specific and actionable advice, improving the overall quality of feedback. Teachers can guide students through technical adjustments, creative decisions, and problem-solving strategies with greater accuracy. By leveraging the capabilities of CineSim, educators can help students refine their skills and develop a deeper understanding of media production techniques.

Furthermore, the scaffolding provided by teachers helps students build on their existing knowledge and skills. As students progress through tasks in CineSim, teachers can gradually reduce the level of support, encouraging greater independence and confidence. This gradual release of responsibility is a key aspect of effective scaffolding, fostering both skill development and self-efficacy in students.

By incorporating coaching and scaffolding at critical times, CineSim ensures that students receive the support they need to succeed. This approach aligns with Herrington's framework, highlighting the importance of instructor guidance in achieving deep, authentic learning (Herrington & Oliver, 2000; Sawyer, 2006; Van de Pol et al., 2010).

5.5.3 Conclusion with Mapping CineSim with Theoretical Frameworks

In conclusion, the integration of Self-Determination Theory (SDT) and Authentic Learning Theory (ALT) within CineSim demonstrates the tool's effectiveness in enhancing media production education. By addressing the key components of SDT - autonomy, competence, and relatedness - CineSim fosters intrinsic motivation among students. Additionally, the alignment with ALT principles, including authentic context, access to expert performances, reflective practices, and coaching and scaffolding, ensures that learning experiences are both relevant and deeply engaging. This theoretical grounding not only validates the pedagogical value of CineSim but also highlights its potential to transform educational practices in media production through immersive and interactive learning environments.

5.6 Autoethnographic Review of Multiple Roles

This section is my autoethnographic review, reflecting on my early involvement in the DBR process for developing CineSim. I have played three distinct roles: researcher, developer, and educator. Each role has provided unique insights and challenges, offering a comprehensive perspective on the development and implementation of CineSim.

My Involvement in Three Roles

In this DBR project, my involvement spans across three primary roles:

1. Developer: Collaborating with part-time developer to design the software, addressing technical issues, and ensuring the functionality aligns with the educational goals.
2. Researcher: Conducting thorough research on theoretical frameworks to ensure the study is academically sound, and investigating relevant media production topics to see how they can be transformed into a game.
3. Educator: Providing feedback and ideas on how to make CineSim engaging for students, drawing from my experience in teaching media production.

5.6.1 Development Background: My Motivation

Back to the early 2010s, I started my academic journey in film, with a strong focus on cinematography and other technical aspects. Throughout my study and filmmaking experience, I quickly realized that storyboarding in the pre-visualization stage is not a step that can be missed. It has an essential role in translating ideas to visual imageries. With images, I can share exactly what I want to make with other crew members. However, there was a problem. I could not draw well. I have a very clear and rich thought in mind, but translating it into pictures was a big challenge.

In order to tackle this problem, I managed to explore various methods to make storyboards without drawing. I tried to use professional 3D software called Autodesk Maya[16]. As an industry standard software for 3D modelling and animation, it worked fine to create storyboards. However, the procedure is complicated, and it is very time consuming and not cost-effective. Thus, Autodesk Maya is an alternative, but not an optimum option to create storyboards. Another approach was taking photographs as storyboards. It works, but is equally time-intensive and has great limitations that hinder expression of my ideas. The last approach is to find similar pictures in the internet to express my thoughts. This approach is quicker, however, the constraint is also significant. With all the above trials, finding ways to assist people to develop storyboards became a dream for me.

Later, I started to work in higher education. During my nine years of experience in teaching media production in different institutes, I found that a significant number of students are facing the same problem as me. Many students, despite having fantastic ideas, could not draw to express their thoughts. In most cases, their thoughts were clear and creative, but translating them visually was a big challenge. When amateur people read storyboards, they usually focus on the quality of the drawing, but not the content. This is not correct. Storyboard is just a form to show ideas and act as blueprints for actual production. As long as it is comprehensive enough and crew can understand it, the quality of the drawing should have no stake.

[16] https://www.autodesk.co.uk/products/maya/overview

With this regard, I even had a stronger motivation to explore the best tool to help my students, and me of course, to develop storyboards.

In search of solutions, I tested existing software. One such tool was "Storyboarder[17]". Initially promising, it quickly showed flaws after some trials with students. Its interface was not intuitive, and it was clear it was built more from a programmer's perspective than that of an educator or filmmaker. Plus, being shareware, support and updates are not available. These experiences pushed me further. I wanted to create a tool. A tool that could help anyone, regardless of drawing skills, to visualize their ideas and stories accurately.

5.6.2 As a Researcher

Starting this project presented several challenges due to limited research on the adoption of technology in media production education. This uncertainty led to self-doubt about the project's viability and relevance.

I noticed a significant gap in existing research on integrating serious games within media production education. This raised questions about whether this area was unexplored due to perceived unimportance or simply because it was new. Convinced of its potential benefits, I decided to pursue the development of CineSim.

The lack of direct precedents in this field led me to seek insights from adjacent areas like engineering education, where simulation and serious games are more studied. I delved into game-based learning literature, adopting Self-Determination Theory (SDT) and Authentic Learning to understand the motivational and contextual dynamics of learning through serious games.

[17] https://wonderunit.com/storyboarder/

Integrating these theories into CineSim was facilitated by the Design-Based Research (DBR) methodology, allowing continuous refinement based on feedback. As developer, educator, and researcher, I had a comprehensive perspective on CineSim's development, aligning educational goals with the software's capabilities to ensure it was pedagogically effective and engaging for students.

Eventually it is about money. Securing funding was a significant hurdle. The University Grants Council (UGC) of Hong Kong announced special funding for virtual teaching and learning initiatives. Encouraged by my Dean, I submitted a proposal to develop a storyboard creation tool, initially requesting around 1 million HKD. After several rounds of interviews, the application was successful, but the approved budget was only 75% of the request. This reduction forced a drastic revision of my plans, ultimately allowing for only one part-time programmer. Despite this, the programmer's high level of responsibility and commitment mitigated the shortfall.

5.6.3 As an Educator

In this stage, my role is to design what topics should be included in the design of CineSim, and input my comments to the development team. This is done by researching on relevant course syllabi and transform them into CineSim Design. I have also made a concerted effort to infuse my previous teaching experience into the development of CineSim. My extensive involvement in media production education has provided me with a deep understanding of what students need to effectively learn these concepts. This insight is crucial in ensuring that the software is not only educational but also engaging and user-friendly.

For example, setting up multiple lights to achieve a dramatic lighting effect in reality can be challenging for students. Recognizing this, I guided the development team to focus on creating a user-friendly layout and realistic simulation in CineSim. This allows students to test different lighting effects immediately with just a few drag-and-drop actions. By making these tasks more accessible, CineSim encourages students to experiment and explore various techniques, thus enhancing their learning experience.

My practical experience in teaching media production has been invaluable in this role. By understanding the needs and preferences of students, I can offer targeted feedback and suggestions to enhance the educational impact of CineSim. This role also involves anticipating the challenges that students might face and addressing them proactively in the software design. Ensuring that CineSim is intuitive and conducive to learning has been a primary focus, and my contributions as an educator aim to make the software a powerful tool for media production education.

5.7 Conclusion

In this chapter, I have detailed the preliminary stages of developing CineSim, encompassing the initial conceptual foundation, data collection from relevant course syllabi, research on common game elements, and the comprehensive design of the software. By integrating theoretical knowledge and practical skills from media production education, along with engaging elements from popular sandbox games, CineSim is structured as a serious game aimed at bridging the gap between classroom learning and real-world application.

The design of CineSim is rooted by the principles of Serious Game design, which emphasizes the balance between entertainment and educational value. Additionally, the incorporation of Self-Determination Theory (SDT) ensures that the software supports key psychological needs such as autonomy, competence, and relatedness, thereby fostering intrinsic motivation and engagement among students. Authentic Learning Theory (ALT) further guides the design by ensuring that the learning experiences within CineSim are relevant, contextually rich, and closely aligned with real-world practices.

The mapping of CineSim features to course syllabi demonstrates its alignment with educational objectives, ensuring that the software meets the needs of both students and educators. The stages of CineSim development, guided by the Design-Based Research (DBR) methodology, highlight the iterative process of design, implementation, analysis, and continuous improvement, emphasizing the importance of flexibility, collaboration, and a user-centred approach.

Furthermore, my autoethnographic review provides insight into the multifaceted roles I have played as a researcher, developer, and educator. This reflection underscores the challenges and insights gained from balancing these roles and the strategies employed to address them.

As this chapter concludes, it is important to recognize that the design of CineSim represents the initial framework before any testing with authentic users. The DBR methodology ensures that the design will evolve continuously, incorporating feedback from users to refine and enhance the software. The subsequent chapters will explore the implementation and feedback phases, guiding the ongoing development and improvement of CineSim, eventually leading to a more effective and user-centred educational tool.

Chapter 6. First Round of Data Collection and Analysis

This chapter presents the results from the first round of data collection and analysis. It includes quantitative survey results, focus group discussions, and my autoethnographic reflections. The chapter integrates these data sources in a mixed-method analysis to derive insights for the future development of CineSim and to prepare for the second round of data collection.

The first section details the results from the initial quantitative survey, providing statistical insights into users' experiences and perceptions of CineSim. This is followed by a summary of the findings from the first round of focus group discussions, offering qualitative insights and personal reflections from participants.

The next section is my autoethnographic reflection, examining the development and implementation of CineSim from the perspectives of my roles as a researcher, developer, and educator. This reflection provides an insider’s view of the challenges and milestones encountered during this phase.

Finally, a mixed-method analysis combines these quantitative and qualitative findings, offering a holistic view of the data collected. This integrated analysis highlights key areas for improvement and informs the strategy for the next development cycle and subsequent rounds of data collection.

6.1 Results from First Round Quantitative Survey

6.1.1 Research Design of the First Round Participant Survey

A series of workshops were organized to introduce participants to CineSim. This workshop was open to students from all majors. With a diverse background of students, it helped to provide varied perspectives on CineSim. The primary goal was to guide participants on how to use CineSim to translate their creative ideas into visual forms.

Across ten sessions, the workshop catered for 80 students who were interested in storyboarding and cinematography. After an hour of hands-on experience with CineSim, participants were invited to share their thoughts and feedback through a questionnaire on a volunteer basis. Out of 80 participants, 57 participants filled in the survey. Participants were a convenience sample recruited through a voluntary sign-up sheet, so the group is heavily skewed toward Animation and Digital Arts majors. As the sample size is not large, the findings here should be read as exploratory rather than generalisable to all MP students. To obtain richer insights, the survey was followed up with a series of focus-group discussions. The same strategy was also applied in the second round data collection.

This questionnaire was designed to understand the user experience and learning journey with CineSim. The survey is divided into three main sections. The first section focuses on user interface/user experience (UI/UX), aiming to understand how users perceive the design and usability of CineSim. Proper UI/UX design is crucial, as it impacts users' enjoyment and willingness to engage with the software, which in turn affects its adoption in educational settings. The second section focuses on the cinematography, lighting, and storyboarding functions of CineSim. It evaluates how effectively the software aids users in applying these concepts and translating their creative ideas into visual forms. For these two sections, respondents are asked to rate their agreement with various statements on a 5-point

Likert scale from "strongly disagree" to "strongly agree." This scale is used to minimize confusion and provide clarity for respondents. Users might find it challenging to understand the subtle differences when rating on a 0-10 scale, such as distinguishing between a 6 or a 7. However, using terms like "agree" and "strongly agree" simplifies the process, making it easier for them to express their opinions accurately. This approach helps capture the intensity of users' opinions and provides detailed insights into their experiences.

The final section solicits overall feedback from participants. It includes ratings on a scale of 1-10 to gauge their overall satisfaction with CineSim and their likelihood of recommending it to peers. While the final section features open-ended questions to gather more personal and detailed responses about their impressions. This comprehensive feedback helps to assess the software's strengths and areas for improvement.

The complete questionnaire is attached in *Appendix 2*.

In order to protect user's privacy and encourage them to answer truthfully, the design of the survey consisted of no identity tracking. It makes it impossible to link responses to any individual participant.

6.1.2 Quantitative Data from First Round Survey

In this section, I focus on the feedback gathered from users of CineSim, examining how the software's design, functionality, and educational potential were received. For details in the result, see Appendix 3.

I. UI/UX

Ease and Accessibility

CineSim's user experience was centred around a design that prioritizes ease and accessibility. Around 71.9% of users agreed or strongly agreed that it is easy to figure out how to use CineSim. This ensures that users can spend more time on crafting creative ideas instead of dealing with technical issues.

However, some users pointed out a few concerns in the open-ended questions in the last part. Here are some comments extracted from the survey:

- “I encounter bugs frequently”
- “Motion sickness is triggered when using the software”
- “There are instances where the camera window sometimes blocks the library window, making it unable to close”
- “Arrows sometimes get blocked by objects within the software”
- “The learning curve is a bit steep, which makes users hard to start to use CineSim”
- "I think it is good enough for beginners."

These comments reflected that the problem of CineSim did not exist in the concept of the software, but in the UI/UX design. These concerns were addressed in the future development of CineSim.

Design and Presentation

The design of CineSim was ambitious in its aim to provide a visually appealing experience for users to experiment with different creative thoughts. 78.9% and even 84.2% of the respondents agreed or strongly agreed that CineSim has a well-organized interface and were satisfied with CineSim's overall appearance respectively.

Responsiveness and Effectiveness

It was crucial to ensure that CineSim reacted precisely to user inputs. In this regard, 70.2% of users expressed a satisfaction with its responsiveness and alignment with user actions. CineSim worked closely with what users had in mind. It also meant that users could make choices confidently as they knew what the software would deliver.

II. Cinematography, Lighting, and Storyboarding Functions

Learning and Realism

For learning purposes, it was important to keep the simulation authentic. In this regard, the generated graphics and simulation functions of CineSim were seen as highly realistic and well-recognized. 70.2% of users agreed that the simulation of cinematography and lighting was accurate. Furthermore, users agreed that CineSim served as an educational tool. Users were not just playing around in the simulated environment, but were also learning in the process.

Specific user comments stating the software's strengths include:

- "It’s helpful for storyboarding."
- "The scene is easy to setup."
- “I appreciate the lighting feature of CineSim.”
- "I think CineSim is a very creative and convenient tool."

- "We can have realistic characters and lighting to simulate the scenes that we need."
- "I like that I can visualize shots and see how lighting or perspective will work before the actual shooting."

Storyboarding application

Storyboarding is a fundamental step in filmmaking pre-visualization. However, in its current iteration, CineSim has shown some limitations in this area. Specifically, only 63.2% of users found CineSim useful in creating and visualizing storyboards, while an even lower 57.9% reported that the software was easy to use as a storyboarding tool. These figures suggest that the storyboarding functionality of CineSim is relatively weak compared to other features, highlighting a critical area that requires further attention.

Overall Project Visualization

Beyond individual features, CineSim acted as a holistic tool to assist users in visualizing and planning their projects beforehand. 68.4% of respondents expressed that CineSim was helpful in translating their creative visions to life.

III. Recommendations to peers

When asked whether they would recommend CineSim as a preferred tool for learning and experimentation in cinematography, lighting, and storyboarding, the response was predominantly positive. The median was 8 on a scale of 10, indicating that users generally saw CineSim as a robust tool for translating creative thought into visual content. This also suggests that CineSim has high potential to function effectively as a storyboarding tool, despite some areas that may require further refinement.

Additional Comments

Apart from the feedback specifically about the UI/UX and Cinematography functions, users also provided some general recommendations and desires for the refinement of CineSim. Here are some direct quotes from users:

- "More facial expressions should be included to allow a broader range of emotions to be represented."
- "Character customization function should be added for a more diverse character representation."
- "I want to have 3D model import functions!"
- "I wish I can run CineSim in Mac."

These comments were taken into account in the future development, subject to technical consideration of the software development.

Overall, the feedback showed a positive picture of CineSim. The highly-realistic simulation functions and user-interface impressed users, and made CineSim an outstanding tool for learning.

6.2 Results from the First Round Focus Group Discussions

6.2.1 Research Design of First Round Focus Group Discussions

Five face-to-face focus group sessions were conducted with the primary objective of understanding the users' journey on using CineSim to acquire media production concepts. This focus group discussion was not focusing on the technical efficacy or usability of the software but more on the cognitive and pedagogical implications it fostered within a learning environment. The discussion sessions also generated insights that would guide the further enhancement of CineSim, eventually ensuring its further refinement as a polished educational tool for media production education.

For this approach, the participants consisted of 20 volunteer students from different degree majors (14 from Animation and Digital Arts / Creative Industries majors and the rest from non-media studies students). These sessions were facilitated by a third-party to mitigate potential bias from the power imbalance between me and my students. The discussions were audiotaped, transcribed and made anonymous after obtaining informed consent from the participants.

Methodology and Thematic Exploration

- Discussions were systematically led by a facilitator, using semi-structured interview questions and the aim was to address the following areas:
- How users contextualized CineSim within their learning journey.
- Users' emotional and subjective engagements with the software.
- Encountered obstacles and challenges during the time they used CineSim.
- Potential enhancements of its educational application.
- Evaluation of its function in translating abstract media concepts into tangible visuals

6.2.2 Result of the First Round Focus Group

This section presents the findings from the focus group interviews using thematic analysis to highlight key themes.

a. Workshop Review

During the focus group interview, many participants expressed that the CineSim workshop was interesting. They were deeply impressed by CineSim’s capability.

However, the duration of the workshop was considered too short (within an hour). They felt that the limited duration hindered their ability to work deeply with the features that the software offered. They wished to enjoy a workshop with longer duration so that they could enjoy expansive functions that CineSim offers. One said "Within just an hour, once I know how to operate in CineSim, and time is up. I have no time to make any interesting experiment". This feedback aligns with my observation and casual conversation with students during the workshop.

b. Pedagogical Aims and Learner Expectations

Through the focus group discussions, a majority of participants expressed very similar users' goals and expectations. At the core of their desire, they wanted a platform that enabled them to prepare storyboards conveniently and precisely. One participant said "it would be good if I can create storyboard with different angle and character position". Participants highly appreciated the flexibility of the software. Such an essential feature enabled them to deliver their creativity without technical constraints. Furthermore, they saw CineSim as a sound platform to practice not only storyboarding but also helped them to study deeper into lighting and photography design. An important message was that users expected to use CineSim to translate their creative ideas into visual imageries effortlessly, and expected help to smooth the transition from pre-production to production.

Beyond these practical functions, users treated CineSim as an invaluable teaching aid that was able to assist both educators and students in the realm of media production.

The discussion also showed that there was room for further enhancement. One said "When I want to choose a prop, for example, a tissue box, I could not find it in the library". This feedback expressed the anticipation that they wanted a further system refinement and an expanded assets library. The library has about 2000 assets, and most of them are furniture or items. They said they would prefer to have more diverse characters and animation assets. By then, they believed that CineSim could become a better creation and educational tool.

c. Advantages from a Learning Perspective

Participants expressed their opinions that CineSim had shown its revolutionary capability to provide real-time reflections on lighting design. This dynamic feature not only allows users to gain a deeper understanding of different complex lighting design but also acts as a tool for users to experiment different crazy ideas with just a few clicks. One said "I am not impossible to put an actor in the rooftop, but in CineSim I can do it". Moreover, from a practical standpoint, CineSim serves as both a time and resource saver, particularly in the pre-production and simulation stages. This, combined with its function as a learning platform, ensures that users can make themselves familiar with various lighting gears and camera setup in an immersive environment.

Moreover, the help it gives to people who cannot draw cannot be ignored. CineSim provides a convenient platform and environment for them to visualize and manifest their creative visions. In the domain of practical applications, CineSim acts as a testing playground, especially for users who wish to verify the real-world applicability of their concepts in lighting design and camera setup.

d. Constructive Comments and Feedback for the Software and Learning Design

From a technical standpoint, several issues were spotted. Participants found specific bugs such as objects disappearing after making "Alt" key press and the inability to save files or modify the viewing angle. Also, they found it difficult to select specific objects in the preset environment or adjust the camera's position. These technical problems made users frustrated when they were doing different tests in CineSim.

Diving deeper into the software's functions, users felt the current pre-built scene options were somehow limited. They expressed a strong desire to see more diverse pre-built scenes, ranging from everyday scenes like restaurants and parks to more specialized settings like 16^{th}-century England or futuristic high-tech scenes. The desire for diversity also extended to characters, their postures, and facial expressions. Participants expressed a need for more diverse characters, such as elderly figures, children, and a wider choices of emotions to more precisely express the plot of their story.

Participants also expressed another strong desire for character customization. Users wanted a tool where they could adjust character skin colour, clothes, and even hair. Moreover, they highlighted the need for more flexible character body pose customizations functions, possibly through skeleton rigging or even integrating Virtual Reality (VR) functionalities for capturing real-time body movements.

While there was an overwhelming call to expand the software's library and add a character customization function, an opposite comment emerged. One participant emphasized the importance of keeping CineSim simple. Instead of adding more functions like importing 3D characters and objects, it might be more valuable to keep the platform streamlined and user-friendly. This perspective emphasised the diverse user base of CineSim and the need to strike a balance between comprehensive features and ease of use.

e. Comments from User Design Perspective

The ease of use of software is crucial for its adoption and further utilization, and the result of user experience testing was diverse. Users who possess prior experience with platforms like Maya[18], Blender[19], or After Effects[20] find CineSim is easy to use in terms of user-interface. The software provides a smooth user-experience design that enabled them to perform tasks efficiently. A specific example of this simplicity is the ability to modify world settings, such as switching between day and night. This action just needs a simple click of a button. It exemplifies one of the time-saving features integrated into CineSim.

However, the comments change when it came to beginners or less experienced users. They found the platform to be quite challenging. It showed a noticeable deficiency in user experience design. The lack of comprehensive guidelines appeared to be a major obstacle for them. Additionally, the current navigation design required a simultaneous use of keyboard and mouse. It sometimes made it difficult to navigate. Participants suggested learning from user-friendly 3D platforms like Minecraft[21]. Minecraft was simple controls that even junior primary school students can master. CineSim may be more accessible for all age groups if more streamlined and straightforward controls can be provided.

Moreover, some of the hotkeys in CineSim may overlap with Maya. While this might be beneficial for some users, it somehow created confusion for users who are familiar with 3D platforms other than Maya (e.g. blender, Cinema4D[22]). It may be helpful to create a hotkey table for users to refer to when necessary. The contrast

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[18] https://www.autodesk.com/tw/products/maya/

[19] https://www.blender.org/

[20] https://www.adobe.com/hk_en/products/aftereffects.html

[21] https://www.minecraft.net/zh-hant

[22] https://www.maxon.net/zh/cinema-4d

between these experiences highlights the significance of versatility in design, ensuring that while the software retains its advanced features, it also accommodates users with varied skill levels.

f. Applications and Potential Uses of CineSim

Using CineSim as a media production tool has gained attention from its users for various applications. Its ability to serve as a reference and testing playboard for creating media work is highlighted by the feature allowing users to visualize how characters, environments, and shadows dynamically respond under different lighting conditions. This feature helps to create a more immersive and realistic experimental and testing environment.

Moreover, the software has also shown a strong potential to be a storyboarding tool. Users appreciated that CineSim enabled them to translate their creative visions into visual storyboards. Furthermore, the detailed simulation features in CineSim offer a powerful preview tool for shooting preparations. Filmmakers and photographers can simulate detailed scene settings, adjusting variables such as camera angles, lightings, and character positions to achieve the best shot.

g. Challenges Limiting the Uses of CineSim

At the moment, Mac computers are not supported. Many users voiced this concern, and I knew it on the first day. It is due to the Mac capability in real-time rendering. Somehow we cannot do much in this issue. Furthermore, technical challenges have emerged, especially in the school lab environments. Users have reported that bugs and lags on lab computers happened occasionally.

Some users also expressed that they prefer to use Maya for more freedom. These users have pointed out certain limitations in CineSim that prevent them from visualizing their visions fully, especially concerning character control and movement.

Moreover, a significant shortcoming of CineSim, as voiced by many, is that it is unable to produce video outputs. They found that at the moment, only static pictures can be exported. This limitation hindered CineSim’s potential as a comprehensive media production tool, especially when dynamic visualizations or simulations are required.

6.2.3 Conclusion

The focus group sessions revealed valuable comments about CineSim's role in media production education. Its strengths lie in dynamic features like real-time lighting reflections and its inclusivity, catering to a wide range of users from experts to beginners. It shows that CineSim is truly a software that is dedicated to storyboarding and pre-visualization.

However, feedback indicated several areas for improvement, especially around instructional content, character and environment diversity, user interface refinements, and expanded platform compatibility. While users appreciated CineSim's advanced features, they also emphasized the importance of maintaining its user-friendly nature.

6.3 Autoethnographic Reflection from Multiple Perspectives

In this section, I explore this research from three different perspectives - developer, educator, and researcher - at the first round of data collection stage. This provides autoethnographic reflections that highlight the interplay and impact of these roles on the development and implementation of CineSim.

6.3.1 As a Developer

At this stage, my role as a developer has shifted from active development to focusing on user feedback. The primary task now involves reviewing comments and feedback from users and implementing necessary technical adjustments. This is challenging because user desires cannot always be easily transformed into technical solutions. For example, users requested full control of character customization, but the development engine did not support this function, requiring me to design the back-end coding myself. Additionally, the part-time developer resigned due to salary issues, which significantly impacted the development process. As such, I actually delayed the deployment plan, and applied for an extension to the project.

6.3.2 As an Educator

As an educator, my responsibilities extend beyond using CineSim in classroom settings. I play a pivotal role in determining the content to be integrated into CineSim, ensuring it aligns with curriculum needs and enhances the learning experience. This dual role as content planner and teacher, allowing me to directly influence the software's educational content and oversee its implementation.

IT Challenges

Deploying the software presented significant challenges due to outdated IT policies at my university. Each version of CineSim, including minor updates, required extensive documentation and approval processes, delaying implementation by up to a month.

Classroom Integration and Student Engagement

Students actively engaged with the software, applying theoretical knowledge in a practical, interactive environment. During the workshop, I could see that students truly enjoyed using CineSim to experiment on different ideas in a handy way. Some are hardly replicated in reality by students themselves. I would say that except for those software bugs, users truly enjoyed their time with CineSim.

Challenges with Beta Version

The beta version of CineSim carried bugs that sometimes disrupted the user experience, potentially demotivating students from using it in their projects. This was actually something I expected at the beginning. In this batch, there were 80 participants. They have varied backgrounds, and they must be able to try something that the development team could not find. The last thing I want to happen is to demotivate users from using CineSim in their learning journey.

Student Reluctance and Insights

Interestingly, some students, particularly those unskilled in drawing, did not welcome the adoption of CineSim as an alternative to traditional storyboarding methods. This resistance highlighted a broader challenge in shifting established creative processes, as some students preferred traditional methods despite the advantages of CineSim. Simply said, they appeared reluctant to change, and to try using new technologies.

6.3.3 As a Researcher

As a researcher, my primary task at this stage is to critically review comments and data collected, linking them to the theoretical frameworks behind CineSim (i.e., Self-Determination Theory and Authentic Learning). This involves analyzing how the software impacts the learning journey and its integration into existing curricula. Implementing data collection activities proved challenging. Recruiting participants was difficult, and the turnout from public recruitment efforts was not promising. However, students majoring in media production were more willing to participate and provide feedback, likely due to my dual role as a researcher and teacher, which fostered good relationships with students. This insider advantage facilitated better engagement and feedback from participants.

6.4 Analysis of First Round User Feedback

In this section, I employ the Sequential Explanatory Strategy to analyze data collected from the first-round users of CineSim. This mixed-methods approach begins with the analysis of quantitative data, followed by qualitative data that helps explain and enrich the initial findings.

6.4.1 Introduction to Data Analysis Strategy

The primary purpose of employing the Sequential Explanatory Strategy in this analysis is to merge quantitative survey results with qualitative focus group insights. This combination allows us to form a full picture of how CineSim has been received by its first batch users. The quantitative data provides a broad overview of user satisfaction and feature usability, while the qualitative data offers depth and context, revealing the reasons behind the users' responses and providing a clearer picture of their actual experiences and feedback. By integrating these two data types, I aim to validate the quantitative findings and uncover deeper insights that may not be immediately apparent through numerical analysis alone. This comprehensive approach ensures that the development of CineSim is informed by detailed user feedback, supporting targeted improvements that will enhance both the functionality and educational effectiveness of the software.

6.4.2 Analysis of both Quantitative Data with Qualitative Focus Group Data

In this phase, the qualitative data elaborates on issues highlighted in the survey, offering detailed insights into user experiences and perceptions of CineSim. This integration aids in interpreting the quantitative data more comprehensively, ensuring that our analysis captures the complexities of user interactions with CineSim.

Exploration of Issues

- **Software Bugs and Technical Issues**

  Questionnaire Findings: 29.8% of users indicated that they felt neutral or disagreed with the statement, "I'm satisfied with CineSim's response time to my actions."

  Focus Group Elaboration: Focus group discussions further emphasized that bugs in CineSim significantly disrupted users' workflow, leading to frustration and disengagement. A recurring issue was the software's response time, which users felt hindered their creative process. Some control design problems also contributed to the bug encountered.

- **Learning Curve Challenges**

  Questionnaire Findings: 42.1% of respondents indicated that they felt neutral or disagreed with the statement, "CineSim is easy to use as a storyboarding tool".

  Focus Group Elaboration: The focus groups provided specific examples of where users struggled. Many mentioned that certain advanced features were not intuitive, requiring them to seek additional assistance from instructors. For example, something normal for digital artists, such as the gizmo and common hotkeys, becomes a nightmare for users from other backgrounds. This feedback is critical for understanding the exact nature of the learning barriers and strategizing how to make these features more accessible.

- **User Experience and Testimonials**

  Questionnaire Findings: 68.4% of users affirmed that "CineSim is useful in helping me to visualize and plan my projects".

Focus Group Elaboration: Despite some challenges, many users shared positive stories about their experiences with CineSim. For instance, one student described how the real-time lighting simulation feature allowed them to experiment with different setups, which was instrumental in understanding lighting effects in cinematography.

Addressing Discrepancies

Discrepancies between the quantitative and qualitative findings provide critical insights into areas requiring further investigation and development:

- **Perceived Usability vs. Actual Use**: Quantitatively, the usability of CineSim scored highly among users. However, qualitative data uncovered that new users, despite recognizing the interface's ease, faced challenges when attempting to utilize advanced features, indicating a gap between initial perception and actual usability. The majority of users may truly be positive toward CineSim. Still, we need to take comments from new users into account.
- **Technical Issues**: Quantitative data did not present serious concerns with software bugs. It seems that the bugs did not severely affect the user experience. However, the focus group result reflected a different result. They expressed that the bugs influenced their experience, and further demotivated them to use CineSim for their storyboard creation.
- **Actual application**: More than 70% users said they would recommend CineSim to their friends. However, almost no one used CineSim after the workshop. The underlying reason may be the hardware support problem.

This synthesis not only validates the findings from each data set but also enriches our understanding of how CineSim functions in real educational environments. It highlights the importance of ongoing user feedback in the iterative development process, ensuring that CineSim evolves in line with user needs and educational standards. For discrepancies, somehow, they are showing another perspective of the case. Results are not completely contradictory to each other.

6.4.3 Recommendations for Second Round

Actionable Recommendations

Based on the synthesis of quantitative and qualitative insights, several actionable recommendations have emerged that can potentially enhance the functionality and user experience of CineSim. These recommendations are aimed at ensuring that future iterations of the software more effectively meet the educational needs of users:

Enhancement of UI and UX:

Enhancements to the UI of CineSim are crucial for improving the user experience, especially for newcomers who may not be familiar with such specialized software. A more intuitive design is needed to simplify the navigation and make advanced features more accessible. This could be achieved through the incorporation of guided tutorials. Besides, a “cheat sheet” can be created to show all common hotkeys at a glance. Additionally, improving the responsiveness of the user interface is essential to ensure that interactions within the software are smooth and free from lags or delays. It was found that the lag was not caused by the slow processing power of the computer, but by the programming.

Adding More Assets:

To foster greater creativity and realism in storytelling and cinematography education, it is essential to expand the library of assets within CineSim to include a wider variety of characters and environments. This enhancement will enable users to create more complex and varied scenes, enriching the educational experience. Additionally, introducing more customizable options for existing assets—such as variable clothing, expressions, and poses—will significantly enhance the versatility of the tool, allowing users to tailor scenes more precisely to different storytelling contexts and educational objectives. However, this functionality is technically challenging, and will not be available in the next release due to time constraints.

Fix Bugs that Disturb User Journey:

Technical stability should be a top priority, focusing on the identification and resolution of software bugs that users frequently encounter. Special attention should be given to bugs affecting critical functionalities such as saving progress, loading assets, and rendering scenes, which are essential for a smooth user experience. Additionally, establishing a routine schedule for updates and patches is crucial. This will allow for the timely addressing of newly discovered issues and enable prompt response to user feedback, ensuring the software remains reliable and effective for all users. However, based on this experience, even I update the software regularly, the IT team of the school are not very willing to work together and deploy to the school lab. This is a big concern.

Worksop arrangement

Another big concern on this research is how to better integrate the software into educational settings. Based on the data collected, I extended the workshop duration to 1.5 hours. With half an hour more, users get more time to explore the software, and truly use it to express creativity, instead of just struggling with the software controls.

Prioritization of Changes

To effectively allocate resources and ensure timely improvements, it is crucial to prioritize these changes based on the urgency and impact of the feedback received:

Immediate Priority: Bug Fixes

Immediate efforts should focus on stabilizing the software by fixing bugs that disrupt the user experience. This is essential for maintaining the credibility and usability of CineSim, especially in educational settings where reliability is key to integration into curricula.

Medium Priority: UI/UX Enhancements

Once the platform is stabilized, the next priority should be the enhancement of the user interface and user experience. This includes both redesigning confusing elements and improving the overall aesthetic and functional flow of the software.

Long-Term Priority: Expansion of Asset Library

As a part of ongoing development, continuously expanding the asset library should be considered a long-term priority, and there will be no finishing point. This ensures that CineSim remains relevant and useful as educational needs and technological capabilities evolve.

6.5 Conclusion of first round data collection and analysis

Chapter 6 has provided a comprehensive analysis of the first round of data collection and user feedback on CineSim, incorporating quantitative survey results, qualitative insights from focus group discussions, and autoethnographic reflections. The mixed-method approach has allowed for a detailed exploration of both the strengths and challenges associated with CineSim's current iteration. Key findings highlight the software's potential as an educational tool in media production, while also identifying critical areas for improvement, particularly in UI/UX design, asset diversity, and technical stability. The feedback gathered has been instrumental in shaping actionable recommendations for the next phase of development. As we move forward, these insights will guide the refinement of CineSim, ensuring that it evolves into a more effective and user-friendly tool, better aligned with the needs and expectations of its users in educational settings.

Chapter 7. Second Round of Data Collection and Analysis

In this chapter, I am going to present the data collected in the second round of data collection. They include:

- Questionnaire data (See Appendix 4)
- Focus group data
- Detailed interviews with professional storyboarder
- My autoethnographic review

In addition to presenting these data, the chapter will also include a comprehensive analysis of the findings from the second round.

7.1 Second Round of Questionnaire Data

The second round of data collection was done with the same questionnaire as in the first round. This aimed to make a direct comparison with the results obtained in the first round. As with the previous one, the survey included questions on the UI/UX, perceived usability and visualization capacity of the software.

For this round, 85 students participated in the 1.5 hours CineSim workshop. Of these participants, 56 responded to the questionnaire.

User Interface and User Experience (UI/UX)

The UI/UX section of the survey assessed participants' perceptions of CineSim's ease of use, interface design, and overall user satisfaction.

1. Ease of Use

- **CineSim is easy to use:** The majority of respondents found CineSim easy to use, with 69.6% agreeing or strongly agreeing.
- **Ease of figuring out how to use CineSim:** Similarly, 75% of users reported that figuring out how to use CineSim was straightforward.

2. User-Friendly Design

- **User-friendly UI/UX:** 80.4% of participants agreed that CineSim has a user-friendly interface.
- **Appealing UI design:** 75% of users found the UI design appealing.
- **Well-organized interface:** A significant 82.1% agreed that CineSim's interface is well-organized.

3. Responsiveness

- **Satisfaction with response time:** The response time of CineSim was satisfactory for 82.1% of the participants.

Educational Effectiveness

Participants evaluated how effectively CineSim facilitated learning in media production, focusing on key areas like cinematography, lighting, and storyboarding.

- **Facilitation of learning:** 85.7% of users agreed that CineSim helps to learn about cinematography and lighting.
- **Real-world application:** 85.7% of users agreed that CineSim is useful in creating and visualizing storyboards.

Open Feedback

Participants provided open-ended responses on what they felt about CineSim and provided suggestions for improvement. Both positive and negative feedbacks were obtained on the uses of CineSim. Here are some direct quotes:

- "CineSim can show me a lot about the lighting"
- "Camera is hard to move."
- “It would be good to have enhancements in UI responsiveness and additional tutorial resources to help new users get used with the software more quickly.”

7.1.1 Comparison of First and Second Round Questionnaire

The second round of questionnaire data provides increasingly positive feedback on the application of CineSim, reflecting the success of enhancements made after the first round. Below is a brief comparison of the results from the first and second round of questionnaires:

Overall User Experience Improvement: After the enhancements to CineSim, user feedback has become more positive, demonstrating that the changes made have facilitated easier integration of CineSim into students' learning activities. In both rounds, around the same percentage of students (70%) found CineSim easy to use. However, other aspects of the user interface saw notable improvements. For example, satisfaction with CineSim's response time improved considerably from 70.2% in the first round to 82.1% in the second round. Additionally, the percentage of users who agreed that CineSim has a well-organized interface increased from 78.9% to 82.1%, indicating enhanced usability. These changes suggest that the revisions made after the first round were effective in maintaining and even improving certain aspects of the user experience.

Educational Effectiveness: The educational effectiveness of CineSim showed marked improvement in the second round of data collection. For instance, satisfaction with CineSim's support for storyboarding increased from 61.4% to 82.1%, and agreement on the realism and accuracy of its simulation of cinematography and lighting rose from 70.2% to 87.5%. These results suggest that the enhancements boosted the educational impact of CineSim.

Engagement and Motivation: The likelihood of recommending CineSim to others has increased, with the average rating rising from 7.79 in the first round to 8.18 in the second round. This upward movement suggests that users are becoming increasingly confident in CineSim's value as a learning tool. This increase in the recommendation score can be seen as a positive indicator of student engagement and motivation, as users are more likely to recommend a tool they find effective and engaging. The stronger recommendation ratings imply that the enhancements made to CineSim have positively influenced how students perceive its ability to support their learning, maintain their interest, and motivate them to explore media production concepts further.

Workshop Adjustments and Feedback: In response to student feedback from the first round, the workshop duration was extended from 1 hour to 1.5 hours. This adjustment addressed a key concern from the first round, and in the second round, no further comments were received regarding the need for additional time. This indicates that the extension was successful in providing students with sufficient time to explore and use CineSim effectively.

7.2 Results from Second Round Focus Group Interview

The focus group interview for the second round of data collection was conducted by a neutral third party again. 10 participants were invited to join the focus group discussion, and 8 showed up at the end. The aim was to gather in-depth feedback from users who participated in the CineSim workshops. This section presents the findings from the focus group interviews using thematic analysis to highlight key themes.

1. Engagement and Learning Experience

Participants generally agreed that CineSim offers a more engaging and interactive learning experience compared to traditional methods. They highlighted how the real-time reflection on changes in lighting and camera settings facilitated a better understanding of these concepts. Participants found CineSim to be a gamified teaching method that made learning more interesting and engaging compared to traditional methods. One participant noted, "CineSim is able to show everything that happens behind the scenes, unlike just watching a movie clip." Another added, "Reading articles can be quite abstract, but CineSim provides a more detailed and substantive scene."

2. Flexibility and Customization

CineSim was praised for its flexibility, allowing users to control various aspects of the simulation. Participants appreciated the ability to control the time of day, sun position, and other elements that are difficult to manipulate in real-life. One participant noted, “High flexibility as able to control time of the day and sun position, which is impossible in real-life.” However, participants also highlighted some limitations regarding scene and character diversity. There were requests for more pre-built scenes and a greater variety of characters and actions to better meet their needs. One participant mentioned, “Some pre-built scenes are not big enough, and there are not enough choices for characters and their actions.” Another added, “It would be better to increase selections on pre-built scenes and characters.” Additionally, participants suggested expanding the variety of characters, with one noting that there were “not enough characters to choose from, especially younger or older characters.”

3. Advantages of CineSim

Several advantages of using CineSim were identified, particularly in terms of its authentic camera settings, realistic scenes, and user-friendly interface. Participants appreciated different camera settings available in CineSim. One said “When I changed any of those settings, I could see changes immediately, which helped me to better understand those concepts.” The high-quality visuals and detailed preset scenes were also praised. A participant mentioned the "very realistic and exquisite preset scenes." CineSim was noted for its efficiency in creating storyboards and simulations, saving time and resources. Another participant commented that it was, "quick and efficient to create a storyboard, especially for those who are not good at drawing." The simple and intuitive UI was highlighted as a significant advantage, with feedback such as, "simple UI and easy to use."

4. Educational Impact

Participants found that CineSim significantly enhanced their learning experience by providing a practical and immersive way to understand media production concepts. CineSim helped students visualize and apply theoretical knowledge in a practical context. One participant noted, "CineSim makes the learning faster as it allows you to see and compare the real-time effect directly with applying different lighting and camera settings." Additionally, the software made learning more convenient and engaging, with another participant stating, "Exploring filmmaking knowledge in CineSim feels like playing games, and it is fun."

5. Areas for Improvement

Participants identified several areas for improvement to enhance their experience with CineSim. Specific technical issues were noted, such as difficulties with camera control and the need for additional customization options. Another participant noted that it was "difficult to locate and adjust camera; adding layers and naming functions like in Maya would help." There was also a desire for more advanced output options, such as video and animation creation. As one participant said, “It would be good to make video output to simulate camera movement."

6. Technical and Accessibility Issues

Participants encountered some technical and accessibility challenges that affected their use of CineSim. One participant noted, "No Mac version available." Additionally, the software's high system requirements limited its usability on some home desktops and in computer labs. As one participant explained, "Home desktop unable to support the software." Direct quotes from participants illustrate the overall experience: "CineSim makes the learning faster as it allows you to see and compare the real-time effect directly with applying different lighting and camera lens." Another participant mentioned, "Exploring camera in CineSim can make you think of some new perspective that you have not thought before." However, there were concerns about resource limitations, as one participant noted, there were "not enough resources to fulfill their theme; it takes time to create a new scene if they cannot choose from preset scenes."

Conclusion

The second round of focus group interviews provided detailed insights into the strengths and areas for improvement of CineSim. Participants appreciated the software's ability to enhance learning through realistic simulations and user-friendly design. However, they also identified several areas where CineSim could be improved, particularly in terms of character diversity, scene customization, and technical performance. These insights will guide future developments of CineSim to better serve the needs of media production students and professionals.

7.3 Analysis of Questionnaire Data with Focus Group Data

This section provides an analysis of the findings from both the questionnaire and focus group interviews, applying a sequential explanatory strategy. By combining the data from both sources, several key areas were selected for analysis, namely engagement and learning experience, flexibility and customization, technical performance and usability, and educational impact.

Engagement and Learning Experience

The questionnaire data indicated that a significant majority of participants found CineSim engaging and effective in facilitating learning, with 85.7% agreeing that CineSim helps to learn more about cinematography and lighting. The focus group data provided context to these findings, highlighting the gamified nature of CineSim, which made learning more engaging compared to traditional methods. This interactive approach was particularly valued because it allowed students to visualize concepts that were previously abstract. One participant noted, "CineSim is able to show everything that happens behind the scenes, unlike just watching a movie clip." This qualitative feedback elaborated the questionnaire results, illustrating that the engaging nature of CineSim is a crucial factor in its effectiveness. However, while engagement levels are high, it is important to consider whether this engagement translates into deeper learning and retention. Future studies could focus on comparing long-term retention rates between students using CineSim and those using traditional methods. Additionally, the novelty effect - where initial engagement might wane over time - should be investigated to ensure sustained interest and learning outcomes.

Flexibility and Customization

Participants appreciated the flexibility of CineSim, particularly in terms of controlling lighting and camera settings, as highlighted in the questionnaire responses. However, there were notable concerns about the limitations in scene and character variety. Focus group discussions elaborated on these concerns, with participants expressing a desire for more diverse characters and customizable scenes. They appreciated the ability to control time of day and sun position but felt restricted by the limited pre-built scenes and character actions. One participant mentioned, "Not enough characters to choose from, especially younger or older characters." This feedback aligns with the quantitative data, indicating a clear area for improvement. The desire for more customization options suggests that while CineSim provides a strong foundation, it needs to expand its resources to cater to a broader range of scenarios. This limitation could impact its adoption in courses with diverse thematic requirements. Addressing this could involve future development, collaborating with users to prioritize the addition of new features and characters based on their specific needs.

Technical Performance and Usability

Participants generally found CineSim to have a user-friendly interface, with 82.1% agreeing that the UI was well-organized, as per the questionnaire findings. However, focus groups participants mentioned encountering performance issues, particularly with camera controls and UI responsiveness. Participants found the camera controls difficult to manage and suggested adding more advanced customization options for character actions and scene settings. One participant noted, it was "difficult to locate and adjust camera; adding layers and naming functions like in Maya would help." The feedback highlighted the need for better performance optimization and more intuitive controls. These technical issues are critical as they directly affect the usability and effectiveness of CineSim. While the software's interface is generally praised, in future, the specific technical challenges need to be addressed to prevent frustration and ensure a smooth user experience. Prioritizing technical improvements in the next development phase will be crucial for maintaining user satisfaction and effectiveness.

Educational Impact

The questionnaire data indicated that CineSim significantly aided in applying theoretical knowledge to practical scenarios, with 85.7% of participants agreeing on its effectiveness in this regard. Focus group participants echoed this sentiment, noting that CineSim allowed them to experiment with different lighting and camera setups, thus providing a hands-on learning experience that traditional methods could not match. One participant noted, "CineSim makes the learning faster as it allows you to see and compare the real-time effect directly with applying different lighting and camera lens." This qualitative data supports the quantitative findings, demonstrating that CineSim enhances practical learning. While CineSim is effective in bridging the gap between theory and practice, it is essential to assess its impact on various types of learners. Some students might benefit more from visual and interactive learning tools, while others may find traditional methods more effective.

Future research could explore its suitability for a more diverse range of learners e.g. those with specific learning difficulties (Hughes et al., 2023) and how CineSim can be tailored to accommodate them.

In conclusion, the analysis of both the questionnaire and focus group data reveals that CineSim is a highly effective tool for enhancing engagement and practical learning in media production education. However, there are clear areas for improvement, particularly in terms of scene and character diversity and technical performance. By addressing these issues, CineSim can further solidify its role as a valuable educational resource. Future development should focus on expanding customization options, optimizing technical performance, and exploring ways to sustain long-term engagement. Additionally, further research into the differential impact on various learners with specific learning difficulties will help in tailoring CineSim to meet the diverse needs of all students. This analysis has inspired a focused approach on these four areas to enhance the overall effectiveness and user satisfaction of CineSim.

7.4 Detailed Interview with Industry Professional

This section presents insights from a detailed interview with Ken Au Yeung, an industry professional with ten years of experience in the film industry, primarily as an assistant director and storyboard artist. With his permission, his name is disclosed in this research. The purpose of this interview was to compare his experience of developing a storyboard using conventional drawing methods with his experience using CineSim. Both the storyboards and the sample script are included in Appendix 5.

Key Findings

Ken was very impressed with CineSim, noting that it is something he has never seen, or thought of, in the industry. He found the highly realistic rendering capabilities, including the ability to incorporate lighting effects, to be particularly noteworthy. He mentioned, "The highly realistic rendering, including lighting effects, is something drawing cannot replicate."

Ken also found that exploring the virtual camera in CineSim provided new perspectives and creative ideas that he might not have considered when drawing storyboards. The accuracy of the virtual camera's perspective was especially beneficial.

However, Ken also identified some areas where CineSim could be improved. One of the issues he noted was that the ultra-realistic rendering could sometimes be a drawback, as it might distract users from focusing on the composition of shots. He explained, "The problem is the rendering is too realistic, with accurate lighting. It can sidetrack the user from considering the shots composition only." This is really something I had never thought about. The development team and I worked so hard to provide realistic rendering, but it turns out that this feature may obstruct users of CineSim when developing storyboards.

Another critical area for improvement identified by Ken was the need for greater flexibility in character postures. He emphasized that while the number of assets does not need to be extensive, providing users with more freedom to adjust character postures and the direction characters are looking is crucial. This specific comment echoes with what students want. He commented:

> Character posture is very important. It does not need to be a lot, but needs to give more freedom for users to adjust the posture and the direction the character is looking at. Assets do not need to be a lot, but posture is key. This should be put in top priority. (Ken Au Yeung)

Ken's positive feedback is a significant validation of CineSim's potential in the industry. His recognition of CineSim as an innovative tool aligns with feedback from other users, reinforcing the value and impact of the software. This consistency highlights the importance of addressing the areas identified for improvement in future updates. I am happy that CineSim received recognition from an industry expert, as it validates the tool's potential and provides valuable direction for future development.

7.5 Autoethnographic Reflection on Round Two

At this stage, my main duty was to use CineSim in formal classroom teaching, so I have mainly reflected on my role as an educator. Embedding CineSim in classroom teaching had quite impressive results once again. Students were particularly impressed by the school's ability to develop such an innovative application. The gamified nature of CineSim encourages students to experiment with different creative ideas in a virtual environment. With CineSim, teaching abstract concepts became much smoother, and students could immediately test their ideas, enhancing their understanding and engagement.

However, in this second round of data collection, some issues identified in the first round remained unresolved. One significant problem I encountered was the implementation of CineSim within the formal classroom setting, specifically related to IT policies. Despite submitting the software to the IT department for a security check more than two months before the lesson, it took over a month for them to complete their review. Even after urging them to speed up the process, it took an additional two weeks for deployment in school computer lab. Unfortunately, when it was finally time to use CineSim in the lab, I discovered that the IT department had not granted students the rights to run the software. This oversight meant that I could not use CineSim during the lesson, leading to disappointment for myself and another professor interested in using CineSim to deliver film ideas. As an alternative, I worked with an IT technician in my department to install CineSim in another room. Although this room was not initially intended for this purpose, it became an alternative solution. This experience highlights how innovative tools like CineSim often face unforeseen obstacles within traditional IT policies. It is highly possible that even for future innovative ideas with using technology in education, educators will still face different challenges, not just on the development and implementation, but on the school policy that impedes work on the project.

Another reflection concerns the availability and usage rate of CineSim. In recent years, there has been a noticeable shift in how students prefer to work. Many students now prefer to work from home on their own laptops rather than using school facilities. In media production area, many students use Mac systems. Unfortunately, due to technical limitations, it is currently not possible to run CineSim on Mac systems because of Mac's poor performance in real-time ray tracing. This limitation means that even if students want to use CineSim for their projects, they are unable to do so. It is found that no student used CineSim to complete their 10-minute storyboards. Yet, from daily observation and conversation with students, it was still observed that students employed and enjoyed CineSim to explore cinematic ideas and visualization. Although CineSim provides extra motivation for students, limiting its availability to school labs can be demotivating. With additional resources, it might be possible to develop a Mac version of CineSim. However, this would require removing the ray-tracing graphic rendering functions, and further studies would be necessary to determine whether this would diminish CineSim's effectiveness as an educational tool.

After talking with Ken Au Yeung, I gained new insights into what CineSim can achieve. It can simulate different cinematic ideas and produce visuals even more than storyboards need. However, there are areas for improvement, such as enhancing character posture and providing more freedom in operations. Ken's feedback offers a professional perspective, suggesting that once students are trained with a professional mindset, they can enjoy CineSim as Ken did.

For the workshop arrangement, based on feedback, I extended the workshop duration from 1 to 1.5 hours in this round of data collection. This additional time allowed for more comprehensive training on how to use CineSim, improving efficiency. However, some users without prior experience still found CineSim challenging to use. In addition to the workshop format, creating video tutorials organized by chapter to include available functions might be beneficial. These tutorials could provide a more accessible introduction to CineSim's capabilities and help new users become more comfortable with the software.

Chapter 8. Discussion

This chapter synthesizes and discusses the findings from the application and analysis of CineSim in media production education, aligning these results with the broader goals of having positive impact on the learning journey and student engagement through the use of serious games. The discussion extends beyond functional evaluation to examine the pedagogical complexities and psychological engagement facilitated by CineSim, using Self-Determination Theory (SDT) and Authentic Learning Theory (ALT) as the theoretical framework. This chapter aims to contextualize the quantitative and qualitative data collected, offering insights into the transformative potentials of CineSim for media education, and critically examine the alignment of educational strategies with technological advancements. Through this analysis, the chapter addresses the core research intentions, evaluates the alignment of the study's design with its objectives, and discusses the implications of the findings for future educational practices and research in media production and serious gaming. Also, a new framework is synthesized based on this research to provide clearer guidance on adopting serious games in education.

8.1 Recapitulation of Research Goals and Objectives

8.1.1 Overview of Study Intentions

The primary intention of this research was to address several significant challenges in media production education, including the need for innovative solutions due to limited access to high-cost equipment, and the inadequacies of traditional online teaching methods in fostering creative expression. There remains a gap in how technology can be leveraged as a solution.

This research takes CineSim as a practical example. CineSim was developed to bridge the gap by offering a dynamic and interactive learning platform that mimics real-world media production settings. The study sought to assess the efficacy of

CineSim in enhancing the pedagogical process and improving the student learning experience in media production education. Specifically, the research aimed to evaluate how SDT and ALT can be integrated within CineSim to support educational goals and foster student engagement. By enabling students to visualize and execute creative ideas without the need for extensive physical resources or advanced drawing skills, CineSim provides a novel approach to overcoming the limitations of traditional media production education.

8.1.2 Alignment with Research Design

The research uses a mixed-methods approach to collect both qualitative and quantitative data across various dimensions of the educational experience. Quantitative data were gathered through structured questionnaires that measured user satisfaction, perceived usability, and educational impact of CineSim. Qualitative data were collected via focus groups and an interview with an industry professional to gain deeper insights into the users' experiences and challenges faced during interaction with CineSim.

The alignment of this design with the initial research goals was shown in several ways:

- Methodological Alignment: The use of a mixed-methods approach allowed for a robust examination of CineSim across different user interactions, ensuring a holistic understanding of its impact. This method was particularly suitable for exploring the complex dynamics of how serious games like CineSim can influence learning outcomes in media production.
- Data Collection Relevance: The data collected directly addressed the research objectives by focusing on key aspects of the user experience that are critical to understanding the educational value of CineSim. This includes

the exploration of motivational aspects through SDT, the authenticity of the learning environment, and students' learning journey through ALT.

- Theoretical Frameworks: The integration of SDT and ALT primarily informed the design of CineSim, ensuring that it was developed with a strong theoretical foundation rooted in educational psychology and instructional design. SDT guided the software's emphasis on enhancing student motivation by fulfilling their psychological needs for autonomy, competence, and relatedness, while ALT shaped the creation of realistic, simulated learning environments to facilitate practical skill acquisition.

From the data collected in two rounds, there is a suggested positive change in both user engagement and the learning journey, indicating that CineSim could be a valuable tool in media production education. Section 8.3 provides a detailed analysis of the impact of CineSim on the learning experience, aligning with RQ1 and RQ2 by exploring how it influences students' creative expression and self-determined learning. Section 8.4 evaluates CineSim as an educational resource, addressing RQ3 by examining its practical implementation, challenges, and pedagogical value.

8.2 Evaluation of CineSim under SGDA

The Serious Games Design Assessment (SGDA) Framework provides a comprehensive method to evaluate the design quality and educational impact of serious games. The framework focuses on six dimensions: purpose, content, framing, mechanics, aesthetics and graphics, and fiction and narrative (Mitgutsch & Alvarado, 2012). Here are the detailed elaboration.

1. Purpose

The purpose dimension assesses whether the game has a clear and well-defined educational or motivational objective. A strong purpose ensures that the game effectively aligns its content and mechanics with specific learning goals (Mitgutsch & Alvarado, 2012). CineSim has a clear purpose, that is to equip students with practical skills in cinematography, lighting, and storyboarding. By simulating real-world workflows, the software bridges theoretical knowledge and practical application. Its alignment with media production education ensures that gameplay meaningfully contributes to skill development, fulfilling the SGDA criteria for purpose-driven design. For example, similar to other serious games in technical education (e.g., Graafland et al., 2012; Jaffray et al, 2021; Padilha et al, 2019; Brereton et al., 2024), CineSim incorporates learning objectives directly into the interactive environment, promoting skill acquisition through hands-on practice.

2. Content

CineSim's content is designed to provide highly accurate simulations that closely mirror real-world media production scenarios. The virtual environment replicates essential aspects of cinematography, lighting setups, and storyboarding, offering students an authentic experience that aligns with industry practices. The tools and features within CineSim, such as virtual cameras, adjustable lighting rigs, and scene composition tools, are modeled to behave as they would in real-world settings, ensuring that students can practice techniques that are directly transferable to professional contexts. By simulating realistic conditions, CineSim allows users to experiment with production techniques in a controlled yet authentic environment, bridging the gap between theoretical instruction and practical application. This high level of accuracy ensures that students gain confidence in their skills and are well-prepared to apply their learning in real media production environments. However, it is acknowledged that CineSim currently offers a limited set of tools and features, meaning not every type of scene can be created. Further development would be desirable to explore whether artificial intelligence technology could be embedded to generate assets on demand, thereby expanding the platform's usability.

3. Framing

CineSim is framed as a supplementary educational tool, designed to enhance traditional media production courses by addressing limitations such as restricted access to equipment and the challenges of remote learning. It is integrated into the curriculum as both a standalone learning platform and a complement to in-class activities. For instance, students use CineSim to practice concepts introduced during lectures, such as experimenting with different lighting setups or storyboarding techniques, in a virtual environment before applying these skills in real-world settings. This framing ensures that CineSim bridges the gap between theory and practice, making it a valuable asset in the broader educational ecosystem. Moreover, as it runs on a personal computer with RTX graphics card, it allows for flexible learning, empowering students to engage with the material at their own pace outside of the classroom. It would be even better if it was available on a Mac computer or iPad.

4. Mechanics

Mechanics refers to the rules, systems, and processes that structure user interaction and facilitate learning. Effective mechanics ensure that the game's actions and feedback loops support the intended educational outcomes (Mitgutsch & Alvarado, 2012). CineSim incorporates intuitive mechanics, such as drag-and-drop features and real-time adjustments to lighting and camera angles, which align with professional workflows. These mechanics empower students to experiment and receive immediate feedback, fostering an active learning process. However, user feedback highlights areas for improvement, such as introducing more dynamic feedback loops and enhancing the range of character actions. These observations echo findings from previous studies that emphasize the importance of iterative refinement to optimize game mechanics for educational purposes (Sailer et al., 2017). Addressing these gaps would further strengthen CineSim's alignment with SGDA's emphasis on robust, educationally aligned mechanics.

5. Aesthetics and Graphics

This dimension evaluates the visual and sensory elements of the game, including its graphics and immersive qualities. High-quality aesthetics can enhance user engagement and create a more compelling learning environment (Mitgutsch & Alvarado, 2012). CineSim excels in this dimension, employing photorealistic 3D graphics to create an immersive simulation of media production environments. This high level of visual fidelity replicates real-world conditions, helping students gain a deeper understanding of professional workflows, similar to the example in Nassar et al. (2016). For details, see Section 2.2.4. Meanwhile, the user interface is specifically designed to provide nice and clear experiences. Further testing is still needed with a wider range of users.

6. Fiction and Narrative

Fiction and narrative refer to the storytelling aspects of a game and how they provide context for learning activities. Strong narratives can enhance engagement by embedding educational tasks within meaningful scenarios (Mitgutsch & Alvarado, 2012). CineSim does not currently include any substantial fiction or narrative elements. While its realistic media production scenarios could serve as a platform for developing stories, no narrative is currently present in the experience. The absence of built-in narrative functions means that learners do not experience the kind of immersive, context-rich progression found in many effective serious games. Without this dimension, CineSim risks feeling more like a static simulation tool than a dynamic learning environment. Future development could address this shortcoming by introducing features such as a "story mode" or other structured narrative layers, but at present, the lack of narrative integration remains a clear weakness in its design.

8.3 Reflections on CineSim's Educational Impact

This Design-Based Research (DBR) explored innovative ways to enhance the learning experience in media production, using CineSim as an illustrative example. This section discusses its educational impact and how the results address research questions 1 and 2.

8.3.1 Pedagogical Contributions and Impact on Creative Thought (RQ1)

CineSim's integration into media production education has marked a significant change in pedagogical practices, blending traditional instructional methods with innovative interactive technologies. This aligns with RQ1: *How does the integration of CineSim into media production education affect the way that students express their creative thought within a university context?* The data collected from both rounds of surveys and interviews, as detailed in Chapters 6 and 7, indicate that CineSim greatly enhances students' ability to express their creative thoughts. Students reported that the interactive and immersive environment allowed them to experiment with various creative ideas more freely and effectively. Specifically, 85.7% of respondents highlighted that CineSim is useful in creating and visualizing storyboards, enhancing their confidence in visualizing and communicating their ideas compared to traditional methods.

Traditionally, media production education offered limited hands-on practice due to constraints like class time, resources, and equipment availability. CineSim provides extensive opportunities for students to practice anytime and anywhere, as long as they have access to a PC. This unrestricted access enables students to experiment with various cinematic techniques beyond the classroom without pressure, facilitating the exploration of innovative ideas. Focus group discussions reinforced these findings, with students expressing that the autonomy offered by CineSim increased their confidence in making creative decisions and encouraged deeper exploration of media production techniques. This autonomy supports ALT by empowering students to take control of their learning, mirroring the decision-making and problem-solving they would experience in real-world professional settings. By granting students the freedom to make meaningful choices and engage actively with the tasks, CineSim aligns with ALT's emphasis on immersive and practical learning experiences that prepare students for actual media production challenges (Herrington et al., 2010). By simulating professional scenarios, CineSim helps bridge the gap between theoretical learning and practical application, furthering creative expression.

Moreover, the autonomy provided by CineSim aligns with SDT, enhancing intrinsic motivation by allowing students to make independent choices and control various aspects of their learning environment. This autonomy fosters a sense of ownership and deeper engagement, as students can experiment with creative decisions such as camera angles and lighting setups. Feedback from focus group discussions further emphasized this, with students noting that the flexibility of CineSim allowed them to experiment with creative approaches without real-world consequences, which increased their confidence and encouraged deeper exploration of media production techniques. This aligns with SDT's principle that autonomy-rich environments promote motivation and creative expression.

8.3.2 Theoretical Implications and Impact on Self-Determined Learning (RQ2)

CineSim's integration into media production education has important implications for SDT, addressing RQ2: *How does the integration of CineSim into media production* *education affect student self-determined learning in a university context?* The positive impact on students' learning journeys is supported by data from both rounds of surveys and interviews, which indicate that CineSim's interactive and immersive environment empowers students to take control of their learning process and enhances their intrinsic motivation. The sub-questions of RQ2 explore two components of SDT individually—autonomy and competence—while omitting relatedness, as it is less relevant to the scope of this research.

Students valued the autonomy provided by CineSim, as highlighted in survey responses like Question 14, where 87.5% of participants stated that CineSim was useful for visualizing and planning their projects. Autonomy was also emphasized in focus group discussions, with students noting that CineSim's open-ended tasks allowed them to explore creative approaches without the fear of real-world consequences. One student commented, "CineSim is able to show everything that happens behind the scenes, unlike just watching a movie clip," underscoring its immersive qualities that boost motivation and engagement. This directly corresponds to RQ2.1, which explores how CineSim impacts student autonomy in media production education by allowing them to make independent decisions and take control of their learning process.

The integration of immediate feedback mechanisms within CineSim helps students to build competence, another core component of SDT. This was echoed in focus group feedback, where students highlighted how real-time changes in lighting and camera settings contributed to their preparedness for real-world tasks. One participant noted, "CineSim makes the learning faster as it allows you to see and compare the real-time effect directly," illustrating how immediate feedback helps build competence and reinforces the learning process; Graafland et al. (2012) found the same effect in VR medical training, where instant loops accelerated mastery. This supports RQ2.2, which focuses on the impact of CineSim on student competence, demonstrating how the tool fosters mastery and skill development through interactive and responsive learning experiences.

These findings underscore that CineSim's design supports both autonomy and competence as described in SDT, enhancing student motivation and engagement, echoing Ryan & Deci (2000). The authentic learning tasks facilitated by CineSim mirror real-world media production challenges, aligning with the principles of ALT by bridging theoretical knowledge and practical application. This research not only grounds itself in theory but also contributes to the academic discourse on serious games and educational technology by demonstrating how integrating SDT and ALT can effectively enhance the learning experience.

Furthermore, the insights gained from this study have led to the development of a new learning design framework called Integrated Motivational and Authentic Learning (IMAL) Framework. It synthesizes the motivational constructs of SDT and the application principles of ALT. IMAL serves as a structured approach for designing educational games that promote intrinsic motivation, encourage creative expression, and deliver authentic, practice-based learning experiences. CineSim acts as a "proof of concept" for this framework, demonstrating how the integration of these theoretical principles can be applied effectively to enhance learning. Details of this framework are elaborated in Section 8.4, providing a comprehensive guide for future educational game development.

8.3.3 Further Revision of Research Design

The present study follows a DBR cycle in which I occupy three overlapping roles—educator, CineSim developer, and researcher. While this insider position provides rich, practice-based insight, it also risks interpretive bias; my dual investment in CineSim's success could unintentionally shape data collection, analysis, and reported outcomes.

To strengthen objectivity in future iterations, two adjustments are proposed:

- **Multiple-instructor adoption.** CineSim would be embedded in the modules of several colleagues who teach film-related subjects (e.g., lighting, directing, post-production). Each lecturer would implement the tool independently, using a shared but flexible lesson template, thereby generating cross-course evidence that is not filtered through a single author-developer lens.
- **Instructor focus-group triangulation.** After one teaching cycle, participating staff would join a facilitated focus group (run by an external moderator) to critique CineSim's pedagogical fit, technical reliability, and impact on student learning. Their collective reflections—compared against my own field notes—would surface convergent and divergent viewpoints, reducing single-observer bias and informing the next design sprint.

By widening the pool of instructor and student, and using peer dialogue to interrogate findings, subsequent DBR rounds would produce a more balanced evaluation of CineSim and a clearer agenda for its development.

8.4 Evaluation of CineSim Development and Implementation

This section evaluates the development and implementation of CineSim, focusing on technical assessments and the main challenges encountered during its integration. It addresses RQ3: *What are the major challenges in integrating CineSim into media production education within a university context?* by highlighting key obstacles and considerations relevant to successful implementation in university settings.

8.4.1 Technical Assessment and Challenges

The aim to develop CineSim was to create a robust educational tool that integrates advanced simulation technologies with user-friendly interfaces. Technologically, CineSim was built using cutting-edge tools such as Unreal Engine 5 to deliver high-quality graphics and real-time interactions, essential for simulating media production environments effectively. The use of modern development engines played a crucial role in enabling a small development team to efficiently design and implement CineSim, showcasing how technological advancements in development engines and computer processing power supported this project. Despite these technological strengths, ensuring the stability and responsiveness of CineSim, particularly on lower-end devices, became a notable challenge as the software's feature set expanded.

8.4.2 Challenges and Limitations

Despite the successes in developing and implementing CineSim, several challenges have impacted its adoption and efficacy in educational settings. IT policy and infrastructure posed a significant barrier, as many schools operate with outdated IT policy that do not readily support innovative software. The slow adaptation of IT policies led to delays in software updates and installations, affecting CineSim's timely integration and relevance in teaching. Initially, substantial effort was required just to navigate the deployment of CineSim within labs, highlighting the importance of aligning software solutions with existing IT infrastructure before their educational potential can be fully realized.

Funding constraints were another ongoing challenge, common to many research projects. Although initial funding was secured, maintaining financial support for advanced routine maintenance and developments—such as expanding the asset library, fixing bugs or enhancing interactive features—was difficult. Justifying further funding often required demonstrating CineSim's educational value against tight budgetary constraints. A potential approach to overcoming this limitation is positioning CineSim in the market to gather user feedback and secure additional funding, aiding in further development and refinement.

The challenge of cross-disciplinary expertise was particularly significant due to the dual roles of educator and developer that I needed to balance. As a non-research track teaching staff member with a heavy teaching workload and no designated research time, I had to invest personal time in the project. Although my background in media production provided a strong foundation, the technical expertise required for software development was substantial, underscoring the importance of collaborative projects that engage both educational and technical specialists to distribute the workload and enhance the development of educational software.

User acceptance and adaptation presented another challenge, as fostering the integration of CineSim into regular teaching practices required overcoming initial resistance to new technologies. While students expressed positive impressions of CineSim and recognized its potential for enhancing learning, none completed their 10-minute storyboard assignments entirely with CineSim. This reluctance to fully adopt the tool can be attributed to factors such as limited access to high-performance devices for home use and students' established work habits. Additionally, although many students enjoyed using CineSim to experiment with cinematic concepts, the limited range of character poses and expressions in the software was noted as a constraint that affected its comprehensive use. Addressing these limitations is essential to improve the tool's adoption for homework and independent projects.

Despite these challenges, CineSim has demonstrated significant value in enhancing students' understanding of complex cinematic techniques and fostering creative experimentation. The findings underscore the need for future improvements, such as expanding the storyboard generation features and making the tool more versatile and accessible, to maximize CineSim's educational impact. Improving the software's compatibility with a wider range of devices, simplifying the user interface to reduce the learning curve, and providing robust support structures will be crucial for broader and more effective adoption. These challenges and insights directly respond to RQ3, highlighting the major obstacles and considerations in integrating CineSim into media production education within a university context.

8.5 Synthesis of a Learning Design Framework for Serious Games

Serious games have gained prominence in educational studies, but a cohesive integration of sound design principles with established learning theories remains limited. To address this gap, this section proposes a new framework "Integrated Motivational and Authentic Learning (IMAL) Framework" for serious games. This framework merges the motivational constructs of Self-Determination Theory (SDT) and the principles of Herrington's Framework for Authentic E-Learning, providing a comprehensive guide for educational game design aimed at enhancing student motivation, engagement, and learning authenticity. The framework is illustrated with data from CineSim, showing how each principle—when realised in specific mechanics—contributed to a more meaningful and motivating learning experience.

The IMAL Framework for serious games is built on seven principles, with the first three derived from SDT and the subsequent four from ALT. For each principle, we point to the relevant CineSim design features and the empirical sections where those features were tested, thereby showing how the framework is both implemented and validated in practice.

Seven principles are:

1. Provide meaningful choices and pathways (Autonomy): Educational games should include opportunities for learners to make decisions and navigate their learning journey independently, which enhances their sense of autonomy and intrinsic motivation (Ryan & Deci, 2017; Deci et al., 1991).

2. Offer progressive challenges and immediate feedback (Competence): Games should be designed with adaptive levels of difficulty that align with individual skill levels, complemented by real-time feedback to help learners feel capable and see their progress (Vallerand & Reid, 1984; Guay et al., 2008).
3. Facilitate opportunities for social interaction (Relatedness): For social interaction, such as peer collaboration or feedback, helps build connections among learners, fostering a sense of community and enhancing engagement (Ryan & Deci, 2017; Baumeister & Leary, 1995). Relatedness is not greatly emphasized in this study, but it is expected that with considering relatedness and foster a sense of learning community, user's motivation and engagement can be further enhanced.

For the principles from SDT embedded in the design of CineSim, see section 3.1.5 and 5.5.1.

4. Create an authentic context: Serious games should simulate realistic, complex scenarios that mirror those in professional environments, ensuring that learning experiences are relevant and applicable in real-world settings (Herrington et al., 2010).
5. Include access to expert performances and modelling of processes: Incorporate expert demonstrations and real-time modelling within the game, providing learners with standards to emulate and helping bridge theoretical concepts with practice (Herrington et al., 2010).
6. Encourage reflective learning: Games should include prompts for learners to reflect on their decisions and outcomes. Real-time simulation results can act as reflective prompts, linking gameplay with classroom learning and promoting deeper self-assessment (Herrington et al., 2010).

7. Provide coaching and scaffolding at critical moments: Ensure that the game environment supports teacher and peer interaction for real-time assistance during critical learning moments, providing the scaffolding needed to guide students through challenges and enhance understanding (Herrington et al., 2014).

For the principles from ALT embedded in the design of CineSim, see section 3.2.5 and 5.5.2.

Table 3 below shows a summary of IMAL framework.

Principle Number	Principle	Theoretical Source
1	Provide meaningful choices and pathways (Autonomy)	SDT
2	Offer progressive challenges and immediate feedback (Competence)	SDT
3	Facilitate opportunities for social interaction (Relatedness)	SDT
4	Create an authentic context	ALT
5	Include access to expert performances and modelling of processes	ALT
6	Encourage reflective learning	ALT
7	Provide coaching and scaffolding at critical moments	ALT

Table 3. Summary of the IMAL Framework Principles

Integrating the IMAL Framework

The IMAL Framework bridges the gap between theoretical motivation principles and practical game design strategies. By integrating SDT's focus on intrinsic motivation—through autonomy, competence, and relatedness—with the authentic, real-world application principles of ALT, the framework ensures that educational games are engaging, motivating, and practically relevant. This unified approach provides developers and educators with a structured path to design educational tools that meet the complex and diverse needs of learners, fostering both immediate engagement and long-term educational value. To strengthen its empirical footing, future studies are encouraged to adopt IMAL as a design lens and report on its effectiveness across a wider range of serious-game contexts.

Chapter 9. Conclusions

In this chapter, I conclude the findings of this research, highlighting the key contributions and outlining recommendations for future research. I begin with a summary of the key findings, detailing how serious games and technology can be embedded in media production education and their impacts. This is followed by a discussion on the contributions to knowledge, emphasizing the theoretical and practical implications of integrating serious games with frameworks like Self-Determination Theory (SDT) and Authentic Learning Theory (ALT). The three main outcomes of this research are:

1. the development of a serious game as a proof of concept with CineSim;
2. the synthesis of a new learning design framework (IMAL) that integrates SDT and ALT to guide educational tool development; and
3. the evaluation of CineSim's educational impact.

I then provide recommendations for future research to enhance educational impact through technology and serious games. Finally, I offer personal reflections on the research journey, discussing challenges and insights from my perspective as both an educator and a PhD candidate.

9.1 Summary of Key Findings

This research explores how serious games and technology can be embedded in media production education. CineSim was developed to demonstrate this idea. I assessed the resulting impacts and changes within the educational setting. The key findings of this study are summarized below.

Enhanced Understanding and Application of Media Production Concepts

The data collected from both rounds of surveys and interviews, as detailed in Chapter 6 and 7, indicate that using CineSim greatly enhances students' understanding and application of media production concepts. Traditionally, media production education relied heavily on theoretical instruction and limited hands-on workshop practice due to constraints such as class time and resource availability. Often, this left students with a gap between theoretical knowledge and practical application. However, with the introduction of CineSim, this gap has been reduced. The interactive nature of CineSim facilitates a deeper understanding of complex cinematography and lighting techniques. As presented in Chapter 7.3, students reported that the hands-on experience allowed them to experiment and visualize media production concepts in real-time, making abstract theories tangible and comprehensible. This shift aligns with Authentic Learning Theory (ALT), which emphasizes the importance of real-world relevance and applicability in learning tasks. By simulating professional media production environments, CineSim provides students with practical experiences that mirror real-world scenarios, thereby enhancing both their understanding and application of media production concepts.

Increased Student Motivation and Engagement

In Chapters 6 and 7, the quantitative and qualitative results showed how excited and engaging students were when they used CineSim to experiment with their cinematic ideas. Traditionally, media production education often requires expensive resources and manpower to experiment with conceptual ideas, which could be discouraging if the results were not as expected. This constraint often led to limited student engagement and creativity. However, by designing CineSim as a serious game, these barriers were reduced. CineSim provided an environment that supported the psychological needs under SDT, which are autonomy, competence, and relatedness. Students were able to make choices and control their learning environment (autonomy), receive immediate feedback and realistic consequences (competence), and collaborate on projects (relatedness). This flexibility allowed students to experiment with different creative ideas in a very handy way without the need for extensive resources. As presented in Chapter 6, the ability to test and refine their ideas in a risk-free, supportive environment made students more motivated to embark on their learning journey and engage deeply with the content. Consequently, this approach appeared to foster higher levels of intrinsic motivation and engagement among students. When students get high levels of motivation and choose to start the learning journey, learning happens, and research can further investigate how to make learning better. Without starting the learning journey, studying how to make learning better is not so meaningful.

Practical Implementation and User Acceptance

While CineSim was positively received by students and showed potential for enhancing learning, several technical and pedagogical challenges were identified. Technically, integrating CineSim into existing IT infrastructures posed significant hurdles due to outdated IT policies in educational institution. These polices often lack flexibility in employing innovative technology in the classroom, which creates hurdles for teachers and students in using CineSim. Additionally, the availability of CineSim on students' personal devices was limited, substantially impacting its accessibility. Many students preferred to work from home, but not all had access to a PC which was required to run CineSim. This limitation created a significant barrier to the widespread adoption and consistent use of the tool.

Pedagogically, there was resistance to adopting new technologies in regular teaching practices. Despite the clear benefits and positive feedback, students often reverted to traditional methods for certain tasks, such as final storyboard assignments. This resistance was partly due to familiarity and comfort with existing methods, but also because of the technical barriers that made CineSim less accessible outside the classroom. The frustration stemming from these accessibility issues cannot be overstated. No matter how well-designed or effective a technological solution is, its availability to students becomes a dominating factor in its success. This situation underscores the critical need for improved technical support and training to facilitate smoother integration. Educational institutions must consider upgrading their IT policies and ensuring that policies provide necessary support to utilize cutting-edge educational tools. Additionally, providing cloud-based solutions or lighter versions of the software that can run on less powerful devices could help mitigate these issues and ensure that all students have equal opportunities to benefit from the tool.

Iterative Development and Continuous Improvement

The study employed a design-based research (DBR) methodology, which emphasized iterative development and refinement based on user feedback. Initial difficulties with the user interface and other technical aspects were addressed through continuous improvements, making CineSim more user-friendly. For example, early feedback indicated that students found the navigation and interface of CineSim complex and challenging. In response, the design team streamlined the interface, simplified navigation menus, and added tooltips and instructional videos to guide users. These enhancements significantly flattened the learning curve, enabling students to focus more on learning and less on navigating the tool.

Additionally, the workshop sessions were extended from 1 to 1.5 hours, providing students with more time to understand how to operate CineSim. This extension allowed for more comprehensive guidance from instructors, ensuring that students could explore the tool’s features more thoroughly and ask questions in real-time. The extended workshops facilitated deeper engagement with the software, as students had more opportunities to experiment with different functionalities and receive immediate feedback from their instructors.

9.2 Contribution to knowledge

This research makes key contributions to the fields of Serious Games, Self-Determination Theory (SDT), Authentic Learning Theory (ALT), and the methodological application of Design-Based Research (DBR) in educational technology development. This section summarizes these contributions, emphasizing their theoretical and practical implications. Notably, a significant outcome of this research is the synthesis of a new learning design framework (IMAL), which integrates SDT and ALT principles to guide the development of educational tools that promote motivation and authentic learning experiences.

9.2.1 Contribution to Serious Games

The primary contribution of this research lies in its application and validation of serious games within media production education. By using CineSim as a case study, this research demonstrates how serious games can be effectively integrated into educational curricula to enhance learning outcomes in media production education. Serious games are designed to combine entertainment with educational objectives, providing an engaging platform for students to learn complex subjects (Gee, 2003; Prensky, 2001). This study validates the effectiveness of this approach, showing that students not only enjoy using CineSim but also achieve a deeper understanding of media production concepts.

The interactive and immersive nature of serious games fosters an engaging learning environment that are often hard to achieve with traditional methods. This research provides empirical evidence supporting the use of serious games in education, particularly in specialized fields such as media production. It contributes to the body of knowledge by demonstrating that serious games can motivate students to embark on their learning journey, allowing them to experiment with creative ideas in a risk-free environment. The ability to simulate real-world scenarios without the constraints of resources and manpower considerably enhances students' engagement and motivation (Gee, 2003).

9.2.2 Application of Self Determination Theory (SDT) in Serious Game Design

SDT is a well-established framework for understanding motivation in educational settings, suggesting that motivation is enhanced when an activity supports the psychological needs for autonomy, competence, and relatedness (Ryan & Deci, 2000). This research demonstrates how SDT can be applied in serious game design by illustrating how CineSim's design elements align with these psychological needs. Autonomy is supported by allowing students to make choices and control their learning paths within the simulation. Competence is enhanced through immediate feedback and the ability to experiment and refine techniques without real-world consequences. Relatedness is fostered through collaborative projects and peer interactions within the platform.

The empirical findings from this study show that when these needs are met, students gain higher levels of intrinsic motivation and engagement. This research contributes to the practical application of SDT by demonstrating how its principles can be effectively integrated into the design of educational technologies, providing actionable insights for enhancing student motivation in similar contexts (Deci & Ryan, 2000).

9.2.3 Application of Authentic Learning Theory (ALT) in Serious Game Design

ALT emphasizes the importance of real-world relevance and practical application in learning tasks (Herrington et al., 2010). This research demonstrates the application of ALT in serious game design by showing how CineSim integrates these principles within a simulated environment that reflects professional media production scenarios. This context allows students to practice and apply theoretical knowledge, effectively bridging the gap between classroom learning and real-world application.

By providing these practical experiences, CineSim reinforces students' understanding and application of media production concepts. This study highlights how authentic learning environments can enhance student engagement and learning outcomes and provides a clear example of how ALT principles can be executed through educational technology, contributing to the evidence base for integrating authentic learning in educational design (Lombardi, 2007).

9.2.4 Contribution to Design-Based Research (DBR)

This research demonstrates the efficacy of using DBR as a framework for developing and refining educational technologies. The iterative nature of DBR, which involves continuous feedback and improvements based on user feedback, was essential in the development of CineSim. This methodology allowed for the practical challenges and user experiences to directly inform the design process, resulting in a more user-friendly and educationally effective tool.

The application of DBR in this research provides a model for other educational technologists and researchers to follow, showcasing how iterative development and close collaboration with users can lead to promising educational innovations. This study contributes to the methodological literature by providing a practical example of DBR in action within the context of media production education, showcasing the importance of responsiveness to user feedback and the benefits of iterative design (The Design-Based Research Collective, 2003; Reeves, 2006).

9.2.5 Synthesis of a New Learning Design Framework (IMAL)

A key contribution of this research is the synthesis of the IMAL (Integrating Motivation and Authentic Learning) framework. This framework merges the motivational principles of SDT, focusing on autonomy and competence, with the real-world application aspects of ALT. The IMAL framework provides a structured guide for developing educational tools that promote intrinsic motivation and simulates authentic professional scenarios, bridging the gap between theoretical learning and practical application.

CineSim serves as a “proof of concept” for IMAL, showcasing how this framework can be effectively implemented to enhance student engagement and learning. The IMAL framework offers educators and developers a clear approach for designing serious games that aligns with both motivational and authentic learning principles.

9.3 Future Development, Research, and Limitations

Building on the findings and discussions from this study, this section outlines critical areas for future development, research directions, and limitations to enhance the impact of CineSim in media production education. While CineSim has shown significant potential and positive outcomes, several aspects require further exploration and refinement to maximize its educational value and applicability.

9.3.1 Future Development of CineSim

Addressing Technical and Accessibility Challenges

One of the main challenges highlighted in this research is the technical and accessibility limitations of CineSim. Although iterative improvements have made the tool more user-friendly, outdated IT infrastructure and limited access to suitable personal devices among students remain obstacles to broader usage. Future development should prioritize creating a cloud-based or multi-platform version of CineSim that can run efficiently on less powerful devices, including tablets. This approach would ensure wider access, enabling all students, regardless of their technological resources, to benefit from CineSim.

Enhancing Pedagogical Integration and Training

My dual role as an educator and the primary researcher has provided valuable insight into the integration of CineSim into teaching practices. To extend this understanding to other educators, comprehensive training sessions are essential. These should equip educators with the skills and confidence needed to effectively embed CineSim and similar tools into their curricula. Such training will help overcome resistance to new technology and ensure the pedagogical potential of CineSim is fully realized across diverse educational settings.

Expanding Functionalities and Scenarios

To further elevate the educational impact of CineSim, future developments should focus on enhancing the storyboard generation feature by incorporating a broader range of character poses, expressions, and item assets. Addressing feedback from users and industry professionals will be key to making CineSim more versatile for various educational tasks, including homework submissions and creative projects. Integrating emerging technologies such as virtual reality (VR) and augmented reality (AR) could provide even more immersive learning experiences, deepening students' understanding of spatial relationships and production dynamics.

User-Centric Improvements

Feedback sessions, pilot programs, and professional development workshops involving a broader community of users, including students and educators, should be a continuous part of CineSim's development process. These collaborations will ensure that CineSim evolves to meet current educational and industry needs, enhancing its usability and effectiveness in media production education.

9.3.2 Future Scholarly Research

Interdisciplinary Applications and Broader Educational Contexts

While this study has focused on media production, the principles demonstrated by CineSim offer valuable insights for educators in other fields. Future research should explore how the concepts of serious games and simulation technology can be adapted to different disciplines to enhance teaching and learning. This work could inspire educators to design discipline-specific tools that leverage similar technological integrations for better student engagement and learning outcomes.

Contribution to Theoretical Frameworks

Future studies should continue to explore how the principles of SDT and ALT are operationalized in educational tools like CineSim and within the newly synthesized IMAL (Integrating Motivation and Authentic Learning) framework. Research should investigate how IMAL's integration of autonomy, competence, and relatedness, and authentic learning can be applied in diverse educational settings to enhance motivation and engagement. This will help validate and refine the framework's effectiveness and contribute to understanding how SDT and ALT principles can be blended to design impactful educational tools.

Additionally, further examination of how autonomy and competence specifically influence student outcomes will enrich the literature on SDT. Investigating how authentic contexts and expert modelling, as emphasized in ALT, can be effectively integrated into educational technologies will optimize learning environments and outcomes. Expanding on these areas will provide deeper insights into how these theoretical frameworks and the IMAL framework contribute to educational technology design and efficacy.

Lastly, future research should explore effective ways to embed relatedness into the design of educational tools. Developing features that foster a sense of community, where students can share their work, provide feedback, and interact, could enhance engagement and motivation. Such community-building aspects can support a more connected learning experience and align with the collaborative nature of educational environments.

Continuous Data Collection and Iterative Design

As a Design-Based Research (DBR) project, CineSim's development should remain iterative, supported by ongoing rounds of data collection. This continuous process will yield deeper insights and inform new directions in research, potentially contributing further to the theoretical frameworks of SDT and ALT. Collecting more data on how users perceive and interact with CineSim will provide valuable feedback for future design and research, paving the way for refined educational practices.

9.3.3 Limitations

Technical Constraints

The technical constraints of developing and deploying CineSim within an academic setting, as opposed to a professional software development firm, posed significant challenges. Resource limitations and technical expertise restricted the incorporation of certain advanced functionalities, potentially impacting the overall user experience. Future collaborations with professional software developers could overcome these barriers and enhance CineSim's technical capabilities.

Participant Diversity

The research was limited to specific educational settings and geographic locations, affecting the generalizability of the results. Future studies should aim to include a broader and more diverse range of participants to strengthen the applicability of findings across different educational and cultural contexts.

Resistance to Change

Adoption of CineSim was sometimes hindered by students' resistance to new technologies, as many were accustomed to traditional learning methods. This resistance may have affected the tool's effectiveness and highlights the importance of providing thorough training and support for educators and students to facilitate smoother integration.

9.4 Final Reflections

As I bring this PhD journey to a close, I am filled with a profound sense of accomplishment, gratitude, and reflection. This journey has been a tapestry of challenges, triumphs, learning, and growth. It has not only been about the creation and evaluation of CineSim but also about my personal and professional growth.

From the very beginning, I had an educational tool idea that would revolutionize media production education by integrating the elements of serious game. This vision was born out of my deep-seated belief in the transformative power of technology to make learning more engaging, interactive, and effective. The journey of developing CineSim has been a testament to this belief, showing how technology can bridge the gap between theoretical knowledge and practical application. This project would not have been possible without the support and opportunities provided by my university. The funding and resources allocated to this initiative were crucial in transforming a conceptual idea into a tangible product. Without this financial backing, the development of CineSim might have remained as a concept only, and this PhD project may never have existed. The university's commitment to fostering innovation and supporting research initiatives provided me with the platform to explore and realize my vision. I am deeply grateful for this chance, which has not only advanced my academic and professional journey but also enriched the learning experiences of my students.

Embedding this project into my regular teaching was a significant challenge. The demands of developing CineSim, conducting research, and preparing my PhD thesis, while maintaining my teaching responsibilities, required an extraordinary level of hard work and dedication. There were countless late nights and weekends spent refining the software, analyzing data, and preparing lessons. Despite the exhaustion, the sight of my students' increased motivation and engagement provided me with the motivation to keep going. CineSim transformed my classroom from a traditional learning space into a dynamic environment where students could experiment, visualize, and implement their creative ideas in real-time. Watching them grasp complex concepts with ease and enthusiasm was incredibly rewarding and reinforced my commitment to this project.

The iterative DBR methodology was instrumental in this process. As an emerging methodology, DBR is particularly suitable for new initiatives like CineSim. It allowed for continuous improvement based on user feedback, ensuring that CineSim evolved to meet the needs of its users. Each iteration brought new insights and refinements, making the tool more user-friendly and educationally impactful. I strongly agree with the idea suggested by Bakker (2018), that a fundamental point of DBR is its focus not merely on exploring the potentialities of what education could be, but rather on critically evaluating and shaping what education should be to optimize learning outcomes. This iterative process was not just about improving CineSim but also about my own growth as an educator and developer. It polished my technical skills, deepened my understanding of the interplay between technology and pedagogy, and taught me the value of perseverance and adaptability. The DBR approach provided a dynamic framework for responsive adjustments, allowing the development process to be flexible and iterative, directly informed by the practical challenges and user experiences encountered. This methodology ensured that each version of CineSim was a substantial improvement over the last, progressively enhancing its effectiveness as an educational tool.

One of the most fulfilling aspects of this journey has been seeing the practical application of CineSim in my teaching. It fulfilled my long-held vision of making media education more interesting and dynamic. In the past, teaching media production concepts often relied heavily on theoretical instruction with limited hands-on practice. CineSim changed this practice by providing an interactive platform where students could apply their knowledge in a simulated real-world environment. The transformation in my students' learning experiences was profound. They were not passive recipients of information but active participants in their learning journey. This shift was precisely what I had hoped to achieve, and seeing it come to fruition was deeply gratifying.

Appendix 1 Courses Syllabi

Lingnan University
Animation and Digital Arts Programme

Course Code & Title	ADA1004 Introduction to Moving Images
Term	Term 2, 2022 – 23
Mode of Tuition & Credit	Lecture mode; 3 credits
Class Contact Hours	3 hours lecture
Day & Time	Lecture: Monday, 13:30 – 16:30
Instructor	

Brief Course Description:
This course introduces studies of moving images as an interdisciplinary subject grounded in film history, updated by computer technology in the 21st century. The course will first focus on a brief history of moving images, covering its phases from pre-photographic optical effects to the institutionalized form of cinema. The second part will cover key elements and tools needed to grasp film as a creative and communicative medium. Students must consider (and assess) ways in which cinema makes sense to audiences, practitioners and theorists. The last part of this course engages students with a broad-based sense of contemporary moving images via intersections between film art and digital technologies. Students will learn the fundamental theories of media technology empowered for creative and artistic ends.

Aims:
The course aims to install a broad knowledge of moving image as a dominant form of visual culture and artistic expression in the 21st century. Students will explore key components and major milestones in the moving image history as it developed into a narrative form in film and animation.

Learning Outcomes (LOs):
1. Explain the concepts of moving image as a creative medium.
2. Analyze and evaluate moving image using the vocabularies of film elements and techniques.
3. Describe standard operating practice, and innovations of directors, writers, drawing artists, cinematographers, sound designers, etc.
4. Identify key themes of digital arts and its crossover with animation and film art.

Indicative Contents:
1. Early Forms and Apparatuses of Moving Images
2. Film Elements
    2.1. Mise-en-scene: Staging and Film space
    2.2. Cinematography: Writing in Light and Composition

    2.3. Editing and Meaning-Making
3. Film and Storytelling
    3.1. Plot and Story
    3.2. Narrative Unit
    3.3. Classical Hollywood Narrative
    3.4. Film Genre
4. Sound and Image
    4.1. Diegetic and Non-Diegetic Sound
    4.2. Sound Field and Soundscape
    4.3. Film Music and Meaning-Making
5. Animating Images and Animation
6. Digital Technologies
    6.1. Digital Imaging
    6.2. Computer Animation
    6.3. Artificial Life and Intelligence
7. Digital Media
    7.1. Intrinsic Properties: Interactivity, Customization, Participation, Dynamic
    7.2. Virtual and Augmented Reality
    7.3. Immersive Game and Interactive Installation
    7.4. Human Computer Interaction

Teaching Method:
Lectures, screenings, tutorial discussions. Assessment by means of tests, class participation and film logs.

Measurement of Learning Outcomes:

	Assessment Method	
Learning Outcome	Assignments	Written Tests
1. Explain the concepts of moving image as a creative medium.	V	V
2. Analyze and evaluate moving image using the vocabularies of film elements and techniques.	V	
3. Describe standard operating practice, and innovations of directors, writers, drawing artists, cinematographers, sound designers, etc.	V	V
4. Identify key themes of digital arts and its crossover with animation and film art.		V

Assessment:
Assignments 30% (Presentation 20% and participation and discussion 10%)
Written Tests 70% (Mid-term test 35% and final test 35%)

Schedule (Tentative):

Lesson	Date	Lecture	Screening
1	16 Jan, 2023	Introduction : Age of early cinema	Modern Times
2	30 Jan, 2023	Cinematography Part 1	As the Light Goes Out
3	6 Feb, 2023	Cinematography Part 2	The Sea Within
4	13 Feb, 2023	Mise-en-scene & Editing Part 1	The Social Network
5	20 Feb, 2023	Editing Tutorial	/
6	27 Feb, 2023	Mise-en-scene & Editing Part 2	Green Book
7	6 Mar, 2023	Film Genres	The Great Buddha Plus
8	13 Mar, 2023	*Speical Topic : Hong Kong New Wave*	*A Chinese Ghost Story 2*
9	20 Mar, 2023	*Mid-term Test*	/
10	27 Mar, 2023	Presentation	/
11	3 Apr, 2023	Presentation	/
12	17 Apr, 2023	Digital Media age : Digital Installation and Virtual Reality	The Jungle Book
13	24 Apr, 2023	*Final Test*	/

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Films
Early animated works (1910s-1920s)
À bout de souffle (Breathless, Jean-Luc Godard, 1960, 90m)
A Trip to the Moon (Georges Méliès, 1902, 13m)
Akira (Katsuhiro Ôtomo, 1988, 124m)
All That Jazz (Bob Fosse, 1979, 123m)
Battleship Potemkin (Sergei M. Eisenstein, 1925, 75m, excerpts)
Eternity and a Day (Theo Angelopoulos, 1998, 137m)
Fallen Angels (Wong Kar-wai, 1995, 97m) Fantastic Planet (René Laloux, 1973, 72m)
Laborer's Love (Zhang Shichuan, 1922, 22m)
Meet Me in St. Louis (Vincente Minnelli, 1944, 113m) Millennium Actress (Satoshi Kon, 2001, 87m) Mulholland Drive (David Lynch, 2001, 147m)
Persepolis (Vincent Paronnaud and Marjane Satrapi, 2007, 96m) Princess Iron Fan (Wan Guchan and Wan Laiming, 1941, 73m) Sherlock Jr. (Buster Keaton, 1924, 45m)
Singin' in the Rain (Gene Kelly and Stanley Donen, 1952, 103m)
Snow White and the Seven Dwarfs (William Cottrell and David Hand, 1937, 83m)
Song of the Sea (Tomm Moore, 2014, 93m) Spiriting Away (Hayao Miyazaki, 2001, 125m) Steamboat Willie (Walt Disney, 1928, 8m)
The Cabinet of Dr. Caligari (Robert Wiene, 1920, 76m) The Great Train Robbery (Edwin S. Porter, 1903, 11m) The Jazz Singer (Alan Crosland, 1927, 88m, excerpts)
The Lonedale Operator (D.W. Griffith, 1911, 17m)
Toy Story (John Lasseter, 1995, 81m)
Up (Pete Docter and Bob Peterson 2009, 96m)
Vivre sa vie (Jean-Luc Godard, 1962, 85m)

<u>Important Notes:</u>
(1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as

stipulated in the Regulations Governing University Examinations. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.

(3) Students are required to submit writing assignment(s) using Turnitin.

(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

Lingnan University
Animation and Digital Arts Programme

Course Code & Title	ADA2006 Storytelling and Storyboarding
Term	Term 2, 2022 – 23
Mode of Tuition & Credit	Workshop mode; 3 credits
Class Contact	Hours 3 hours per week
Day & Time	(1) Friday 09:30 - 12:30 or (2) Friday, 13:30 - 16:30
Venue	SEK-G02 / LBY203
Instructor	

Brief Course Description:
Storytelling and Storyboarding is an essential part of new media production. This course introduces to students characteristics and techniques of creative storytelling, helps students to gain hands-on experience in producing multimedia artifacts, and develop different formats of storyboards that will best serve the intended media. Students will learn to translate concepts such as shot types, continuity, pacing, transitions and sequencing into a visual narrative. Exploration of cinematic vocabulary and storyboard technique in the creation of both personal and professional expression are emphasized.

Aims:
This course aims at helping students to develop their original script and storyboard for new media and tell their story with different format of storyboards.

Learning Outcomes (LOs):
1. Compose stories for animation project;
2. Create visually different shot types, angles, cuts, transitions, posing, staging and camera moves on practical exercises;
3. Apply different formats of storyboards that best serve the intended purposes.

Indicative Contents:
1. Resource and Research
2. Storytelling
    2.1. Elements of Story, Plot and Narrative
    2.2. Characterization and Vignettes
    2.3. Storytelling & Personality
3. The Art of Storyboarding
    3.1. Types
        3.1.1. Traditional Storyboard
        3.1.2. Text Only Storyboard
        3.1.3. Graphical Storyboard
        3.1.4. Hand-Drawn Thumbnails
        3.1.5. CGI Storyboard

3.1.6. Presentational Storyboard
3.2. Techniques
3.2.1. Traditional Mediums
3.2.2. Computer Applications
3.2.3. Alternative Methods
3.3. Flow (Linear/Hierarchical/....)
3.4. Text, Image and Diagram
3.5. Symbols, Camera Arrows
3.6. Cinematography
3.7. Staging and Subject Size
3.8. Composition And Perspective
3.9. Transitions
4. Studies of Selected Scripts and Storyboarding Artist

Teaching Method:
3-hour workshop comprises of lectures, demonstrations, in-class exercises, screenings and critical appreciations. The course is organized to maximize hands-on experience and will include numerous in-class exercises. Because of this, participation in the weekly classes and doing the in-class exercises is extremely important and is considered in grading calculations.

Measurement of Learning Outcomes:

Learning Outcomes	Assessment Methods		
	Participation (in-class exercises)	Mid-term Project	Final Project
1. Compose stories for new media project	V	V	V
2. Create visually different shot types, angles, cuts, transitions, posing, staging and camera moves on practical exercises.	V		V
3. Apply different formats of storyboards that best serve the intended purposes.	V		V

Assessment:
Participation (in-class exercises) 20%
Mid-term Project 30%
Final Project 50%

Schedule (Tentative):

Lesson	Week	Topic	Screening
1	13 Jan 2023	Introduction to Storytelling and Storyboarding / The Structure of Story	The Terminal
2	20 Jan 2023	Introduction to Storytelling and Storyboarding / The Structure of Story (cont.)	At Café Six
3	27 Jan 2023	Storytelling Discussion	Bullet in the head
4	3 Feb 2023	Mini-story sharing	
5	10 Feb 2023	Scene Breakdown	The Kings Speech
6	17 Feb 2023	Visual Literacy	Love Education
7	24 Feb 2023	Character Set-up workshop	
8	3 Mar 2023	Storyboarding Workshop	
9	10 Mar 2023	Lighting Workshop	
10	24 Mar 2023	Mid-term Presentation	
11	31 Mar 2023	Mid-term Presentation	
12	14 Apr 2023	Animatics and Script Writing	A Better Tomorrow
13	TBC	Final Project Presentation	

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Koenitz, H. (Ed.). (2015). Interactive Digital Narrative: History, Theory and Practice. New York and London: Routledge.
Paez, S., & Jew, A. (2013). Professional Storyboarding: Rules of Thumb. Oxford: Focal Press. done
Phillips, A. (2012). A Creator's Guide to Transmedia Storytelling: How to Captivate and Engage Audiences Across Multiple Platforms. New York: McGraw-Hill.
Simon, M. (2000). Storyboards: Motion in Art. Oxford: Focal Press
Tumminello, W. (2005). Exploring Storyboarding. Independence, KY: Thomson Delmar Learning.
Wellins, M. (2005). Storytelling Through Animation. Hingham, MA: Charles River Media.

Important Notes:

1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.
3) Students are required to submit writing assignment(s) using Turnitin.

To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

Course Title	Basic Videography
Course Code	VIS2109
Recommended Study Year	NIL
No. of Credits/Term	3
Mode of Tuition	Studio-based, guided practice
Class Contact Hours	3-hours per week
Category	Required (for students from the 2020-21 intake)
Discipline	-
Prerequisite(s)	NIL
Co-requisite(s)	NIL
Exclusion(s)	NIL
Exemption Requirement(s)	NIL

Brief Course Description

Video technology plays an important role in the information age. Video equipment or devices that have video recording functions embedded in them are widely available nowadays. The general public has access to such equipment--in various forms and with different standards and specifications--as do media professionals. Video presentation can animate personal communication, enrich entertaining activities, empower artistic expressions, vivify educational functions and enhance workplace performance. The ability to manage audio-visual presentations will be a skill needed to communicate effectively in the near future. Most video production equipment is portable, which empowers individuals to produce different types of visual evidence and visual expression with limited resources and in connection with various persuasive, artistic, and creative strategies.

This course will provide training focused on video production from camera operation, video editing, and audio manipulation through to the completion of a video work. Several cinematographic theories and techniques of storytelling will be further introduced and explored in the studio setting.

Aims

This course is designed to:

1. introduce students to basic cinematography.
2. provide hands-on training to audio-visual equipment applications.
3. develop students' ability to manage audio-visual presentation.

Learning Outcomes

Upon completion of this course, students will be able to:

- i) use the basic skills in operating video-audio equipment.
- ii) describe the meanings and apply terms that are commonly used in the video/film industry.
- iii) demonstrate a variety of basic skills and techniques in project design, video production and editing.

Indicative Content
1. Video basic concepts
2. Film language and video terminology
3. Techniques of story telling
4. Production workflow
5. Editing techniques

Teaching Method
Lectures, video exercises and studio projects

Measurement of Learning Outcomes
Students' progress towards the learning outcomes outlined above will be measured by means of:
1. Active participation in class which requires students to take an active role in class discussion and exercises; regular attendance is one of the basic criteria for active participation. This participation reflects students' willingness to learn, and their ability to apply common terms that are used in video/film practice. (LOs 1,2)
2. A technical test which requires students to demonstrate their video production skills on camera operation, lighting setting, audio recording and stabilizer control. (LOs 1,2)
3. Two video exercises that allows students to practice and demonstrate their video production skills, ability to operate video-audio equipment properly, experiment on various videographic potentials, and control the consistent quality of their video projects. (LOs 1,2,3)

Assessment

Active class participation	20%
Production technical test	20%
Video exercises	60%

Active class participation
This mainly focuses on the effort put into learning and the active involvement in the video exercises and discussions while full attendance is expected.

Production technical test
The technical test includes two parts: individual and team-based. The individual test focuses on camera operation and stabilizer control, while the team-based test focuses on lighting setting and audio-video production.

Video exercises: two 2-min videos
The short videos focus on the standard of technical competence in production and post-production. Student should also demonstrate abilities to explore and apply aesthetic or expressive potentials of the video medium.

Required/Essential Readings

Brown, Blain. Cinematography Theory and Practice : Image Making for Cinematographers and Directors.
2nd ed. Burlington, MA: Focal Press, 2012.
Ford, Andrew. The Sound of Pictures : Listening to the Movies, from Hitchcock to High Fidelity.
Collingwood, Victoria : Black Inc. 2010.
Jackman, John. Lighting for Digital Video and Television. 3rd ed. Burlington, MA: Focal Press, 2010. Malkiewicz, J. Kris. Film Lighting : Talks with Hollywood's Cinematographers and Gaffers. 2nd ed. New
York ; London: Touchstone, 2012.

Reference Reading

Cheetham, Mark, Elizabeth Legge, and Catherine M. Soussloff. Editing the Image : Strategies in the Production and Reception of the Visual. Toronto: University of Toronto Press, 2016.

Agreement On Granting the Department of Visual Studies Free Permission for Educational and Promotional Purposes:

The Department of Visual Studies (VS) creates and preserves textual and photographic records as well as audio and video recordings of students, alumni and guests, their works of different kinds (e.g. project reports, presentations, artworks, media outputs), and their participation in school and co-curricular activities. This note requests students' agreement on granting free permission to the VS department for using the aforementioned records for educational and promotional purposes. For students in this studio course who would like to withdraw such permission, please contact the main office at vs@ln.edu.hk for the opt out.

Important Notes:

(1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.
(3) Students are required to submit writing assignment(s) using Turnitin.
(4) To enhance students' understanding of plagiarism, a mini-course "Online Tutorial on Plagiarism Awareness" is available on https://pla.ln.edu.hk/.

Course Title	Cinematography by Practice
Course Code	VIS3006
Recommended Study Year	NIL
No. of Credits/Term	3
Mode of Tuition	Studio-based, guided
Class Contact Hours	3-hours per week
Category	Programme Elective under 'Category 3: Studio Courses' (for students up to the 2019-20 intake) and 'Category III: Art Practice and Curating (for students from the 2020-21 intake)'
Discipline	-
Prerequisite(s)	NIL
Co-requisite(s)	NIL
Exclusion(s)	NIL
Exemption Requirement(s)	NIL

Brief Course Description

This course is designed to sophisticate students' abilities in digital cinematography which in essence is about visual storytelling with video. Moving image examples by acclaimed filmmakers and artists will be shown to students to learn advanced skills in the field. Students will work toward a final project in this course to reflect their research development in the storyline, camera operation, video editing, audio treatment, and post-production skills. By learning creative choices like where to put the camera or how the editing pace should be, students will master the skills in controlling audience's viewing experience.

Lectures, in-class exercises, presentations and discussions will consolidate students' learning experience in various cinematography theories and visual narrative techniques learned from the course.

Aims

This course is designed to:

1. train students to apply cinematographic knowledge and techniques
2. explore narrative organizations or time-based expressions in the video medium
3. cultivate good video production sense and styles
4. develop practices of research expression

Learning Outcomes

On completion of the course, students will be able to:

1. manage a video project and solve unexpected practical incidents during production process.
2. employ production skills and techniques proficiently in project development, video production and editing.
3. integrate multiple technical and intellectual knowledge into a meaningful/powerful video expression.

Indicative Content
1. Research and project theme development
2. Techniques of storytelling
3. Camera, lighting and audio recording techniques
4. Production workflow
5. Editing techniques
6. Teamwork management

Teaching Method
Lectures, video exercises and studio projects

Measurement of Learning Outcomes
Students' progress towards the learning outcomes outlined above will be measured by means of:
1. Active participation in class which requires students to take an active role in class discussion and exercises; regular attendance is one of the basic criteria for active participation. This participation reflects students' willingness to learn, and their ability to apply common terms that are used in video/film practice. (LOs 2,3)
2. A project proposal requires students to list and identify the research materials related to their video theme and sketch their production plan accordingly. Research presentation requires students to illustrate their knowledge in production through analysis of an existing video or cinematic work of art. (LOs 3)
3. A video project which requires students to develop a video project and execute the agreed upon project. The students are expected to apply/integrate academic knowledge which is developed from other university courses into their video project. The first-cut, project statement and final-cut assessment are opportunities for students to demonstrate their ability in content development, camera work, video editing, project, and teamwork management. (LOs 1,2,3)

Assessment

Active class participation	20%
Project proposal & Research presentation	40%
Video project	40%*

*includes first-cut (15%), project statement & reflective journal (10%) and final-cut (15%)

<u>Active class participation</u>
Regular attendance (10%) and active participation in workshop exercises (10%) are expected. Students are also expected to do required readings and actively participate in class discussions.

<u>Project proposal (5-6 pages per group)</u>

A 5-6 pages project proposal (20%) requires each group to list and identify the research materials related to their video theme and sketch their production plan accordingly. The proposal should include concepts, project description, artistic reference, storyboard, scripts, action plan and schedule, potential difficulties and solution, and any other related materials. Each group will also give oral presentation of their project proposals (10%). Students are also required to have a group research presentation (10%) on the analysis of an existing video or cinematic work of art to illustrate their knowledge in video production.

Video project: first-cut (less than 15 minutes per group) & final-cut (around 10 minutes per team)
Two screening sessions will be arranged for each cut during mid-term and at the end of term. The first-cut should be sufficient to show the basic sequence of the final work with essential audio-visual elements included. The final cut will be evaluated as a completed project.

Project statement (1 page per group) and peer evaluation (1 page per individual)
The project statement consists of a few short paragraphs prepared with the potential audience of the video work in mind. It usually includes a brief description of the storyline and the possible extended meaning of the project. In short, the function of the statement is to introduce and identify the video project to external viewers. The peer evaluation writing includes a description of actual teamwork distribution and credits to outstanding team members.

Required/Essential Readings

Biemann, Ursula, ed., Stuff It : The Video Essay in the Digital Age .Zürich : Edition Voldemeer ; New York : Springer Wien, 2003.
Bordwell, David, and Kristin Thompson, Film Art: An Introduction. Boston: McGraw Hill, 2015.
Brown, Blain. Cinematography Theory and Practice : Image Making for Cinematographers and Directors.
2nd ed. Burlington, MA: Focal Press, 2012.
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Cousins, Mark. The Story of Film. Rev. Hardback ed. London: Pavilion, 2011. Cubitt, Sean, Timeshift : On Video Culture. London , New York : Routledge, 1991.
Elwes, Catherine, Video Art : A Guided Tour. London ; New York : I.B. Tauris ; London : In Association with University of the Arts ; New York : In the United States of America and in Canada distributed by Palgrave Macmillan, 2005.
Gibbs, Tony. The Fundamentals Of Sonic Art & Sound Design. Lausanne: AVA Publishing, 2007. Jackman, John. Lighting for Digital Video and Television, 3rd Edition. Oxford: Focal Press, 2010.
Lovejoy, Margot, Englewood Cliffs, Postmodern Currents : Art and Artists in the Age of Electronic Media.
N.J. : Prentice Hall, 1992.

Spielmann, Yvonne , trans, Video : The Reflexive Medium. Cambridge, Mass. : MIT Press, 2008. Manovich, Lev, The Language of New Media. Cambridge, Mass. : MIT Press, 2002.
Meigh-Andrews, Chris, A History of Video Art : The Development of Form and Function. Oxford ; New York
: Berg, 2006.
Pelle, Veronika, "A new genre in art education: The power of video essays" Skills for Managing the Arts: Open Educational Resources and Experiential Learning in Support of Youth Entrepreneurship and Employment in the Arts and Creative Sector, (2016).
Spielmann, Yvonne, trans, Video : The Reflexive Medium. Cambridge, Mass.: MIT Press, 2008.
Todd, Tamara, ed., Screen/Space : The Projected Image in Contemporary Art. Manchester, UK ; New York : Manchester University Press, 2011.
Wheeler, Paul. Digital Cinematography. Oxford: Focal Press, 2001.

Important Notes:

(1) Students are expected to spend a total of 9 hours (i.e. 3 hours of class contact and 6 hours of personal study) per week to achieve the course learning outcomes.
(2) Students shall be aware of the University regulations about dishonest practice in course work, tests and examinations, and the possible consequences as stipulated in the Regulations Governing University Examinations. In particular, plagiarism, being a kind of dishonest practice, is "the presentation of another person's work without proper acknowledgement of the source, including exact phrases, or summarised ideas, or even footnotes/citations, whether protected by copyright or not, as the student's own work". Students are required to strictly follow university regulations governing academic integrity and honesty.
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Appendix 2 Questionnaire

User Interface and User experience

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. CineSim is easy to use					
2. It's easy to figure out how to use CineSim					
3. CineSim has a user-friendly UI/UX					
4. CineSim has an appealing UI design					
5. CineSim has a well organized interface					
6. I'm satisfied with CineSim's response time to my actions					
7. I'm satisfied with CineSim's overall appearance					

Cinematography, lighting and storyboarding functions

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
8. CineSim helps me to learn more about cinematography and lighting					
9. CineSim's simulation of cinematography and lighting is realistic and accurate					
10. I'm satisfied with CineSim's representation of cinematography and lighting					
11. CineSim is easy to use as a storyboarding tool					
12. CineSim is useful in creating and visualizing storyboards					

13. I'm satisfied with CineSim's support for storyboarding					
14. CineSim is useful in helping me to visualize and plan my projects					

15. How likely would you recommend CineSim to a friend or others for learning and experimentation in cinematography, lighting and storyboarding? (0-10)

16. Did you encounter any issues while using CineSim's features? If yes, what are they?

17. What do you like most about CineSim?

18. Do you have any thoughts on how to improve CineSim?

Appendix 3 First Round Questionnaire Result

In this round, the sample size is 57.

Part 1 : User Interface and User experience

1. CineSim is easy to use

Strongly Agree	10	70.2%
Agree	30	
Neutral	12	21.1%
Disagree	5	8.7%
Strongly Disagree	0	

2. It's easy to figure out how to use CineSim

Strongly Agree	10	71.9%
Agree	31	
Neutral	12	7.0%
Disagree	3	21.1%
Strongly Disagree	1	

3. CineSim has a user-friendly UI/UX

Strongly Agree	13	75.4%
Agree	30	
Neutral	12	3.5%
Disagree	2	21.1%
Strongly Disagree	0	

4. CineSim has an appealing UI design

Strongly Agree	12	70.2%
Agree	28	
Neutral	12	8.7%
Disagree	3	21.1%
Strongly Disagree	2	

5. CineSim has a well organized interface

Strongly Agree	14	78.9%
Agree	31	
Neutral	8	7.0%
Disagree	2	14.0%
Strongly Disagree	2	

6. I'm satisfied with CineSim's response time to my actions

Strongly Agree	11	70.2%
Agree	29	
Neutral	11	10.5%
Disagree	5	19.3%
Strongly Disagree	1	

7. I'm satisfied with CineSim's overall appearance

Strongly Agree	13	84.2%
Agree	35	
Neutral	5	7.0%

Disagree	2	8.8%
Strongly Disagree	2	

Part 2 : Cinematography, lighting and storyboarding functions

8. CineSim helps me to learn more about cinematography and lighting

Strongly Agree	18	70.2%
Agree	22	
Neutral	12	8.8%
Disagree	1	21.0%
Strongly Disagree	4	

9. CineSim's simulation of cinematography and lighting is realistic and accurate

Strongly Agree	16	70.2%
Agree	24	
Neutral	11	10.5%
Disagree	2	19.3%
Strongly Disagree	4	

10. I'm satisfied with CineSim's representation of cinematography and lighting

Strongly Agree	19	70.2%
Agree	21	
Neutral	10	12.3%
Disagree	3	17.5%
Strongly Disagree	4	

11. CineSim is easy to use as a storyboarding tool

Strongly Agree	14	57.9%
Agree	19	
Neutral	17	12.3%
Disagree	3	29.8%
Strongly Disagree	4	

12. CineSim is useful in creating and visualizing storyboards

Strongly Agree	14	63.2%
Agree	22	
Neutral	14	12.3%
Disagree	3	24.5%
Strongly Disagree	4	

13. I'm satisfied with CineSim's support for storyboarding

Strongly Agree	13	61.4%
Agree	22	
Neutral	15	12.3%
Disagree	3	26.3%
Strongly Disagree	4	

14. CineSim is useful in helping me to visualize and plan my projects

Strongly Agree	13	68.4%
Agree	26	
Neutral	12	10.5%

Disagree	2	21.1%
Strongly Disagree	4	

15. How likely would you recommend CineSim to a friend or others for learning and experimentation in cinematography, lighting and storyboarding? (0-10)

7.79/10

Appendix 4 Second Round Questionnaire Result

In this round, the sample size is 56. Including the numbers from the first round of the questionnaire in parentheses will facilitate comparison.

Part 1 : User Interface and User experience

1. CineSim is easy to use

Strongly Agree	11	69.6% (70.2%)
Agree	28	
Neutral	13	23.2% (21.1%)
Disagree	3	7.1% (8.7%)
Strongly Disagree	1	

2. It's easy to figure out how to use CineSim

Strongly Agree	12	75% (71.9%)
Agree	30	
Neutral	12	21.4% (7.0%)
Disagree	1	3.6% (211%)
Strongly Disagree	1	

3. CineSim has a user-friendly UI/UX

Strongly Agree	12	80.4% (75.4%)
Agree	33	
Neutral	6	10.7% (8.7%)
Disagree	4	8.9% (21.1%)
Strongly Disagree	1	

4. CineSim has an appealing UI design

Strongly Agree	12	75% (70.2%)
Agree	30	
Neutral	11	19.6% (8.7%)
Disagree	2	5.4% (21.1%)
Strongly Disagree	1	

5. CineSim has a well organized interface

Strongly Agree	14	82.1% (78.9%)
Agree	32	
Neutral	7	12.5% (7.0%)
Disagree	2	5.4% (14.0%)
Strongly Disagree	1	

6. I'm satisfied with CineSim's response time to my actions

Strongly Agree	13	82.1% (70.2%)
Agree	33	
Neutral	5	8.9% (10.5%)
Disagree	4	8.9% (19.3%)
Strongly Disagree	1	

7. I'm satisfied with CineSim's overall appearance

Strongly Agree	17	82.1% (84.2%)
Agree	29	

Neutral	9	16.1% (7.0%)
Disagree	0	1.8% (8.8%)
Strongly Disagree	1	

Part 2 : Cinematography, lighting and storyboarding functions

8. CineSim helps me to learn more about cinematography and lighting

Strongly Agree	21	85.7% (70.2%)
Agree	27	
Neutral	7	12.5% (8.8%)
Disagree	0	1.8% (21.0%)
Strongly Disagree	1	

9. CineSim's simulation of cinematography and lighting is realistic and accurate

Strongly Agree	20	87.5% (70.2%)
Agree	29	
Neutral	5	8.9% (10.5%)
Disagree	1	3.6% (19.3%)
Strongly Disagree	1	

10. I'm satisfied with CineSim's representation of cinematography and lighting

Strongly Agree	18	91.1% (70.2%)
Agree	33	
Neutral	3	5.4% (12.3%)
Disagree	1	3.6% (17.5%)

Strongly Disagree	1	

11. CineSim is easy to use as a storyboarding tool

Strongly Agree	21	82.1% (57.9%)
Agree	25	
Neutral	6	10.7% (12.3%)
Disagree	3	7.1% (29.8%)
Strongly Disagree	1	

12. CineSim is useful in creating and visualizing storyboards

Strongly Agree	18	85.7% (63.2%)
Agree	30	
Neutral	5	8.9% (12.3%)
Disagree	2	5.4% (24.5%)
Strongly Disagree	1	

13. I'm satisfied with CineSim's support for storyboarding

Strongly Agree	21	82.1% (61.4%)
Agree	25	
Neutral	6	10.7% (12.3%)
Disagree	3	7.1% (26.3%)
Strongly Disagree	1	

14. CineSim is useful in helping me to visualize and plan my projects

Strongly Agree	20	87.5% (68.4%)

Agree	29	
Neutral	4	7.1% (10.5%)
Disagree	2	5.4% (21.1%)
Strongly Disagree	1	

15. How likely would you recommend CineSim to a friend or others for learning and experimentation in cinematography, lighting and storyboarding? (0-10)

8.18/10

Appendix 5 Sample Script and Storyboard

Title: The Final Lesson

INT. HIGH SCHOOL CLASSROOM - DAY

A classroom bathed in the golden light of late afternoon. The room is almost empty, save for ALEX, a thoughtful, slightly rebellious student sitting at a desk, and JAMIE, the respected and innovative teacher, standing at the front.

JAMIE (concerned)

Alex, you've been quiet lately. Everything alright?

ALEX looks up, surprised by the direct question. A beat of hesitation.

ALEX (defensively)

I'm fine. Just tired.

JAMIE walks slowly towards ALEX, stopping at the desk in front of him. JAMIE leans forward, hands clasped.

JAMIE (softly, with conviction)

You know, "fine" often means you're anything but. It’s okay not to be okay, Alex.

ALEX shifts uncomfortably, eyes darting away. A tense silence fills the room.

ALEX (muttering)

It's just... everything feels pointless. School, grades... What does it all matter in the end?

JAMIE straightens up, takes a moment to choose words carefully.

JAMIE (inspiring)

It matters because this is where you start shaping your future. Every challenge, every "pointless" assignment, is a step towards discovering who you are and who you want to be.

ALEX looks up, skepticism mixed with curiosity.

ALEX

And what if I don't know who I want to be?

JAMIE (smiling)

Then you explore. You question. You learn. Not just from books, but from the experiences around you. School is more than grades, Alex. It's about growing, not just academically, but as a person.

ALEX shows a spark of understanding in their eyes.

ALEX (thoughtfully)

So... what's the point of all this, then?

JAMIE (passionately)

The point is to build a foundation. A foundation strong enough to support whatever dreams you decide to chase. And trust me, Alex, it’s never pointless.

ALEX nods, a newfound respect in their gaze. The afternoon sun casts long shadows across the room, symbolizing the beginning of a new understanding between teacher and student.

ALEX (determined)

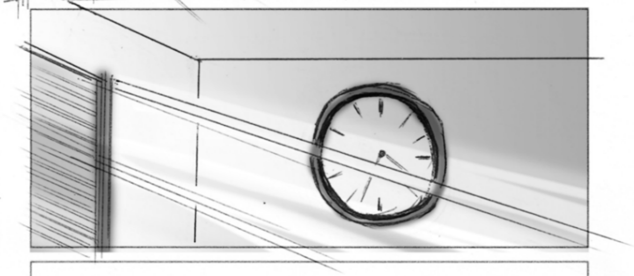
Alright. I'll give it another shot. But I’m going to need help.

JAMIE (grinning)

And I’ll be here. Every step of the way.

The bell rings, signaling the end of the day, but for ALEX and JAMIE, it’s the start of something new.

FADE OUT.



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