Chapter 2

RESEARCH FRAMEWORK

2.1.Literature Review

2.1.1 Cognitive Load Theory

Cognitive Load Theory (Sweller, 1988) explains that learners have a limited amount of working memory available for processing information. When this capacity is exceeded, learning becomes less effective. For effective learning to occur, it is essential to manage and reduce the cognitive load on learners (Paas, Renkl, & & Sweller, 2003)

Traditional learning methods, such as reading from textbooks or watching lectures, can sometimes overload the working memory because they often present abstract concepts without engaging the learner's sensory or spatial understanding. Virtual Reality (VR) environments offer a potential solution to this issue by creating immersive, interactive, and visually rich experiences that align closely with how our brain naturally processes information (Mayer, 2005)

In VR-enhanced Learning Management Systems (LMS), learners can interact with 3D models, simulations, or scenarios that replicate real-world environments. This immersive nature helps reduce extraneous cognitive load, which occurs when learners spend mental effort deciphering abstract or overly complex materials. For example, a VR simulation of a chemical experiment allows learners to intuitively understand processes by directly manipulating virtual tools, as opposed to interpreting static diagrams or descriptions.

Moreover, VR can increase germane cognitive load, which is the mental effort dedicated to building and integrating knowledge. By providing context-rich, engaging experiences, VR makes learning more meaningful and memorable. For instance, a medical student practicing virtual surgeries in an LMS gains practical understanding while making fewer errors than they would in traditional theoretical learning environments (Merchant, The Design of Virtual Environments for Meaningful Learning, 2014).

Studies have shown that VR can improve learning outcomes by helping learners focus on the core material rather than struggling with abstract representations (Dalgarno & & Lee, 2010). However, it is crucial to design VR content carefully to avoid overwhelming learners with unnecessary details or distractions, which could inadvertently increase cognitive load (Makransky & & Petersen, 2019).

So, Cognitive Load Theory supports the integration of VR in LMS as a tool for reducing unnecessary mental effort while enhancing meaningful learning. By leveraging immersive technology, we can make education more effective, especially for complex or skill-based subjects.

2.1.2 Self Determination Theory

Self-Determination Theory (SDT), developed by Deci and Ryan (1985), posits that learners possess innate psychological needs for autonomy, competence, and relatedness. Satisfying these needs is essential for sustaining motivation and engagement. VR technology offers a unique opportunity to meet these needs in educational contexts.

First, VR fosters autonomy by enabling learners to control their own learning paths. In a virtual environment, learners can explore, experiment, and interact with content at their own pace, creating a personalized and self-directed experience (Deci & & Ryan, 1985). For example, a VR-based history module might allow learners to roam ancient cities, choosing which aspects to study in detail.

Second, VR supports competence by providing interactive and immediate feedback within simulated environments. This scaffolding helps learners build skills and confidence in complex tasks. For instance, a virtual laboratory allows chemistry students to practice experiments safely and repeatedly until mastery is achieved (Merchant, The Impact of Virtual Reality on Collaborative Learning, 2014)

Finally, VR facilitates relatedness by enabling collaborative activities in immersive environments. Learners can engage in group simulations, such as medical team exercises, fostering a sense of connection and shared purpose (Makransky G. e., 2020)

By addressing the core tenets of SDT, VR has the potential to revolutionize motivation and engagement in education, making learning more meaningful and effective.

2.1.3 Social Learning Theory

Social Learning Theory, introduced by Bandura (1977), emphasizes the importance of observing, modeling, and imitating behaviors, attitudes, and emotional reactions of others in the learning process. This theory highlights the role of social interaction in acquiring knowledge and skills, making it highly relevant to modern educational practices.

VR technology aligns well with Social Learning Theory by providing immersive environments where learners can observe and interact with avatars, mentors, or peers in realistic scenarios. For example, in a VR training program for medical professionals, students can observe expert surgeons performing procedures and then replicate the steps themselves. This process strengthens observational learning and skill acquisition (Bandura, 1986).

Additionally, VR enables learners to engage in collaborative tasks, promoting learning through shared experiences. For instance, team-based problem-solving activities in VR can simulate real-world challenges, enhancing teamwork and communication skills. These environments also foster self-efficacy, as learners witness their peers successfully completing tasks, boosting their own confidence to achieve similar outcomes (Makransky et al., 2020).

By using Virtual Reality (VR) along with Social Learning Theory, teachers can design exciting and interactive lessons that help students learn in three main ways: by watching, doing, and working together.

a. **Observation**: In VR, students can watch virtual characters or experts demonstrating tasks in a way that feels very real. For example, a medical student might observe a virtual doctor performing surgery. This makes it easier to understand how something should be done because they can see it step by step.
b. **Practice**: After watching, students can try doing the tasks themselves in a virtual environment. For instance, they can practice surgery in the VR space without any risks involved. This hands-on practice helps them learn better and gain confidence in their abilities.
c. **Collaboration**: VR allows students to work together in virtual spaces. They can solve problems as a team or complete tasks while communicating with each other. This helps them learn teamwork and communication skills, which are very important in real life.

When these three elements—watching, doing, and working together—are combined in a VR-based lesson, learning becomes much more engaging and fun. Students feel more connected to what they are learning, understand concepts better, and are more motivated to participate. This approach makes learning not just effective but also enjoyable.

2.1.4 Constructivist Theory

Constructivist Theory, developed by Piaget (1972) and expanded by Vygotsky (1978), emphasizes that learners build their understanding through experiences and interactions within their environment. By integrating Virtual Reality (VR) into Learning Management Systems (LMS), educators can provide learners

with immersive and interactive environments that align with the principles of constructivist learning.

VR in LMS allows students to actively participate in their learning journey. For instance, instead of passively reading about historical events, learners can explore virtual historical sites, engage with artifacts, and experience events as though they were present. This supports the idea that knowledge is constructed through direct interaction with the environment (Jonassen, 1999).

Additionally, VR supports experiential learning, a key tenet of constructivist theory, by providing virtual scenarios where learners can apply theoretical knowledge. For example, nursing students can practice diagnosing and treating virtual patients in a risk-free setting. This hands-on practice fosters deeper understanding and skill development (Merchant, The Design of Virtual Environments for Meaningful Learning, 2014).

Collaboration is another critical aspect of constructivism. VR-enabled LMS can create shared virtual spaces where learners work together on projects or simulations. For example, architecture students can collaboratively design a building in a virtual environment, mirroring real-world teamwork and problem-solving dynamics (Makransky & & Petersen, 2019).

Finally, VR facilitates self-directed exploration, allowing learners to navigate virtual environments at their own pace. This aligns with constructivist ideas that learning is most effective when students are empowered to explore and discover based on their interests and needs (Dalgarno & & Lee, 2010).

By integrating VR into LMS underpinned by Constructivist Theory, educators can create highly engaging, meaningful, and effective learning experiences that promote critical thinking, collaboration, and creativity.

These theories suggest that integrating an LMS with a virtual reality platform can have significant benefits for improving user engagement, motivation, and retention in educational settings by reducing cognitive load, meeting psychological needs, facilitating social learning, and supporting constructivist learning.

2.2.Previous Research

Table 1. Previous Research on Virtual Reality in Education

No	Authors	Paper Title	Journal and Edition	Findings
1	N. A. S. Putri, et al.	Learning Management System Based on Virtual Reality Technology in Elementary School	N/A (Development Study)	VR-based LMS improves student interaction and motivation in elementary education.
2	A. B. Cahyadi	Integration of Virtual Reality in Technical Skills Training Programs	N/A (Case Study)	VR enhances participant engagement and supports skills transfer to the workplace.
3	LMS Portals	Virtual Reality Integration Options for an LMS	N/A (Literature Review)	Integrating VR with LMS enhances learning experiences through interactive simulations.
4	Z. Merchant, et al.	Virtual Reality and Perceived Learning Effectiveness in Accounting Education	Computers in Human Behavior, 2024 Edition	VR aids in understanding accounting standards through real-world application scenarios.
5	J. Smith, et al.	A Review on Cultivating Effective Learning: Synthesizing Educational Theories	Educational Technology Review, 2023 Edition	VR can enhance learning effectiveness when aligned with

No	Authors	Paper Title	Journal and Edition	Findings
		and Practices Linked to the Use of VR Systems		appropriate educational theories.
6	D. E. F. Ginting	The Use of Virtual Reality as a Learning Medium and Its Application in History Materials	Historical Education Journal, 2022 Edition	VR increases knowledge retention and interest in history education materials.
7	R. Rahman, M. R. Islam	VREd: A Virtual Reality-Based Classroom for Online Education Using Unity3D WebGL	International Journal of Online Education, 2023 Edition	VREd system improves interaction and control in online learning environments.
8	S. H. Kurniawan	Potential Use of Virtual Reality as a Learning Medium in Higher Education	Higher Education Studies Journal, 2021 Edition	VR holds significant potential to improve education quality in higher education institutions.
9	F. Ramadhanya	The Use of Virtual Reality in Indonesian Language Learning: Benefits, Challenges, and Opportunities	Indonesian Language Education Journal, 2024 Edition	VR enriches language learning experiences but faces challenges like digital divide and infrastructure limitations.
10	A. H. Wijaya, et al.	Development of Learning Innovation Using Augmented Reality Technology with a Learning Management System	Education Technology Innovations Journal, 2023 Edition	AR integration with LMS offers interactive and immersive learning experiences.

No	Authors	Paper Title	Journal and Edition	Findings
		as a Learning Supplement		

Below is list of gaps from previous research:

Table 2. Gaps from previous research as base on current research

No	Authors	Paper Title	Journal and Edition	Findings
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		Educational Theories and Practices Linked to the Use of VR Systems	Review, 2023 Edition	appropriate educational theories.
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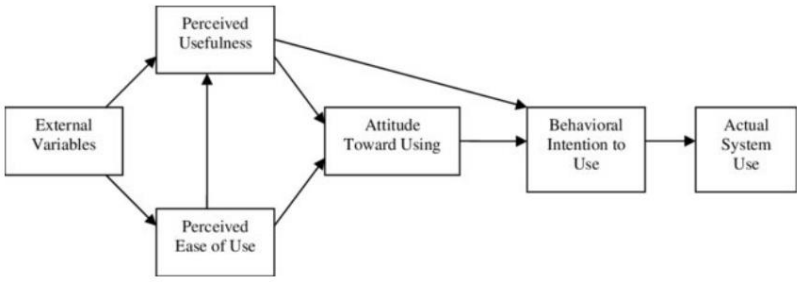
Previous studies, like those by N. A. S. Putri et al. (VR-LMS in elementary education) and Z. Merchant et al. (VR in accounting education), show that Virtual Reality (VR) can improve motivation, engagement, and retention in learning. However, there are still gaps, such as mixed results in different contexts, lack of studies on long-term effects, challenges in practical use, and limited focus on certain groups. While these studies provide valuable insights, more research is needed to address these gaps and improve how VR is used with Learning Management Systems (LMS). Based on these gaps, this research seeks to determine whether integrating an LMS with a VR platform is impactful in enhancing user engagement, motivation, and retention. It focuses on evaluating the effectiveness of VR design and instructional strategies tailored to Indonesian users, addressing the gaps in existing studies and providing insights into the role of VR in education.

2.3.Research Model

The conceptual framework for the integration of an LMS with a virtual reality platform to investigate the effectiveness of this technology for improving user engagement, motivation, and retention in educational settings may include the following components:

2.3.1. Technology Acceptance Model (TAM): This model can be used to examine how users perceive and use the VR technology integrated with an LMS. The TAM includes factors such as perceived usefulness, ease of use, and attitude towards technology, in which when applied to the integration of Virtual Reality (VR) technology with a Learning Management System (LMS), TAM can provide insights into users' perceptions and behaviours.



Picture 1. Technology Acceptance Model (TAM)

a) **Perceived Usefulness:** According to TAM, perceived usefulness refers to the degree to which individuals believe that using a particular technology will enhance their performance or make their tasks easier. In the context of VR integrated with an LMS, users may perceive the usefulness of VR in terms of its ability to provide immersive and engaging learning experiences. They might see VR as a tool that can enhance their understanding, retention, and application of knowledge compared to traditional learning methods.

b) **Perceived Ease of Use:** This factor refers to the degree to which users believe that using a technology will be free from effort and complexity. Users' perception of the ease of use of VR integrated with an LMS can influence their acceptance and adoption of the technology. If users find the VR technology intuitive, user-friendly, and accessible through the LMS interface, they are more likely to embrace it. On the other hand, if they perceive it as complex or difficult to navigate, their acceptance might be hindered.

c) **Attitude Toward Using:** Attitude toward using is a measure of an individual's positive or negative feelings towards adopting and using a technology. In the context of VR integrated with an LMS, users' attitudes can be influenced by factors such as their prior experience with VR, their perceptions of its educational value, and their beliefs about the impact it can have on their learning outcomes. Positive attitudes are more likely to result in greater acceptance and willingness to use the technology.

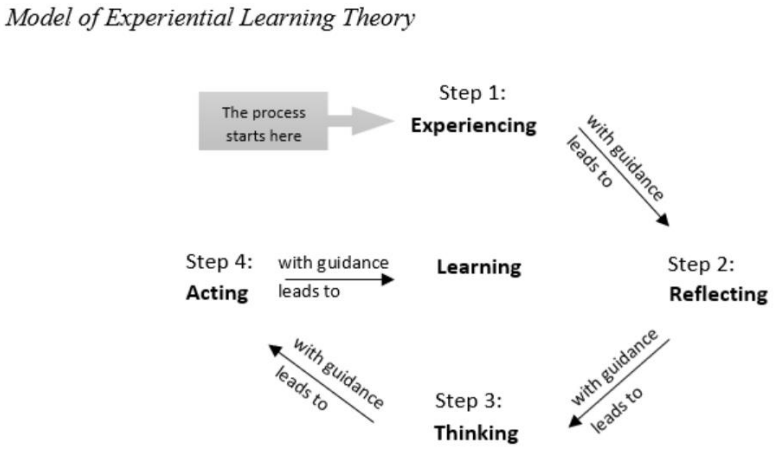
d) **Behavioural Intention to Use:** TAM suggests that users' behavioural intention to use a technology is a strong predictor of their actual technology usage. If users perceive VR integrated with an LMS as useful, easy to use, and have a positive attitude toward it, they are more likely to intend to use it in their learning activities. Their intention to use

VR can be influenced by factors such as their motivation, perceived benefits, and social norms.

It's important to note that TAM is a model and not an absolute predictor of user behaviour. Other external factors such as institutional support, access to necessary hardware, training, and technical support can also impact users' perceptions and usage of VR integrated with an LMS.

By considering the factors outlined in TAM, educators and developers can gain insights into users' acceptance and usage patterns of VR technology integrated with an LMS. This understanding can inform the design, implementation, and support strategies to enhance users' learning experiences and outcomes.

2.3.2. Experiential Learning Theory (ELT): ELT can be used to explain how users learn through the immersive and interactive nature of the VR-based learning environment. This theory suggests that learning is most effective when users are actively engaged in the learning process and can relate new information to their prior experiences.



Picture 2.Experiential Learning Theory by David Kolb. (Asiri)

Experiential Learning Theory (ELT) is a learning framework developed by David A. Kolb, an influential theorist in the field of adult education. ELT is based on the idea that learning is an active and continuous process that occurs through the direct experience of the learner.

According to Kolb's model, learning is a four-stage cyclical process that involves concrete experience, reflective observation, abstract conceptualization, and active experimentation. These stages are interconnected and provide a holistic approach to learning.

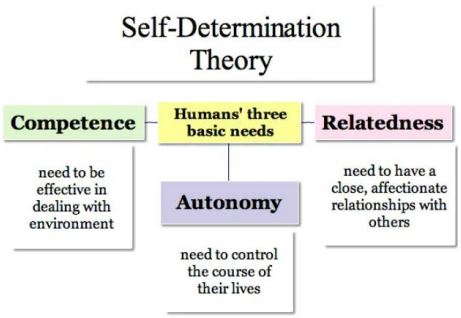
a) **Concrete Experience:** This stage involves the learner's direct experience with a situation or an event. It could be a real-life experience, a simulation, or any hands-on activity that provides the learner with a tangible experience.
b) **Reflective Observation:** After the concrete experience, learners reflect on their experience and observe what happened, what they felt, and what they learned from the experience. This stage emphasizes introspection and self-assessment.
c) **Abstract Conceptualization:** In this stage, learners derive general principles, concepts, or theories from their reflective observations. They try to make sense of their experiences by relating them to existing knowledge frameworks or by developing new conceptualizations.
d) **Active Experimentation**: The final stage of the cycle involves applying the newly formed concepts and theories to practical situations. Learners actively test their understanding and knowledge by engaging in new experiences and experiments. They seek feedback, evaluate outcomes, and modify their approaches accordingly.

According to Kolb, effective learning occurs when individuals engage in all four stages of the learning cycle, continually building on their prior experiences. This cycle can be applied to various educational settings, from classrooms to professional development programs.

ELT emphasizes the importance of integrating theory and practice, and it acknowledges that learners have different learning preferences and styles. Kolb identified four learning styles associated with the stages of the learning cycle: converging, diverging, assimilating, and accommodating. These styles reflect individual differences in how learners approach the learning process and engage with different stages of the cycle.

To conclude, Experiential Learning Theory emphasizes the significance of active engagement, reflection, and application of knowledge in the learning process. It has been widely applied in fields such as education, training and development, and organizational learning to promote effective and meaningful learning experiences.

2.3.3. Self-Determination Theory (SDT): SDT can be used to examine how the integration of VR technology with an LMS can support users' psychological needs for autonomy, competence, and relatedness. This theory suggests that when these needs are met, users are more likely to be motivated and engaged in the learning process.



Picture 3.Self Determination Theory. (Courtney E. Ackerman, 2018)

Self-Determination Theory (SDT) provides insights into how users perceive and use Virtual Reality (VR) technology integrated with a Learning Management System (LMS) based on their intrinsic motivation and psychological needs. Here's how SDT can be applied in this context:

a) **Autonomy:** Users' perception of autonomy in using VR integrated with an LMS can influence their engagement. When users have a sense of choice and control over their VR experiences, such as the ability to select activities or navigate content, it enhances their autonomy. Allowing users to customize their learning paths and explore VR environments based on their interests and preferences can foster a sense of autonomy, leading to increased engagement and usage.

b) **Competence:** Users' perception of their competence in using VR technology integrated with an LMS is crucial for their engagement. When users believe that using VR can improve their learning outcomes, enhance their skills, and provide a sense of accomplishment, it strengthens their competence. Providing clear instructions, scaffolding, and opportunities for skill development and mastery within VR experiences can boost users' perception of competence and drive their usage.

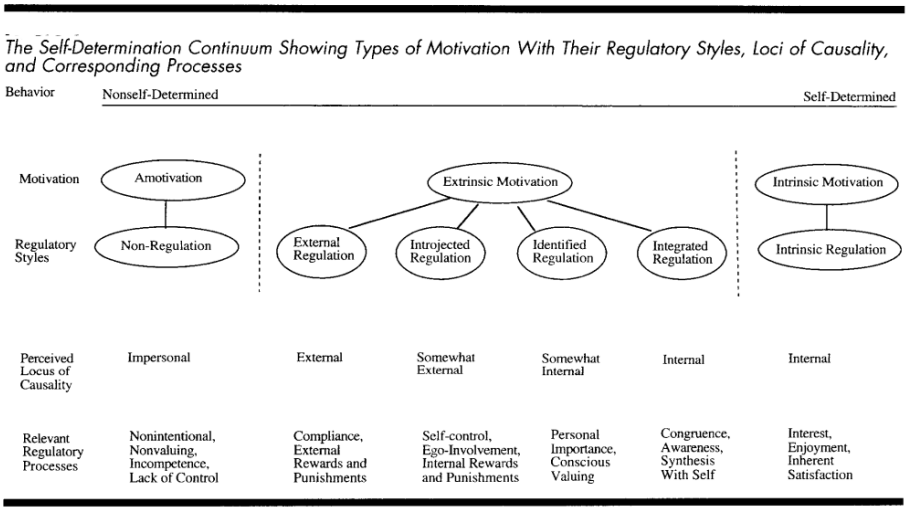
c) **Relatedness:** The perception of relatedness, or the sense of connection and social interaction, can impact users' engagement with VR integrated with an LMS. By incorporating collaborative and social features within VR experiences, such as group activities, multiplayer simulations, or shared learning spaces, users can interact with peers, instructors, and experts. These social interactions foster a sense of relatedness, leading to increased motivation and sustained usage of VR technology.

d) **Intrinsic Motivation:** Intrinsic motivation, driven by inherent interest and enjoyment, plays a vital role in users' perception and usage of VR integrated with an LMS. When

users find VR experiences stimulating, enjoyable, and personally meaningful, it fuels their intrinsic motivation. Designing immersive and interactive VR scenarios that align with users' interests, provide novel experiences, and promote curiosity can enhance intrinsic motivation, leading to higher engagement and prolonged usage.

To promote users' perception and usage of VR technology integrated with an LMS based on SDT, educators and designers can consider the following strategies:

- Provide choices and autonomy within VR experiences, allowing users to customize their learning paths and activities.
- Scaffold the use of VR technology by providing clear instructions, guidance, and opportunities for skill development.
- Incorporate collaborative and social elements, enabling users to interact and learn from peers, instructors, and experts within VR environments.
- Design VR experiences that are stimulating, meaningful, and aligned with users' interests, fostering intrinsic motivation.
- Offer opportunities for reflection and feedback, enabling users to track their progress and enhance their sense of competence.



Picture 4. The self Determination Continuum. (Ryan & Deci, 2000)

By addressing the autonomy, competence, relatedness, and intrinsic motivation needs of users within the integration of VR technology with an LMS, educators can enhance users' perception, engagement, and utilization of this powerful learning tool.

2.3.4 Social Learning Theory (SLT): SLT can be used to examine how users learn from and with each other in the VR-based learning environment. This theory suggests that learning is a social process, and users can benefit from interacting and collaborating with their peers in the VR-based learning environment.

Social Learning Theory (SLT), developed by Albert Bandura, suggests that individuals learn by observing and imitating others' behaviours, as well as through social interactions and reinforcement. When applied to users' perception and usage of Virtual Reality (VR) technology integrated with a Learning Management System (LMS), SLT can provide insights into the social factors that influence their engagement and adoption.

a) **Observational Learning:** According to SLT, users learn by observing others. When users see their peers or instructors using VR technology within an LMS and benefiting from it, they are more likely to perceive its value and be motivated to use it themselves. Demonstrating successful VR usage scenarios, sharing positive experiences, and showcasing the benefits of VR can encourage users to perceive it as a valuable tool for learning.
b) **Imitation:** SLT highlights the role of imitation in learning. Users are more likely to adopt VR technology within an LMS if they see others imitating its usage. This can be achieved by creating opportunities for users to observe and imitate VR interactions, either through recorded demonstrations, live sessions, or collaborative activities. Encouraging peer-to-peer sharing and collaboration within VR environments can further facilitate imitation and adoption.
c) **Social Reinforcement:** Social reinforcement plays a crucial role in SLT. Users are more likely to perceive and use VR technology integrated with an LMS if they receive positive reinforcement from their social environment. This can include praise, recognition, or rewards from instructors, peers, or the educational institution for actively engaging with VR experiences. Positive reinforcement helps create a supportive learning environment that encourages users to explore and adopt VR technology.
d) **Collaborative Learning:** SLT emphasizes the importance of social interactions in the learning process. VR integrated with an LMS can provide opportunities for collaborative learning experiences, where users can engage with peers, solve problems together, and share knowledge within immersive environments. Collaborative VR activities can enhance users' perception of the technology by promoting engagement, interaction, and knowledge exchange among peers.

To leverage SLT in users' perception and usage of VR technology integrated with an LMS, educators can implement the following strategies:

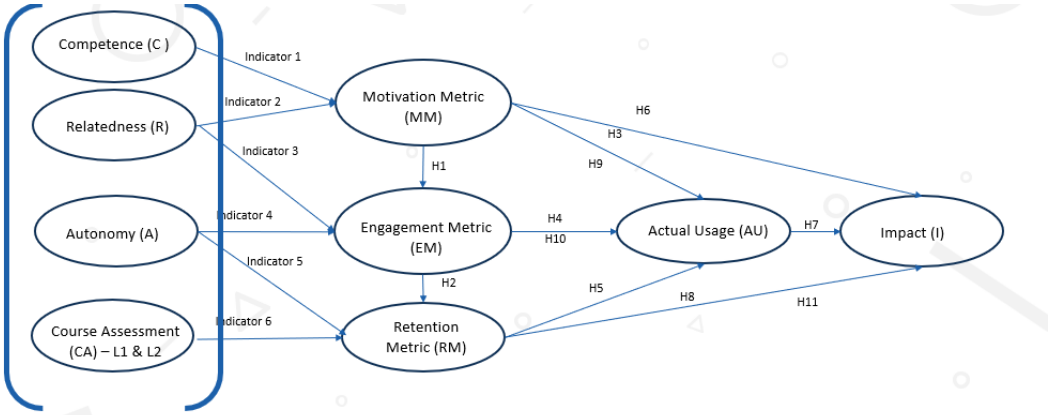
- Provide opportunities for users to observe and learn from demonstrations and successful VR usage examples within the LMS environment.
- Encourage peer-to-peer sharing and collaboration by facilitating group VR activities and projects.
- Offer positive reinforcement and recognition for users who actively engage with VR technology and demonstrate meaningful learning outcomes.
- Foster a supportive learning environment where users can freely discuss, reflect, and exchange experiences related to VR technology usage.
- Provide guidance and support to users as they navigate VR experiences, ensuring they feel comfortable and confident in their interactions.

By integrating social learning principles into the design and implementation of VR technology within an LMS, educators can foster a collaborative and supportive learning environment, promote the perception of VR's value, and enhance users' engagement and adoption of this technology.

This conceptual framework can provide a holistic understanding of how the integration of an LMS with a virtual reality platform can improve user engagement, motivation, and retention in educational settings. It can also help identify the key factors that contribute to the effectiveness of this technology for learning purposes and inform the design and implementation of VR-based learning environments.

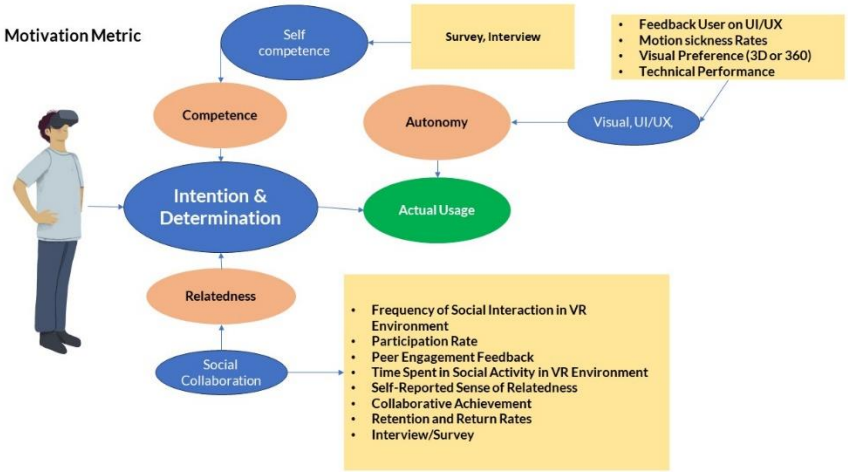
2.4 Research Framework

To evaluate the impact of integrating a Learning Management System (LMS) with a Virtual Reality (VR) platform in educational settings for the enhancement of user engagement, motivation, and retention, a comprehensive research framework is essential. This framework aims to provide a structured approach to understanding the multifaceted dimensions of this integration and its implications on educational outcomes. By systematically investigating the relationships between LMS, VR technology, and user engagement, motivation, and retention, this research seeks to shed light on the potential benefits and challenges of this innovative approach to learning, ultimately contributing to the advancement of effective pedagogical practices in the digital age.



Picture 5. Proposed metric to measure impact on VR and LMS integration to enhance user engagement, retention, and impact.

As we explore the merging of Learning Management Systems (LMS) with Virtual Reality (VR) in education, we're not just looking at cool technology. Instead, we're delving into the reasons that push users to learn. We all have a natural desire to be in control, to feel good at what we do, and to connect with others. This research follows the path of self-determination theory to understand how combining LMS and VR can make learning feel more self-driven, competent, and connected for users. In simpler terms, it's about figuring out how this tech combo can make users want to learn, feel capable, and engage with their studies.



Picture 6. Motivation metric measurement

2.5. Hypothesis Development or Proposition Development

The transformative potential of virtual reality (VR) technology in educational environments is examined in this thesis, with a focus on how well it fosters critical soft skills in students. It fills

a significant vacuum in the current body of research on educational technology by examining the complex linkages between learner motivation, engagement, retention of information, real usage of VR systems, and the ensuing impact on the development of soft skills through a series of propositions. Here are propositions based on each hypothesis:

Proposition 1: Motivation acts as a primary driver for engagement in VR-based educational systems, where higher motivational levels predict increased learner engagement.

Proposition 2: Engagement in VR-based educational activities is critical for enhancing the retention of content, suggesting that more engaged learners will retain information more effectively over time.

Proposition 3: Learner motivation significantly influences the frequency and depth of VR technology usage, indicating that motivated learners are more likely to utilize VR tools extensively.

Proposition 4: Engagement with educational content in VR is a key factor that encourages regular use of VR technologies, with higher engagement leading to higher actual usage.

Proposition 5: The retention of educational content through VR platforms positively impacts the extent of VR technology usage, where learners who retain more information tend to use the VR system more frequently.

Proposition 6: The level of motivation in learners using VR for training correlates positively with the impact on their soft skills, suggesting that motivated learners show better soft skills development.

Proposition 7: Actual usage of VR systems has a direct impact on the development of soft skills, proposing that more frequent use of VR enhances soft skills competencies.

Proposition 8: Learners who better retain information from VR training sessions demonstrate a greater improvement in soft skills, indicating the effectiveness of VR for skill development.

Proposition 9: Actual usage serves as a mediator between learner motivation and the development of soft skills, suggesting that increased usage is necessary for motivation to translate into tangible soft skills improvement.

Proposition 10: The actual usage of VR mediates the relationship between engagement and soft skills development, emphasizing the role of active participation in VR environments for skill enhancement.

Proposition 11: The retention of information is a mediating factor in the relationship between VR training and soft skills development, highlighting the importance of information retention in achieving effective soft skills training outcomes.

These hypotheses and propositions can guide the research design and data analysis for investigating the effectiveness of the integration of an LMS with a virtual reality platform for learning purposes.