Levels of Immersive Teaching and Learning: Influences of Challenges in the Everyday Classroom

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Abstract: This chapter discusses theoretical models for immersive learning and immersive teaching. The subjective and objective factors used in these models are distinguished by levels: micro, meso, and macro. We discuss the terms *immersive teaching* and *immersive learning* and possible strategies for implementing learning experiences in the everyday classroom.

Keywords: Augmented Reality, Classroom Integration, Constructive Alignment, Immersive Learning, Immersive Media in Schools, Immersive Teaching, Virtual Reality

Introduction

After recent technological advances in the field of immersive media, teaching and learning with virtual and augmented reality (VR/AR) are closer to everyday classroom integration. Early pilot studies carried out in controlled settings suggest great potential for using such technologies for pedagogical endeavours: particularly, effect on learning (e.g., Krokos et al., 2018; Le et al., 2015), motivation (e.g., Bacca et al., 2019; Mei & Sheng, 2011), and engagement (e.g., Allcoat & van Mühlenen, 2018; Bressler et al., 2019). Further, literature reviews provide evidence for the use of immersive media in language education (Peixoto et al., 2021), history and cultural heritage education (Challenor & Ma, 2019), computer science education (Pirker et al., 2020), teacher education (Billingsley et al., 2019), medicine (Kavanagh et al., 2017), STEM education (Pellas et al., 2020), and various other application areas (Freina & Ott, 2015). However, virtual learning environments face similar conditions, restrictions, and challenges as traditional educational media. The integration of VR and AR in the everyday classroom comes with affordances and constraints that are seldom observed in laboratory settings.

This chapter contributes to research on the challenges of using holistic models to facilitate immersive teaching and learning. First, we present existing theoretical models and frameworks for educational immersive experiences. Second, we categorize these models and frameworks into

three pedagogical levels of immersive teaching and learning. The macro level presents general institutional and governmental factors that facilitate or hamper endeavours to integrate immersive media in schools. The meso level describes teacher- and classroom-specific factors. The micro level focuses on learner-specific factors such as individual perceptions and learning activities. Distinguishing between immersive teaching (the process of teaching with immersive technology) and immersive learning (individual learning processes supported by immersive technology) helps clarify internal and external factors related to the educational process, particularly influences and challenges. Third, we outline three pedagogical considerations: the immersive constructive alignment (aligning learning objectives, learning activities, and performance assessment through immersive media), the focus on the learner (keeping in mind the complex interaction of perceptual stimuli with the traits and states of the individual), and the role of the teacher (the need to integrate an immersive experience in an overall teaching sequence rather than as isolated activities).

Vignette

Diane is a primary school teacher with interest in designing technology-enhanced learning environments for her students. In a workshop, she learned about the potential of VR technology. According to the lecturer, VR is now more easily available for schools too: for example, mobile VR based on cardboard glasses and using students' smartphones. However, after looking more deeply into VR technology and the effects studied when used in education, as well as the associated challenges, Diane realized that using VR is more complex than she thought. For example, in her primary school smartphones are not allowed, making it difficult to use the mobile VR approach. Furthermore, during her search for suitable educational VR materials, she came to realize that there are simply no real learning materials available yet that align with the curriculum. The solution usually recommended is to create your own VR content. However, she lacked the skills for this, and neither the school nor the school authorities provide resources for content creation. All of this has left Diane frustrated. In her teacher training, the integration of VR in the classroom had sounded relatively easy and quick to implement. In practice, it didn't turn out that way. Diane decides to tell others about her experience. In doing so, she wants to present a holistic picture on the use of VR. This should then really help other teachers to create effective and engaging learning environments with VR.

Challenges Arising in Classroom Teaching: An Example from Elementary School

To illustrate the complexity of integrating immersive technology in contemporary classroom settings, we present an implementation realized in a German elementary school. In this case study, Buchner and Aretz (2020) describe a mobile immersive VR instructional design based on four critical components. First, an analysis of the circumstances is required. Does the school allow the use of smartphones? Is there a steady WiFi connection? What are the teachers' and parents' attitudes towards using immersive media for learning? Second, the teachers are encouraged to name the learning objectives and to check how these fit the choice of an immersive technology. Third, suitable instructional methods supporting learning with immersive technologies should be specified. Fourth, with a focus on the technology, decisions must be made about what immersive media is appropriate to address the learning objectives or whether there is a need to create new materials.

Considering these components and asking the above questions lead to instructional decisions that guide the development of the instructional design. It is necessary to talk with parents, teachers, school management, and students. As in Buchner and Aretz (2020), mobile VR smartphones and cardboard VR glasses are needed to display the virtual content. In German elementary schools, bringing smartphones to class is not allowed, or these young students do not have a device. Consequently, the parents must be involved, allowing their children to use smartphones. The school management must also be involved, agreeing to the use of smartphones in class for the VR experience. In Buchner and Aretz's (2020) study, other teachers were also involved in the design process. They stated that VR should not be used to separate the students from each other, which directly influenced decisions regarding the instructional method.

The learning objective was to explore the life and habits of past cultures and compare those to our modern way of life. For the instructional method, we considered the concerns mentioned by the other teachers as well as curricular recommendations. For example, in the curriculum for primary education in Germany, teachers are encouraged to design learning environments that engage learners in physical and cognitive collaborative learning activities. In terms of available educational VR applications, it was not possible to find an existing one that covers the described

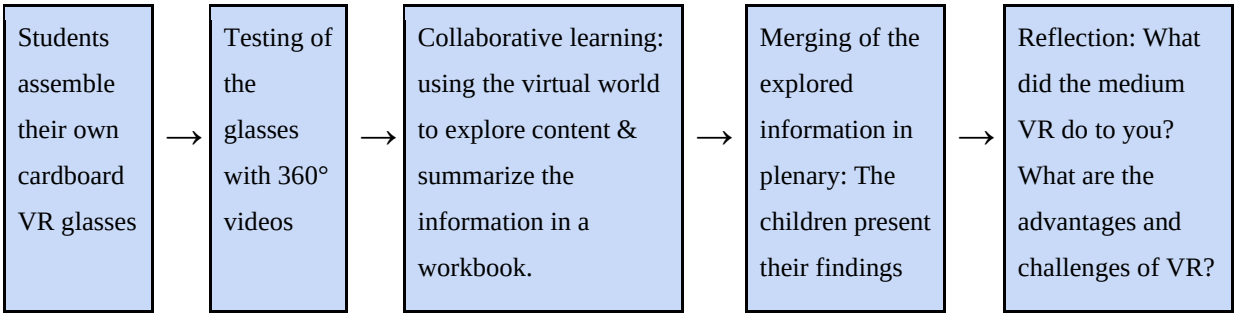
content. Therefore, Buchner and Aretz (2020) designed their own virtual environment, including 360° pictures with hotspots as shown by students exploring in Figure 1. Considering all these concerns and recommendations led to the instructional design shown in Figure 2 that was carried out in one morning (4 hours) with one class and three teachers.

Figure 1

Two Learners Explore Content with Cardboard VR Glasses and a Workbook

Figure 2

Instructional Design of Using Mobile VR in the Classroom



Implementing VR into a classroom is challenging and needs careful planning and consideration. The results of controlled pilot studies are essential to learn more about what works with VR. As well, to provide practitioners with helpful strategies for implementing VR into the everyday classroom, a more holistic view is needed.

Frameworks and Models for Immersive Education

Endeavours to explore and to explain how people learn in immersive environments have led to the development of various theoretical models. To gather relevant factors influencing immersive education, this section provides a rough overview of existing approaches to structuring predictors, correlates, and outcomes in teaching and learning settings with immersive technologies. One of the most influential theoretical ideas for explaining learning in and with virtual experiences is Dalgarno and Lee's (2010) elaborated model of learning in 3-D virtual learning environments. While the model itself refers to three-dimensional virtual environments in general, the authors note that these influences and relations might apply to highly immersive technologies such as head-mounted-displays, CAVEs, or spherical displays. Dalgarno and Lee (2010) propose representational fidelity, immediacy of control, and presence to describe the relation between immersion and learning. The individual perception comprises the sense of presence (the feeling of *being there*), together with co-presence (*being there together*) and the construction of identity, which is similar to Biocca's (1998) understanding of self-presence. These individual perceptions result from the medium's representational fidelity and the learner interaction. Dalgarno and Lee (2010) present a straightforward conclusion: "[I]t is essentially the fidelity of the representation along with the types of interactivity that are available within the environment that will lead to a high degree of immersion and consequently a strong sense of presence" (p. 12). The different forms of presence will, in turn, lead to greater transfer. Through the afforded learning tasks, three-dimensional virtual environments can benefit learning in five ways: spatial knowledge representation, experiential learning, engagement, contextual learning, and collaborative learning (Dalgarno & Lee, 2010).

This explanation of learning in virtual environments was criticized by Fowler (2015) since higher levels of representational fidelity and interaction might not inevitably lead to better learning. Taking a more pedagogical perspective, Fowler presents three fundamental stages: 1)

conceptualization (explaining/describing the context), 2) construction (interacting with the concept), and 3) dialogue (interacting/discussing within a social context). By connecting these stages with the technological, psychological, and pedagogical affordances of virtual learning environments, Fowler (2015) introduces empathy as being able to identify and empathize with concepts; reification, the ability to make the concept more concrete; and identification, the ability to engage in thoughtful and structured arguments and discussions about the concepts.

Quintana and Fernández (2015) present a pedagogical model for creating spaces where pre-service teachers can simulate teaching practices. The model focuses on the construction of scenarios that can help build meaningful learning experiences in VR. Integrating innovative methods in the teaching-learning process supports students in incorporating immersive experiences as teaching resources. According to Quintana and Fernández, future teachers should consider three categories for teaching and learning with immersive media: the scenario, the tools, and the interaction. The scenario comprises the intended learning objectives (depending on class type and setting), the area within VR, the students and their characteristics, the available time for learning activities related to the learning objectives, and the task type. Tools comprise sources or instruments needed for providing a virtual experience in the classroom in the first place, such as tutorials or hardware. The interaction gathers all factors that relate to the exchange of information with other agents (e.g., teachers).

Dengel and Mägdefrau (2018) define immersive learning as learning activities in a media-enriched environment connected to a sense of presence. Their Educational Framework for Immersive Learning (EFiL) localizes the sense of presence as an important predictor of learning outcomes. The framework describes learning in and with immersive experiences as a complex relationship that happens as an interplay of objective and subjective factors. The EFiL proposes objective factors as educational *supply* and subjective factors as the active *use*. The immersive medium, including its technological, didactical/content, and context characteristics, is an objective factor that can be controlled by the teacher. To influence internal factors, such as the individual's motivational, emotional, perceptual, and cognitive states and traits, the immersive medium must be used actively by the learner. Further, the learner's context (e.g., culture, class, peer group, family) influences this relationship between supply and use (Dengel & Mägdefrau,

2018). A recent study connected to the EFiL showed that presence, prior knowledge, and school performance are predictors of learning outcomes in virtual environments (Dengel & Mägdefrau, 2020).

Spiliotopoulos et al. (2019) proposed a framework focusing on game-based learning and the creation of dynamic and interactive virtual tasks, changing the role of the learner from passive observer to active participant. Instructional content blends with game characteristics, leading to a game cycle of judgement, behaviour, and feedback (which leads to judgement again). This cycle of decision, action, and results leads to learning outcomes.

Southgate et al. (2019) give recommendations on the use of VR within educational settings. They name ethical (e.g., touching students) and safety aspects (e.g., barrier-free spaces) concerning the behaviour of teachers and that of and learners when using VR, and organizational difficulties regarding time and space. As well, Southgate et al. (2019) refer to socioeconomic differences among schools. These differences are also evident in the technological equipment. Moreover, the authors claim the need for a carefully designed balance between attending to learning goals and providing fun through immersive technologies.

Popescu et al. (2011) provide a four-dimensional framework synthesizing such factors as mode of representation (e.g., levels of fidelity, immersion, interactivity), context (e.g., learning situation, equipment, technical support), pedagogical considerations (e.g., learning approaches), and learner-specification (e.g., learner profile). The factors of the framework encompass aspects essential for game design, evaluation, and effective adoption in educational processes. The specification of the teaching and learning processes involves investigating the characteristics of the learner population to meet their requirements and optimize outcomes.

Based on Mayer's (2014) Cognitive Theory of Multimedia Learning (CTML), Mulders et al. (2020) propose a meaningful iVR learning (M-iVR-L) framework. Six recommendations for designing iVR learning environments are postulated: 1) reducing extraneous processing by avoiding unnecessary immersion if it is not relevant to achieve the learning objective, 2) providing learning-relevant interactions inside VR (e.g., object manipulation with virtual

representations) but avoiding learning-irrelevant nice-to-have interactions, 3) breaking down complex tasks into smaller segments and providing scaffolds to manage essential processing to avoid cognitive overload, 4) providing guidance by highlighting essential material or using pedagogical agents, 5) building on learners' previous experiences and, if necessary, provide pretraining to free working memory capacities for the essential processing within the iVR learning task, and 6) providing constructive learning activities (e.g., summarizing, memory palaces) to apply the knowledge obtained to problem-based tasks inside and outside of iVR.

With their Cognitive Affective Model of Immersive Learning (CAMIL), Makransky and Petersen (2021) combine the technological (e.g., immersion, representation fidelity) and the interrelated psychological (e.g., presence, agency) factors of VR. These psychological factors influence six learning-relevant factors: 1) interest arising from contextual conditions, 2) intrinsic motivation, 3) self-efficacy, 4) embodiment (e.g., presence as the feeling of being in VR and controlling a body), 5) cognitive load, and 6) self-regulation. Therefore, CAMIL offers relevant design criteria for VR application developers and instructional designers.

Emihovich et al. (2021) developed the S.P.E.C.I.A.L. framework. The acronym stands for the following five concepts: situated learning, play, embodied interactive learning, connectivism and social learning, and immersive assessments for learning. For each concept, Emihovich and colleagues offer design, implementation, and evaluation considerations. For example, to support embodied interactive learning, the authors suggest creating embodied interactions that are meaningful and congruent to the learning content. They recommend avoiding embodied interactions that lead to additional cognitive load. The framework synthesizes pedagogical theories, strategies of cognitive development, and innovative assessments that are relevant to immersive learning.

De Freitas et al. (2010) introduce four dimensions regarding the development and evaluation of immersive learning experiences: 1) learner specifics, 2) pedagogy, 3) representation, and 4) context. Learner specifics address the necessary matching of learner characteristics and learning activities with learning objectives. Pedagogy refers to learning theory models, such as whether task-oriented or situated immersive learning opportunities are created. The representation

dimension indicates the levels of fidelity (e.g., enabled interactions) and their interplay with immersion and learning. Finally, the context dimension is outlined as an essential factor affecting immersive learning, such as the differences between formal and informal educational contexts.

As the analysis of the theoretical models and frameworks presented in this section shows, there are multiple perspectives on immersive education that are all equally valid. While some of the frameworks take a rather broad view with general, external factors, other models are more concerned with internal, individual learning processes. In the next section, we present a way of distinguishing such approaches into two perspectives.

Defining Immersive Learning and Immersive Teaching

Distinguishing immersive learning and immersive teaching as two different perspectives on immersive education allows the carefully planned use and evaluation of VR and AR in the classroom. We distinguish immersive learning as individual learning processes supported by immersive media (the internal, person-specific side of an educational activity) and immersive teaching as the process of teaching with immersive technology (the external, objective side of education). While immersive teaching describes objective factors together with the learning objectives that can be influenced by teachers and institutions, immersive learning focuses on the subjective, internal processes of the learner as well as the actual learning outcomes. The frameworks and models reported in this chapter offer valuable insights into different factors that are influences and challenges for teaching and learning (summarized in Table 1).

Table 1

Influences and Challenges of Immersive Teaching and Immersive Learning (Dengel et al., 2021)

	Teaching	**Learning**
Influences	● curricula ● technological equipment ● ethical and safety aspects ● temporal and spatial conditions ● interplay between defined learning objectives, learning activities, and learner characteristics	● physical, social, and self-presence ● representational fidelity and interactivity ● cognitive load and processing ● motivation and interest ● emotional states ● individual contextual circumstances

		• ethical and safety aspects
Challenges	• unequal learning opportunities due to differing perceptions of immersive experiences • prevalence and use of learning strategies inside/outside of VLEs • meaningful learning requires integration in the overall teaching sequence • assessment methods	• user acceptance of game-based approaches is needed before learning can happen • extraneous processing through overwhelming multi-sensory presentation • varying previous knowledge regarding the learning objectives and use of the medium • novelty effect

On the immersive teaching side, some factors influencing the beneficial use of immersive media in the classroom can be controlled by the teacher, while others rely on external conditions. The curriculum is a factor of where (for which contents) and when (in terms of the lesson-plan) immersive media can be used (Quintana & Fernández, 2015; Southgate et al., 2019). Most of the time, this is controlled by governmental institutions. The external conditions can be rather restrictive or can give the teacher enough freedom to use various media and methods. The available technological equipment in the classroom or schools in general is one of the most important factors when considering the use of innovative educational media, especially VR and AR (Quintana & Fernández, 2015; Popescu et al., 2011; Southgate et al., 2019). Depending on the school's financial resources, teachers might have a say in what technology will be acquired. It is important to note that this decision process should be driven by considerations about not only costs, but also about the spectrum of application for different classes, age groups, methods, and topics/learning objectives. In light of the COVID-19 pandemic, an interesting aspect might also be how these media could support potential e-learning or blended learning settings. Ethical and safety aspects are also crucial influences (Southgate et al., 2019). Whenever privacy or health concerns (or local/national privacy policies) arise, such considerations come into play. Temporal and spatial conditions as decisive variables (Quintana & Fernández, 2015; Southgate et al., 2019) refer to the school's resources in terms of available rooms, including storage for different media. In particular, head-mounted-displays with positional tracking need more space than a traditional classroom setting can provide, and time is required to plan and carry out immersive experiences. While the interplay among the defined learning objectives, learning activities, and learner characteristics (Dengel & Mägdefrau, 2018; de Freitas et al., 2010)

happens on the learner's side, it is the teacher's task to select fitting objectives, activities, and assessment methods inside and outside of the virtual experiences to constructively align the teaching and learning processes.

Challenges on the teaching side comprise unequal learning opportunities deriving from differing perceptions, the varying use (or lack) of learning strategies to employ during the learning experience/activity, the need for an efficient integration in an overall teaching sequence, and the integration of assessment methods inside and outside the virtual environments. Regarding the perception of the learning material, varying levels of presence might have an impact on how much the students learn, as presence can be seen as a predictor of learning outcomes (Dalgarno & Lee, 2010; Dengel & Mägdefrau, 2018; Fowler, 2015). The prevalence and active use of learning strategies can benefit the learning process with a given medium (Mulders et al., 2020). This could lead to a strong effect of accumulated advantage, where gifted students—in this case, students who can use efficient learning strategies—will benefit more from learning opportunities (Kempe et al., 2011). To create meaningful learning opportunities, integration in an overall teaching sequence is crucial (Fowler, 2015; Dengel & Mägdefrau, 2018; Mulders et al., 2020; Spiliotopoulos et al., 2019).

While many pilot projects observe the effects of educational immersive media as isolated experiences, integrating such media in the everyday classroom requires careful planning and connections to lessons before and after application of the medium. Considerations about the use of a medium in a particular phase of the learning process (e.g., task definition, fundamentals for solving the task, task solution) can be crucial to learning (Tulodzieckiet al., 2019). Another challenge refers to assessment methods related to the learning objectives and learning activities. Following the approach of constructive alignment, it is necessary to think about the extent to which assessment tasks "embody the target performances of understanding, and how well they lend themselves to evaluating individual student performances" (Biggs, 1996, p. 356). While immersive experiences can help align learning objectives with learning activities through experiential and situated learning (Dalgarno & Lee, 2010), assessment in virtual environments still poses a problem (Emihovich et al., 2021).

In terms of learning influences, various forms of the feeling of presence, technological characteristics, internal cognitive processes, learner traits and states, individual context variables, and ethical and safety aspects affect the learning activities and outcomes. Presence as the perception of non-mediation (Lombard & Ditton, 1997) occurs in the forms of physical presence, social presence, and self-presence (see Biocca, 1997). The theoretical frameworks of Dalgarno and Lee (2010), Fowler (2015), and Dengel and Mägdefrau (2018) emphasize the important role of these different types of presence in the learning process. A higher sense of presence might be connected to better learning outcomes. The importance of technological aspects, such as representational fidelity and interactivity, as influences of learning are mentioned in several models (e.g., Dalgarno & Lee, 2010; Quintana & Fernández, 2015). When taking a deeper look into learning as a subjective process, factors such as cognitive load and even the cognition process itself come into play. Such influences on learning are modeled especially in frameworks based on Mayer's cognitive theory of multimedia learning (Mayer, 2005), such as Mulders et al.'s (2020) M-iVR-L as well as Makransky and Peterson's (2021) CAMIL. Individual characteristics such as motivation and interest are factors closely connected to learning activities (Dengel & Mägdefrau, 2018; Makransky & Peterson, 2021; Spiliotopoulos et al., 2019;). Further, each student has different contextual circumstances regarding culture, religion, family, and peer groups. Together with the student's traits and states (e.g., emotions), these factors influence the learning process (Dengel & Mägdefrau, 2018). In addition, safety and privacy aspects as well as other ethical issues influence the students' experiences with immersive media in educational settings (Southgate et al., 2019).

Challenges on the learning side comprise user acceptance, the possibility of being overwhelmed by multi-sensory stimuli, varying degrees of previous knowledge, and a potential novelty effect. Especially for game-based approaches, a certain level of user acceptance is needed before inducing learning activities (Spiliotopoulos et al., 2019). When taking into account Mayer's (2005) theoretical approaches on internal processing, the dual-channel assumption, the limited capacity assumption, and the active processing assumption, the multi-sensory presentation of immersive media can lead to perceptions of being overwhelmed and to cognitive overload (Mulders et al., 2020). Further, varying previous knowledge regarding the learning objectives and using the technology can make it difficult to provide equal learning experiences for every

student (Mulders et al., 2020). Also, while an initial novelty effect can boost students' motivation and interest in using a new medium, it can distract learners from the learning objectives, and the effect can wear off quickly (Southgate et al., 2019).

Pedagogical Levels of Immersive Education

To take a holistic and a more realistic view on the influences and challenges of teaching and learning with immersive media, we assembled aspects of the different theoretical approaches in a comprehensive model. The following three pedagogical levels combine ideas and concepts from educational technology research with a special focus on immersive experiences (see Figure 3):

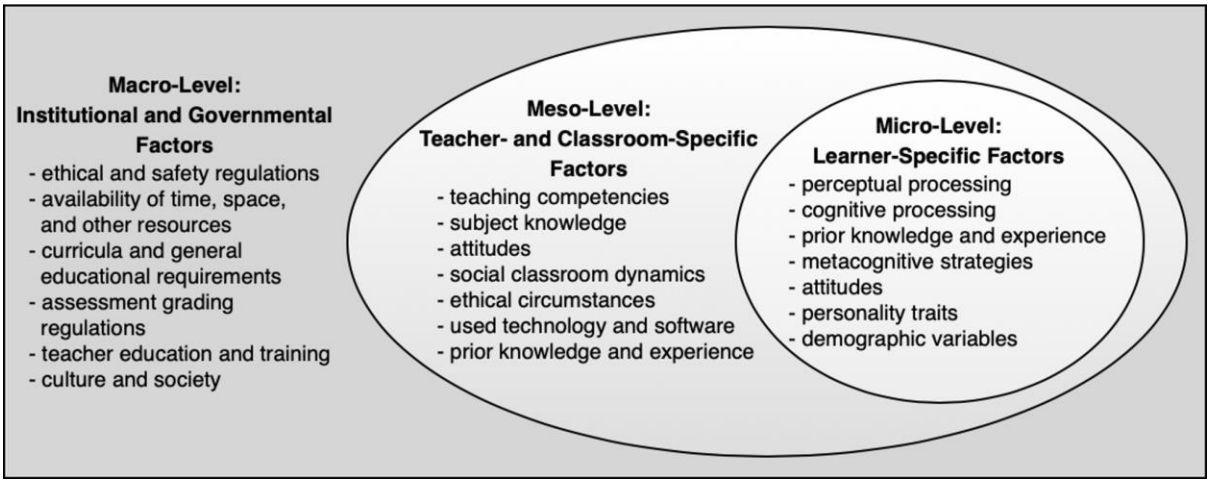
- **The Macro-Level:** Every pedagogical effort influenced by several institutional and governmental factors, including ethical and safety regulations; the availability of time, space, and other resources; curricular and general educational requirements; regulations for assessment and grading; characteristics of general and domain-specific teacher education and professional training; and cultural and social factors. One example is the issue of classroom space. A typical classroom is a small space with fixed tables and chairs. For VR experiences, space is also needed to allow learners to use their bodies and physical movements to explore content in the virtual simulation. One solution is to purchase flexible furniture with wheels so that space can be created quickly and easily. Such a task must be initiated and completed by those responsible at the macro-level.

- **The Meso-Level:** This level comprises teacher- and classroom-specific factors such as teaching competencies, technological, pedagogical, and content knowledge, attitudes, social classroom dynamics, ethical circumstances, and technology and software in use as well as prior knowledge and experience with digital media. At this level, teachers can act; for example, they can collaborate in a school development group focusing on VR learning scenarios. Developing the scenarios and designing the materials, as well as testing, evaluating, and reflecting on the implementation process can also be done as a group. Afterwards, the results of these teaching experiments are presented to other colleagues and extended to other subjects.

- **The Micro-Level:** This level addresses learner-specific factors directly related to the learning activities. These comprise perceptual processing (e.g., physical, social, and self-presence), cognitive processing, prior knowledge and experience (on the learner side), metacognitive strategies, attitudes, personality traits, and demographic variables. Teachers should have these aspects of learning in mind when designing VR scenarios. For example, as outlined in Parong and Mayer (2018), VR can be distracting, but in combination with generative learning activities (e.g., summarizing), this problem can be solved and learning with VR improved. As well, adding generative learning activities does not diminish motivational and affective factors when learning with immersive technologies (Buchner, 2021; Parong & Mayer, 2018).

Figure 3

Macro-, Meso-, and Micro-Levels of Immersive Teaching and Learning (Dengel et al., 2021)



Strategies for Implementation of Design

By separating these perspectives and levels, we can draw out pedagogical considerations for the educational design of immersive educational experiences.

- **Immersive constructive alignment.** More than any other technology, immersive media can support the alignment of learning objectives, hands-on learning activities, and performance assessment by letting students act in a close-to-reality simulation. This was suggested by

Biggs' idea of Constructive Alignment long before immersive technologies were foreseen as everyday educational media (see Biggs, 1996). Because immersive technology in everyday classrooms is still a novelty, ground-breaking guidelines for school management are required. Schools as well as governmental institutions should work closely together to publish guidance regarding costs, implementation in existing curricula, and safety concerns (e.g., minimum size for rooms). Ethical aspects, such as how to deal with learners who are not able to wear VR helmets, must be discussed on a governmental level.

- **Focus on the learner.** Separating objective from subjective teaching and learning processes clarifies that immersive media interact with many person-specific states and traits and, thus, affect students differently. Therefore, implementing immersive media into everyday classrooms needs to account for individual pre-experiences and attitudes towards the technology. In advance, the teacher can open a discussion in plenary or ask students individually in writing or verbally. Teachers may also provide incentives and distribute tutorials and further explanations while avoiding false expectations. Moreover, individual attitudes should be tracked continuously during the implementation process. For example, motivation can diminish as the novelty effect wears off or exhaustion increases: both effects are common for immersive media. Observing individual learning processes by using immersive technology is crucial to achieving learning objectives. To that end, assistant teachers may be needed to support learners simultaneously. Next to variable learner-specific factors, stable factors such as age and gender should be considered. For example, younger pupils may need more support to distinguish between reality and VR after using immersive technology.

- **Integration in the teaching sequence.** As with every other medium, VR and AR are educational technologies that must be used efficiently in the learning process. Immersive experiences need to be implemented in an overall teaching sequence carefully planned by the teacher. The teachers can be considered guides who connect all levels: they design and influence the meso-level of the classroom and the instructional medium—given the circumstances of the macro-level—to achieve the potential, activities, effects, and outcomes at the micro-level of the student. Inexperienced teachers may rely on best-practice solutions

from colleagues, but comprehensive train-the-trainer concepts are also needed. Therefore, collegial exchange, whether within a discipline (e.g., history) or interdisciplinary, should be established to convey technical skills and share materials.

Conclusion

Integrating immersive media in everyday classrooms requires more than a theoretical exploration of influencing factors. The practical integration of educational technology strongly relies on teachers' self-efficacy and attitudes towards the use and usefulness of media in the classroom. Therefore, future teacher education programs need an open-minded and explorative approach for preservice teachers to try out and experiment with various immersive technologies as part of their courses or practical studies.

We have synthesized existing approaches for learning and teaching with immersive media, including their beneficial and challenging aspects. As our approach was based on theoretical assumptions rather than empirical studies, this assembling of existing frameworks can be considered an overview of the theoretical perspectives on the affordances and constraints of immersive teaching and learning. We created a comprehensive model with three different pedagogical perspectives (micro-, meso- and macro-levels): a holistic approach to immersive learning that comprises institutional and governmental factors, classroom dynamics, and the internal, subjective processes of the individual learner. As such, this model can be used to predict and explain learning in and with immersive experiences. Future studies might investigate specific paths within or between the levels. In doing so, the framework can be used for generating hypotheses to predict certain interactions among factors, which can then be tested in field studies in the everyday classroom. Further research and systematic analyses of published pedagogical frameworks concerning learning and teaching with immersive technology are needed to gather evidence for a desirable yet futuristic goal: integrating immersive educational experiences in the everyday classroom.

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