DIGITAL LITERACY

DIGITAL LITERACY USING METAVERSE: ESSENTIAL SKILLS FOR THE FUTURE

CHAPTER 2

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Digital literacy using metaverse: Essential skills for the future

Content

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1. Introduction

As digital technologies rapidly evolve, STEM education faces both unprecedented challenges and opportunities. Today's STEM teachers are expected not only to master subject-specific content but also to navigate a digital landscape that includes virtual environments, interactive simulations, and online collaborative tools. The incorporation of metaverse—a vast network of 3D virtual spaces where users can interact with a computer-generated environment and other users in real-time—further pushes the boundaries of traditional teaching, demanding new skills and strategies from educators. As metaverse is in an ongoing development, the importance of digital literacy becomes increasingly apparent. Navigating virtual environments requires a unique set of skills that go beyond traditional digital literacy. Frazier (2022) “Digital literacy is critical in picking through this mass of information and finding useful information that meets our needs. It's about finding the best matches out of all the possibilities that are out there on the internet.”

1.1. Definition of STEM careers

Digital literacy is a critical competency for STEM educators, equipping them to meet the demands of this ever-expanding digital ecosystem. At its core, digital literacy for STEM educators is about more than technical know-how; it involves a foundational understanding of how to integrate technology meaningfully to enhance learning and create engaging, student-centred experiences. Educators must be able to evaluate and utilize digital tools and resources in ways that complement the curriculum, foster critical thinking, and support students in applying theoretical knowledge to real-world problems.

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1.2. Importance of STEM in today's society

In this chapter, the aim is to outline the essential digital literacy skills for STEM educators and provide a practical roadmap to navigate the digital environments integral to modern STEM teaching.

- Comprehensive guidelines for leveraging digital resources and tools,
- Technical proficiency for overcoming challenges in virtual and digital teaching spaces,
- Collaborative skills to work effectively with others using digital tools for virtual or hybrid environments
- Critical thinking and problem-solving to analyze information and apply logical reasoning to solve complex problems and
- Ethical awareness and digital citizenship - this will be presented in full in chapter 7 but it is important to include it already in this context.

The chapter will empower STEM educators to effectively bridge the gap between conventional classroom teaching and the immersive, technology-driven possibilities within the metaverse and other digital platforms. By doing so, the classroom can be transformed or the STEM educators can transform their classrooms into spaces that not only deliver content but also cultivate digital fluency, collaboration, and problem-solving skills in their students. The materials presented here are crafted with the unique needs of STEM teachers in mind, enabling them to enhance their digital competence while embracing the creativity, engagement, and real-world applicability that metaverse can bring to STEM education.

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2. General context of digital literacy

Digital literacy encompasses the ability to effectively use technology to communicate, access information, and create content. In the metaverse, this includes understanding how to interact within virtual spaces, manage digital identities, and engage with immersive technologies.

Digital literacy in the context of STEM education encompasses a blend of technical, cognitive, and critical skills that empower educators to effectively incorporate technology into their teaching. It's about equipping educators with the knowledge and confidence to not only use digital tools but to apply them in ways that deepen students' understanding of STEM concepts and foster interactive, student-centered learning. This section will break down the core elements of digital literacy essentials for STEM educators, particularly as they navigate innovative digital platforms in the metaverse. The following, chosen skills are described in Damaševi˘cius, R & Sidekerskiene, T (2024) but also in Fonseca, J.& Borges-Tiago, T. (2024).

2.1. Evolution and relevance of information literacy

- Definition: Information literacy encompasses the ability to locate, evaluate, and use information not only effectively but also ethically.
- Relevance in STEM: STEM educators need to guide students in distinguishing reliable sources from misinformation, especially when researching scientific data, new technologies, or problem-solving methodologies. For example, when students are exploring climate change simulations in a virtual world, educators should help them assess the accuracy of data presented and question the sources and methods behind the simulation. This is especially important when it comes to teaching situations with younger students as the experience of virtual worlds can merge with the real world and the student cannot automatically distinguish between the two. This is something you as educator needs to be aware of and take into account while planning your lessons.
- Practical application: Educators can model critical analysis by questioning the credibility of information sources used in digital and virtual environments. Encouraging students to use reliable academic databases or verified educational websites can foster a critical mindset toward information consumption. This will give the students skills to use both within virtual worlds as well while working in other, totally different settings.

2.2. Technical proficiency

- Definition: Technical proficiency refers to the skills necessary to use digital devices, software, and online platforms confidently. It is wrongly assumed that this is something that students of today just know about but they need our guidance to expand on their knowledge within this area to learn how to use tools like these to enhance their own learning.
- Relevance in STEM: In STEM classrooms, technical proficiency is foundational. Educators need to know how to operate basic digital tools, such as coding platforms (like Scratch and Python), data visualization software, and virtual simulation programs. They also need to understand more advanced technologies if they're incorporating metaverse, which requires familiarity with virtual worlds, VR or AR devices, and also 3D modelling. All these described tools will give a deeper understanding of the metaverse, how it is built and created but also how it works. By doing so you can invite the students to co-create lesson plans but also the actual virtual worlds you are going to work in. In this way, you create a life long learning for the students.
- Practical application: STEM educators can start with user-friendly metaverse platforms like CoSpaces or the platform being offered in this particular project, then a 3D-modeling tool like Google Sketch Up or Tinkercad, gradually moving to more complex tools as both the educators and the students confidence is growing. Training on these platforms helps ensure that technology becomes a seamless extension of the learning experience, rather than a distraction. It is really important that these occasions does not become happenings that gives the impression of doing them for the fun of it, without a deeper context but instead is implemented in the regular teaching and that it is mixed with analogue activities as well as digital ones. It is the professionalism of the educator to know what is needed to enhance the learning of the student.

2.3. Collaborative skills

- Definition: Being able to collaborate with others is truly important both in the real world as well as in digital worlds. Collaborative skills in digital literacy involve the ability to work effectively with others using digital tools, adapting communication methods for virtual or hybrid environments. Students need guidance in how to combine tools and to learn how and what tools are the most efficient ones and being able to choose for themselves.
- , learning to divide tasks and collaborate remotely.

- Relevance in STEM: In order to work efficiently both in school but also when the students will get employed, being able to collaborate is a skill the students need to master. Collaboration is crucial in STEM, where teamwork mirrors real-world scientific research and technological development. In virtual spaces, such as metaverse, educators need to facilitate interactions that build teamwork skills. The students need to practice this skill in many different environments and surroundings. Educators should guide students in using digital communication platforms such as Microsoft Teams/Google Workspace and other collaborative tools that allow shared access and editing of content together.
- Practical application: STEM educators can organize collaborative projects where students must communicate and solve problems together in real-time within metaverse. The more used the students are to this way of working in the classroom the easier it is in virtual spaces. This could involve a virtual group project in for example Minecraft: Education Edition or in a tool like Frame, Co-Spaces, the tool that is available on the project website or similar where students jointly construct and analyze simulations.

2.4. Critical thinking and problem-solving

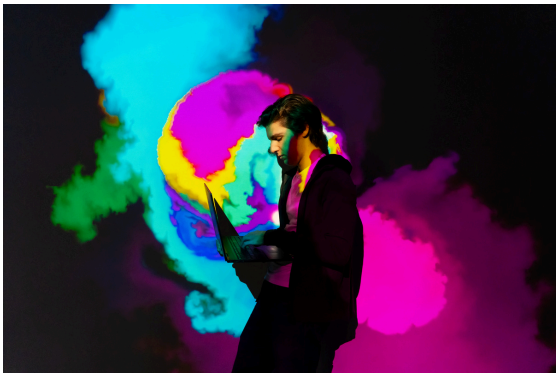
- Definition: These skills are referred to as really important to prepare students and help them build up the knowledge and skills needed to be active world citizens. To define these skills refer to the ability to analyze information critically and apply logical reasoning to solve complex problems. This should start already when the students are very young because it takes time to build up but it is also important to involve them early in education.
- Relevance in STEM: Digital literacy in STEM isn't just about knowing how to use tools; it's also about knowing when and why to use them. Educators must help students approach virtual environments with a problem-solving mindset, using critical thinking to analyze scenarios, make decisions, and evaluate outcomes. This is a double aspect because it is about using problem-solving to actually find a solution to a challenge that is identified but it is also about the students using problem-solving to decide what tools best can both help them solve the challenge but also present the solution in the best possible way.
- Practical application: Educators can use digital simulations to introduce STEM challenges that require critical thinking. For example, a physics educator could create a virtual lab in the metaverse where students experiment with forces and motion. Educators should encourage students to hypothesize, test, and revise their ideas based on the simulated outcomes. In this context metaverse creates a unique environment where the students can simulate situations that would never be possible otherwise and they also get immediate feedback when they experiment so that they can easily adapt, change and try again. This way of getting immediate feedback they will be recognised from the gaming world and they will get motivated to keep on trying until succeeding.

2.5. Ethical awareness and digital citizenship

- Definition:Becoming an ethical, digital world citizen is something that the students need to be aware of early on in education. Ethical awareness in digital literacy involves understanding the ethical implications of technology use, including respecting intellectual property, practicing privacy, and behaving responsibly in digital spaces. When the students have learned this, they are able to make decisions that benefits many citizens, they can make an impact and influence others in a positive way.
- Relevance in STEM: Ethical issues in STEM often intersect with digital citizenship, such as understanding data privacy in research or ensuring respect for others' work. In the metaverse, where interactions are highly immersive, educators need to teach/guide students in maintaining respectful conduct and understanding the ethical aspects of their digital actions. They will experience how important it is to listen to others, to discuss and solve problems together with others and that when you do so the result will improve and evolve.
- Practical application: It is of the essence that educators always include ethical awareness and digital citizenship while working with all different subjects. This should never be a stand-alone subject or planning but always part of a context. STEM educators can foster ethical awareness by discussing real-world scenarios that may arise in digital spaces, such as the importance of attributing sources in research or the ethical considerations of virtual experimentation. Integrating modules on digital ethics or setting ground rules for virtual interactions promotes a respectful and conscientious use of digital tools especially while integrated into other subjects.

2.6 Conclusion

These key components of digital literacy combined will enhance the understanding of digital literacy for the students, and STEM educators can become more effective facilitators of technology-rich learning environments. It is important to note that the skills mentioned above need to be combined and be integrated into other subjects in order to have the biggest impact. The goal is to move beyond simply using digital tools and instead leverage them to build deeper, more interactive learning experiences for the students so that they can learn their content in a bigger context. A digitally literate educator not only equips students with technical skills but also empowers them to think critically, collaborate effectively, and behave ethically in an increasingly digital world which is a necessary skill to have in order to become an active world citizen.



3 Key skills for digital literacy in the metaverse for STEM educators

Educators need to feel secure in digital literacy in order to be able to support their students in becoming secure as well. Students need the support of educators to navigate the digital world and learn how to identify tools that best work for them. Developing digital literacy in the metaverse goes beyond basic technical skills; it involves a comprehensive understanding of how to leverage virtual environments to enhance STEM learning. Here are the key digital literacy skills that STEM educators need to have to effectively implement metaverse technologies in the classroom:

3.1. Spatial awareness and virtual navigation literacy

- Skill definition: If the educator feels lost and does not know the basics the students will start to wander within the metaverse instead of enhancing the learning. This is the foundational ability to orient oneself and navigate within a 3D digital environment, essential for teachers guiding students through complex virtual spaces.
- Relevance in metaverse: Educators need to move easily within these virtual spaces, perform tasks, and demonstrate navigation skills to students. Understanding spatial design in virtual worlds—like locating “zones” or interactive areas—enables teachers to foster an intuitive learning flow for students. When knowing this they will build in a flow that will motivate the students and encourage them to want to learn more.
- Application in STEM: Educators could, for instance, guide students through a virtual molecular model, showing them how to move around and interact with the elements in 3D space. This promotes a hands-on approach to otherwise abstract STEM concepts. This will give the students an experience that will give them a deeper understanding and therefore also will motivate them to ask more questions. Why not invite a doctor to your metaverse and have him/her explain even more and deeper?

3.2. Digital content literacy for virtual worlds/the metaverse

- Skill Definition: As an educator you need to know how to combine different tools in order to give students meaning and enhance their learning. By using a real context for learning the students will have a better chance of seeing how it is all connected. This includes the ability to recognize, create, and organize digital content within the metaverse, using 3D models, simulations, and other digital assets.
- Relevance in metaverse: Educators must be digitally literate in choosing, modifying, and/or creating educational content for their virtual lessons. Understanding the types of assets that are compatible with metaverse such as 3D models or simulations and how to source or create them is crucial for engaging learning. When the educator knows how to do this it is recommended to invite the students to also create content for others and by doing so also learn more themselves.
- Application in STEM: Educators can integrate pre-existing digital resources—like interactive anatomy models in a biology lesson or physics simulations—and add tailored content to build immersive experiences that align with specific STEM objectives.

3.3. Digital communication and collaboration literacy

- Skill Definition: This skill involves using virtual communication tools effectively within the metaverse to manage a class, encourage collaboration, and communicate instructions. Preferably several educators can work together to help each other out and to learn from each other but also use each other's created virtual worlds.
- Relevance in metaverse: In virtual settings, educators must adapt their communication methods, using avatars, chat functions, or voice tools to manage interactions and encourage collaborative problem-solving among students. When the educator knows this skill they can also not only guide their students but also assess their work in an even more efficient way since they have a thorough understanding.
- Application in STEM: For group projects, educators can assign tasks and facilitate student discussions in real-time within the metaverse. Students might work in teams to complete a digital chemistry experiment, with teachers using communication tools to provide feedback, answer questions and assess their work.

3.4. Critical thinking and digital decision-making

- Skill definition: This skill enables educators to evaluate and make strategic decisions about which Metaverse tools, simulations, or resources best support learning objectives. Often this is what makes educators stressful because they have not been given the opportunity to learn this skill. It gives confidence and efficiency.
- Relevance in metaverse: Educators must critically assess the value of digital tools and virtual environments to avoid “tech for tech’s sake,” focusing instead on selecting applications that genuinely enhance STEM comprehension. When an educator master this skill they also feel confident in knowing when and where to use digital and/or analogue methods and tools.
- Application in STEM: In choosing a simulation for an environmental science lesson, educators should assess whether it provides accurate data and real-world relevance, fostering students’ abilities to think critically about environmental issues and solutions.

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3.5. Ethical and responsible use of digital spaces

- Skill definition: Without mastering this skill as an educator it is easy to fall into the trap of restricting your students too much because we feel insecure and it is better “to be safe than sorry”. This encompasses digital ethics, privacy awareness, and responsible use of digital resources within the Metaverse.
- Relevance in metaverse: Educators need to set standards for responsible digital behavior, such as respecting intellectual property, protecting personal information, and ensuring positive interactions in virtual spaces. In order for them to have the expected impact it is preferred to also include the students in the work to set these standards.
- Application in STEM: Educators can, together with their students, create guidelines for ethical behaviour. To set these standards the educators need to think a bit differently from the usual ethical standards in the class. Standards such as respecting virtual avatars and intellectual property rights on digital assets used for projects, helping students understand the impact of their actions in a digital setting should be included.

3.6. Adaptability and technical troubleshooting

- Skill definition: This is also a skill that will make educators feel more secure and be able to work more efficiently. Adaptability in digital literacy means knowing how to troubleshoot and quickly solve technical issues that might disrupt a lesson.
- Relevance in metaverse: Metaverse can present unique technical challenges. Educators must be prepared to troubleshoot, adapt, and guide students through glitches or unexpected issues to maintain learning continuity.
- Application in STEM: For example, if a virtual environment crashes during a physics experiment, a teacher needs to redirect the lesson, perhaps by moving to an alternate platform or continuing with a 2D simulation while addressing the technical problem. Preferably this skill is learned together with other educators who help each other out. Educators also need to involve their students in this work because it is both a skill they need to have but also a skill that they might develop easier than us educators. The benefits of working like this is partly to learn faster together and partly that the knowledge of troubleshooting is more widely spread and easy accessible.

3.7. Digital assessment and feedback skills

- Skill definition: This skill involves utilizing virtual tools and analytics within the metaverse to assess students' progress, engagement, and comprehension, and providing meaningful feedback based on digital interactions. This is a very important skill to have since the more we work with our students in the metaverse, the more adjustments are needed to assess them in these virtual worlds. Therefore it is necessary to know how.
- Relevance in metaverse: Effective assessment in a virtual environment requires educators to understand how to measure student participation and performance in a digital format, especially when physical cues are limited. This is relevant since metaverse opens up for a totally new way of learning since we can experience areas that is physically impossible otherwise.
- Application in STEM: An educator might use interactive checkpoints in a metaverse lab simulation to assess comprehension, or use built-in analytics tools to track student engagement. Feedback can then be given in real-time within the virtual space or through digital portfolios or a combination of them all, it is all up the educator to make this decision.

3.8. Conclusion key skills for educators

By developing these key digital literacy skills, STEM educators can navigate the metaverse with confidence and create engaging, ethical, and impactful learning experiences. These skills help educators leverage virtual environments as powerful teaching tools that enhance students' understanding of complex STEM concepts, digital literacy but also the subject in question itself.

This approach frames each skill as a component of digital literacy uniquely relevant to the metaverse, ensuring educators can apply these competencies effectively in their teaching.

4. Conclusion

Digital assessment and feedback skills were mentioned last but not least because this skill closes the loop of all skills mentioned here by allowing educators to measure student progress and provide targeted feedback based on virtual interactions. This ensures that students not only engage with metaverse content but also achieve meaningful learning outcomes and skill development.

Digital literacy is foundational for successful participation in the metaverse. As technology advances, fostering these skills will empower users to thrive in virtual environments and engage responsibly.

As STEM educators venture into the engaging world of the metaverse, developing a nuanced and agile set of digital literacy skills becomes essential. Metaverse presents extraordinary opportunities to transform traditional STEM education into an immersive, interactive experience that enhances students' understanding of complex scientific and mathematical concepts. However, realizing the full potential of this environment requires a robust digital literacy foundation tailored specifically to virtual learning spaces.

Collectively, the above-mentioned competencies create a comprehensive framework for navigating and leveraging the Metaverse to enhance STEM education. Metaverse is not merely a technological novelty, it is a transformative educational platform. By mastering these skills, educators can inspire curiosity, deepen understanding, and prepare students for a future where digital literacy and ethical engagement are paramount. In doing so, they not only foster academic success but also cultivate a generation of innovative, adaptable, and responsible thinkers ready to thrive in an interconnected world.

The skills required by educators and students in the Metaverse are deeply interwoven, forming a symbiotic relationship where one cannot thrive without the other. Educators must first start to develop their competencies to effectively guide their students, but as soon as they have the basic knowledge it is time to involve the students in this work too. These foundational skills enable educators to curate meaningful learning experiences, navigate challenges, and model best practices in virtual environments.

At the same time, the process of teaching these skills to students reinforces and refines the educators' own abilities. For instance, as educators introduce students to critical analysis and ethical digital citizenship, they gain deeper insights into the complexities of these concepts, tailoring their approaches to meet diverse student needs. Similarly, when students collaborate and problem-solve within metaverse, their progress challenges educators to remain adaptive, innovative, and receptive to new ideas.

This dynamic creates a continuous feedback loop, where educators and students build upon each other's growth. Without skilled educators to lay the groundwork and provide mentorship, students would struggle to navigate the demands of virtual learning. Conversely, without engaged and curious students, educators would lack the opportunity to apply and evolve their expertise in meaningful ways. Together, this co-dependence fosters a thriving educational ecosystem within the metaverse, where both educators and learners grow, adapt, and succeed in tandem.

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