

Digital Twins from The Perspective of Educational Technology

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Abstract: *Digital twin technology can play a vital role in the future of the educational environment – highlighting the potential benefits and challenges that can arise during the implementation of digital aids for the visually challenged. The technology has been used widely in the areas of manufacturing, health care, and urban design. However, the possibility of applying the same in an educational environment is a road less traveled. This article is an attempt to highlight the existing literature in relation to this subject. The reviews have been explored to see the vast impact it may have on areas like interactive or immersive learning, simulations, and customized learning pace. The successful integration of digital twin technology can add to quality education.*

Keywords: *Digital twin technology, education, educational technology, review.*

1. Introduction

Digital twins are the visual representations of physical objects and processes. They act as a bridge between the physical and digital environments to help allowing a real-world entity to be replicated, monitored, explored and controlled in a digital environment. Many industries like health care, manufacturing and transportation etc. have been started to adopt the models of digital twins. However, the application of digital twins is not a much-explored area in the educational context. The major features of digital twins can be listed as virtual representation, real-time monitor, simulations, predictions, remote control, and case applications. The features of digital twin technology can be considered as a powerful tool for enhancing efficiency, cost reduction, performance monitoring and leveraging capabilities of artificial intelligence. The idea of digital twin got introduced by Michael Grieves in 2002. The concept has its origin in the NASA's two identical space vehicle initiatives, where engineers can mirror the conditions of the space vehicle during the mission in the vehicle being present on the earth. They have argued that the idea of digital twin of the physical space associated with the virtual equivalent can penetrate through many problematic cases [1]. They door for possibilities are endless and its application in education will be of tremendous impact.

In education, the digital twin technology can be started from designing the course or curriculum and to the evaluative methods or techniques we employ in it. The post covid hybrid class rooms and the on-going dependence made digital technologies as better tool for educational processes.

Immersive learning refers to the application of teaching and learning approach that adopt immersive technologies to develop extremely engaging and interactive educational experience. The learning experience help the students to get engaged and connected to the

subject they are interested. Immersive learning often uses the techniques like virtual reality, augmented reality or mixed reality. This learning practice can make the students to have a real-world context and to experience the learning process. The digital twin technology helps to create the digital twin models of objects or environment they are trying to learn through advanced modelling or simulations. [2] has pointed out that deep learning-based computer vision algorithms, immersive analytics and simulation software, virtual reality modeling tools, and smart manufacturing techniques works closely with digital twin technology. Enhanced student engagement is an outcome of this learning process. It can be used to improve the learning outcome. There are many situations in which students may find difficulties to analyse or understand different subject either due to its complexity or subjective matters such as lack of interest, poor familiarity and non-availability of original models can some of the factors which may act as a hindrance to learning progress. Ministry of Human Resource Development (MHRD) has initiative for virtual lab is a crucial step towards introducing educational technology [3]. In such learning students are getting an opportunity to have layered visualizations of human body through guided teaching which in turn benefit them to have understanding about pathological scenarios.

In India, the education of children with visual impairment is another significant area where educational technology can be incorporated. Digital twin based haptic environments can help children with visual impairment to have tactile sensations and vibrations to feel physical objects, structures or environments. This will provide an enhanced learning experience for them and may facilitate the independent living. Camera based wearables are another example for the same [4]. In education, the most important stakeholders are students themselves. Simulation models will help facilitating the learning process and benefit the multi-sensory learning. Along with these digital twins can be used as a modified tool for evaluation as it can detail the cognitive understanding of students. Using digital twins for educational assessment and evaluation can take different forms as well. Assessments through gamified and virtual environments are good options in this regard. Gaming is a source of fun and entertainment. Learning become more enjoyable and interesting when it happens through gaming. The toughest part of learning is assessment itself because of the complexity associated with the stress and tension involved in it. Gamification if assessments make the process more creative and meaningful. Simulation process helps the content to be in a more accessible fashion [5].

In order to improve the education system UNESCO has developed education sector plans (ESPs) for countries to develop the Education Policy & Strategy Simulation Model. It is an excel based education simulation model helping the users to have a library of formulas [6]. The What-if-analysis tab makes the calculation works easy for the users.

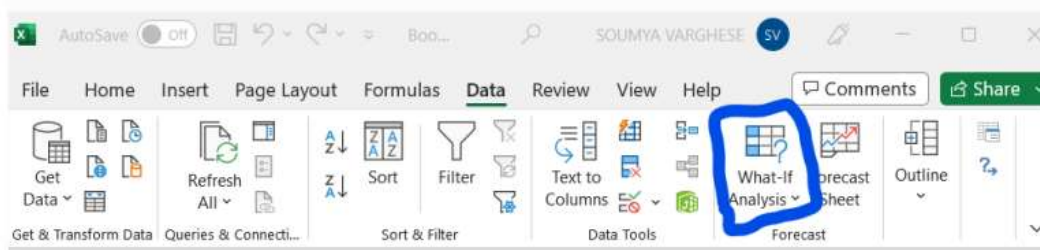


Figure 1. The What if Analysis on Excel

Simulation is frequently used for complex data systems and great help to learners who experience difficulties due to disabilities. For a person with dyscalculia, the interface act as

a best tool for doing the calculations by having theoretical understanding and step wise instructions about how-to-do it? Nutshell, simulation model of education helps to improve learning by confronting the barriers and nullify the effects of them.

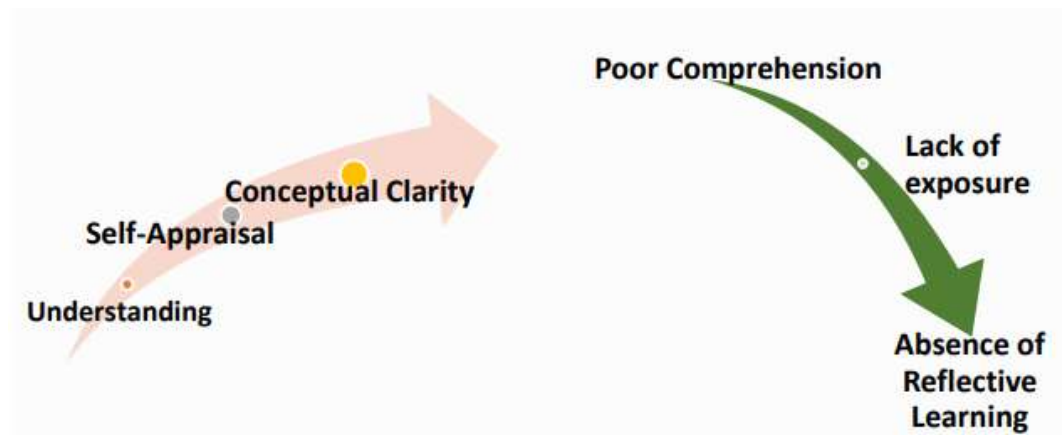


Figure 2. The theoretical model of simulation for education

Simulation helps to improve conceptual clarity by confronting the challenges like poor comprehension, lack of exposure and reflective learning. Simulations help learners to get involved in the learning process through reflective and experiential methods. These practices will help the students to develop the abilities to create and test their own understanding about the concepts. Learners can start by reading or understanding the concepts and by using skills like reflection, decision making, creativity or innovation to develop insights on the concepts of their interests. Digital twin technologies help them to have a deeper understanding by having the replica of the real models. Learners have the multi-sensory experiential learning and can overcome the barriers like poor comprehension, lack of exposure or negligence on reflective practices. It is highly welcoming to have digital twin adaptations in education as it can impart drastic changes. Understanding Self-Appraisal Conceptual Clarity Poor Comprehension Lack of exposure Absence of Reflective Learning

Digital twin can make the class rooms more inclusive through multi-sensory learning. It can overcome geo spatial boundaries and can nourish the learner to learn in a reflective and holistic manner.

Conclusion

The reviews speak volume about the acceptance of virtual reality platforms and gamification of learning. It can contribute to the development of manual capabilities and cognitive awareness. It accelerates the learning process. Experiential and experimental learning can also be accommodated with the help digital twins. Learners get an opportunity to manipulate or modify the digital representation of objects or situations they are dealing with. Hence it has the potential to transform the traditional narrative methodology to creative and meaningful experiential phenomenon. The digital twin technology can design or contribute to inclusive class rooms to produce better learning – teaching outcomes.

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