

Contextual Factors to Consider Whether AR Supports Children's Learning

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Abstract

This essay uses Shifu Orboot as an example, analyses the contextual factors that need to be considered when AR supports children's learning and uses Bronfenbrenner's ecosystem theory as a framework. The analysis is mainly from the perspective of the individual and microsystem in Bronfenbrenner's ecosystem theory. The conclusion reached is that AR technology is widely used in education as one of the tools to support children's learning, but it still faces several limitations and challenges.

Keywords

Shifu Orboot; Bronfenbrenner's Ecosystem Theory; AR.

1. Introduction

This essay uses Shifu Orboot as an example and Bronfenbrenner's ecosystem theory as the theoretical framework to analyse the contextual factors to consider whether AR supports children's learning. Shifu Orboot is an interactive globe incorporating AR functionality designed for children aged 4-10. It aims to help children learn about culture, geography and science interactively. Firstly, this essay briefly summarises the current state of AR in education and provides a brief overview of Bronfenbrenner's ecosystem theory. Secondly, based on the individual and microsystem of Bronfenbrenner's ecosystem theory, it critically analyses how these contextual factors influence children's use of Shifu Orboot for learning from the perspective of the child themselves, the family and the school, respectively.

2. The Current Development of AR in Education

According to Garzón (2021), the amount of research into augmented reality (AR) in education continues to grow, with more and more academics and education experts beginning to delve into the use of AR in education and explore its potential impact on student learning. Current applications of AR in education cover a wide range of subjects, such as history, chemistry and English (Fitria, 2023). As shown by Yuen et al. (2011), the use of AR in various fields and disciplines is directly or indirectly educational, and not only do AR books have great educational potential, but AR games are also helpful for children's learning. In addition, AR technology positively contributes to children's cognitive abilities, as well as learning gains and motivation, providing them with more prosperous and more diverse learning experiences (Garzón et al., 2019; Akçayır & Akçayır, 2017; Zambri et al., 2022). As a result, AR technologies are starting to be widely used in education and support children's learning. However, according to the research claims of Bower et al. (2014) and Yapici and Karakoyun (2021), there are also some limitations and challenges faced by AR in the field of education, which will be detailed in this essay when analysing how contextual factors affect children's use of AR to support learning.

3. A Brief Overview of Bronfenbrenner's Ecosystem Theory

Bronfenbrenner's ecosystem theory centres on the individual - a child and uses different one-way or two-way arrows to illustrate how the microsystem, mesosystem, exosystem, macrosystem and chronosystem are interconnected within and across systemic contexts, for example, from home to school or from kindergarten to the community (Darling, 2007). Of the five systems promoted in Bronfenbrenner's ecosystem theory, the microsystem is one in which the individual is directly involved and covers the child's unique learning environment (Leu, 2008). Furthermore, according to Härkönen (2007), Bronfenbrenner's ecosystem theory has been used repeatedly in early childhood education, proving the authority of this theory. Therefore, it is valid and appropriate to use Bronfenbrenner's ecosystem theory to analyse the role of contextual factors in influencing children's use of Shifu Orboot for learning, and this essay focuses on the individual and microsystem perspectives.

4. Contextual Factors to Consider Whether Shifu Orboot Supports Children's Learning

Firstly, the individual in Bronfenbrenner's ecosystem theory, the child himself, actively participates in the overall ecosystem. When considering whether AR can support children's learning, children's cognitive abilities play a crucial role in children's learning. As Radu and MacIntyre (2012) have shown, a child's level of cognitive development affects how easy it is for them to use AR, and more attention should be paid to children's physical and cognitive skills in the design of AR products. Such as the Shifu Orboot, an educational AR toy, uses a globe as its infrastructure, with patterns of different countries, cities and landmarks. Using an app on their phone or iPad, children can scan the globe to reveal 3D objects and shapes to explore the culture, famous landmarks, natural resources and science of different countries and regions, such as the Eiffel Tower in Paris (Hassinger-Das et al., 2020). Children with higher cognitive abilities are more likely to understand and grasp the functionality and usage of the Shifu Orboot learning system. However, because learning with AR requires children to handle multiple complex tasks, children can feel overwhelmed, leading to cognitive overload (Dunleavy & Mitchell, 2009). The complex setup and functionality of Shifu Orboot make it difficult and overwhelming for children with lower cognitive abilities to operate the system and learn the content, resulting in reduced interest and motivation to learn, thus affecting the effectiveness of the use of Shifu Orboot in facilitating children's learning. In addition, AR technology can provide the benefit of enhanced knowledge retention for students in educational settings (Radu, 2014). For children with higher cognitive abilities, Shifu Orboot provides interactive participation and game mechanics to engage children in learning through interactive quizzes and unlocking levels, so learning through Shifu Orboot can deepen the understanding and retention of knowledge more than learning from books. On the other hand, as shown in Garzón et al. (2019) study, AR is well suited to illustrate concepts that cannot be directly observed and can help children make the connection between the concrete and the abstract. For children with low cognitive abilities, Shifu Orboot can improve their cognitive skills by making what they learn and the information they get more realistic, helping them combine concrete physical shapes with abstract concepts. However, as the study by Huang et al. (2016) suggests, the limited prototypes of AR can lead to AR products not being sufficiently engaging for children to continue using them after a few uses. Children's cognitive development can also be limited if they rely solely on AR to provide knowledge in their learning (Bower et al., 2014). Due to Shifu Orboot's lack of flexibility and variety in customising the learning experience, children cannot adapt the content to their level of learning. Although Shifu Orboot covers a wide range of countries and cultures, the depth and detail of its content may be limited, which is insufficient for children with a strong interest in a

particular country or region. Therefore, children's cognitive abilities influence the role of AR in supporting children's learning.

Furthermore, children's development depends on the environment and the interaction between the individual, and the environment plays a decisive role in children's development (Leu, 2008). In Bronfenbrenner's ecosystem theory, the microsystem is the closest to the child and has a direct and close influence on the development of the individual (Msangi, 2012). More importantly, family factors profoundly affect children's learning more than other factors, such as social institutions (Niklas & Schneider, 2017). According to Cascales et al. (2013, p. 422), "family background, especially the influence from parents, has an impact on children's information and communication technology use in general, which in turn has an impact on education." Parental attitudes and support are crucial to children's use of AR for learning because parents' values and behaviours indirectly influence their children's learning development (Cascales et al., 2013). Therefore, families who provide a supportive learning environment are more likely to support their child's use of AR technology for learning. More specifically, parents who see AR technology as a tool to help their children progress and develop academically and encourage them to explore and learn about the culture of countries will be more likely to have their children use Shifu Orboot as a learning tool to help them explore cultures and geography around the world in a virtual world, and to motivate them to use it frequently and for long periods. However, some parents may maintain a negative attitude towards their children's use of AR learning; for example, they believe that learning through AR will gradually diminish their children's imagination (Cheng, 2017). As Shifu Orboot uses AR technology to display 3D objects and shapes to teach children about geography, culture and landmarks around the world, parents believe that this will lead to a gradual loss of imagination and creativity that comes from using traditional textbooks to read about them, thus limiting children's use of Shifu Orboot and reducing its usefulness and effectiveness in supporting their learning. Therefore, when considering whether AR can support children's learning, parental attitudes and support regarding children's learning with AR cannot be ignored.

On the other hand, it is essential to note that the microsystem is determined by the child's active participation in the environment, not by geographical location and that the family and the school class are included in the microsystem (Härkönen, 2007). In the school setting, for AR to support children's learning, AR technology must match the content and consider in the curriculum and instructional design (Dalim et al., 2017). When using Shifu Orboot for learning, consideration needs to be given to balancing the content of the curriculum with the functionality of Shifu Orboot, helping children to reinforce key learning concepts and ensuring that children use Shifu Orboot for relevant and meaningful learning activities. Shifu Orboot covers many areas, such as geography, history and culture. Using Shifu Orboot as a learning tool in literature, geography, or history lessons will support children's learning better than using Shifu Orboot in other subjects. However, according to Kerawalla et al. (2006), research claims that discussions using AR technology in the classroom are mainly teacher-led, resulting in a lack of student engagement with the educational content presented through AR. Children would be more active and dynamic in a traditional classroom than passively watching the presentation of AR animations in an AR classroom. As such, in terms of instructional design, providing children with more practice approaches and opportunities for interaction can help enhance AR technology's effectiveness in supporting children's learning. For example, due to Shifu Orboot set up with pass-through and scavenger hunts, consider a virtual scavenger hunt for children to gain knowledge as they search for countries, regions and cultures, and include tasks and interactive elements of questions so that children can consolidate and apply their knowledge in the game, increasing their engagement and interest and thus enhancing learning. Moreover, AR technology is inflexible in education (Kerawalla et al., 2006). In some AR systems, as in Shifu Orboot, learning content and knowledge are fixed, teachers are unable to change the content of

AR to fulfil teaching objectives or meet the needs of individual children (Wu et al., 2013), and teachers do not have sufficient technology and information to create AR materials (Lu & Liu, 2015), thus limiting children's use of AR to facilitate learning. On the other hand, according to Yapici and Karakoyun (2021), children using AR for learning in a school environment must face problems with their internet connection stability. A stable internet connection is essential for learning with Shifu Orboot. If a school's internet connection is not stable enough, it can lead to children interrupting lessons while using Shifu Orboot for learning, thus distracting their attention from their learning. Therefore, when considering whether AR can support children's learning, it is vital to consider not only the impact of curriculum and instructional design on children using AR to learn but also the challenges of teachers using AR as a teaching resource and the stability of the internet.

5. Conclusion

To sum up, AR technology is widely used in education as one of the tools to support children's learning, but it still faces several limitations and challenges. This essay uses Shifu Orboot as an example, analyses the contextual factors that need to be considered when AR supports children's learning and uses Bronfenbrenner's ecosystem theory as a framework. The analysis is mainly from the perspective of the individual and microsystem in Bronfenbrenner's ecosystem theory. More specifically, on an individual level, children's cognitive abilities play an essential role in the adaptation and effectiveness of AR technology, exploring the limitations and challenges of cognitive abilities to children's learning using AR. In addition, family and school environments are crucial in children's learning. This essay separately analyses the family and school environments in terms of the microsystem. The impact of parental attitudes and support on children's use of AR technology for learning in the family environment is discussed. Meanwhile, in the school setting, the role of curriculum and instructional design on children's use of AR technology for learning is considered on the one hand. On the other hand, the challenges of teachers using AR as a teaching resource and the necessity of a stable internet connection for AR use are explored. Therefore, in order to better use AR technology to support children's learning in the future in the education sector, designers need to consider and analyse various aspects to make the products more flexible and diverse to integrate AR technology into teaching better, thus achieving the goal of making AR better for children's learning.

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