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INDUSTRY 4.0: INTEGRATION OF INCLUSIVE EDUCATION AND DIGITAL TRANSFORMATION
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Abstract:
This article explores methods to enhance educational accessibility by integrating inclusive education and digital transformation. It underscores that merging these two concepts can broaden educational prospects for all students, with particular attention to those with special needs. Beginning with definitions of inclusive education and digital transformation, the article delves into fundamental theories supporting their integration. It also explores digital technologies and tools that enhance accessibility, with a specific focus on their role within inclusive education. Lastly, the article puts forth strategic approaches for integrating digital technologies within inclusive education frameworks.

Key terms: Industry 4.0, inclusive education, digitalization, digital transformation, digital tools, people with disabilities, special needs.

Introduction

The year 2011 was a significant milestone for Western industry. It marked a pivotal moment that would enable a deeper exploration of how technological advancements impact social structures. At the Hannover Fair, one of the world's largest industrial exhibitions, the term "Industry 4.0" was introduced for the first time.[1] This term was coined to describe the transformation of integrated industrial processes through technological evolution.

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[1] Vogel-Heuser, B., & Hess, D. (2016). Guest editorial Industry 4.0–prerequisites and visions. IEEE Transactions on automation Science and Engineering, 13(2), 411-413.

The advent of Industry 4.0 is characterized by innovations such as artificial intelligence, big data, the internet of things, and other digital technologies. This technological revolution significantly impacts education, transforming various aspects from teaching methodologies to student interactions. This transformation presents significant opportunities, particularly in advancing inclusive education practices.[2]

Inclusive education is an approach that strives to ensure the full and effective participation of every student in educational processes, embracing differences and accommodating special needs.[3] Today, digital technologies have the potential to enhance equal opportunities in education by facilitating the implementation of this approach.[4] Digital tools have become integral to inclusive education by offering personalized learning experiences and adapting to diverse learning requirements.[5]

This article thoroughly examines the impact of digital transformation on inclusive education and highlights the crucial role of technology in this context. Furthermore, it underscores the flexibility and extensive reach facilitated by digital tools and platforms, illustrating how inclusive education can transcend physical limitations.

Defining Inclusive Education and Digital Transformation: Concepts and Extent

The rapid evolution of contemporary society has led to a rise in individuals requiring specialized assistance across physical, psychological, and cultural dimensions. Statistics indicate a continuous increase in the number of children with special needs and exhibiting antisocial behaviour each year. Globally, one in every ten children has special needs, amounting to approximately 240 million children in total.[6] Furthermore, individuals with special needs constitute approximately 15% of the world's population.[7]

Education contributes to social and financial well-being, whereas vocational training facilitates the integration of individuals with special needs into society.[8] Inclusive education represents the initial stage of social integration and humanization, characterized by a deliberate qualitative transformation of the education system rather

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[2] Hamburg, I., & Lütgen, G. (2019). Digital divide, digital inclusion and inclusive education. Advances in Social Sciences Research Journal, 6(4).

[3] UNESCO. (1994): The UNESCO Salamanca Statement and Framework for Action on Special Needs Education. UNESCO, Paris.

[4] Ari, R., Altinay, Z., Altinay, F., Dagli, G., & Ari, E. (2022). Sustainable management and policies: the roles of stakeholders in the practice of inclusive education in digital transformation. Electronics, 11(4), 585.

[5] Burke, A., & Hughes, J. (2018). A shifting landscape: Using tablets to support learning in students with diverse abilities. Technology, Pedagogy and Education, 27(2), 183-198.

[6] UNICEF. (2021). Seen, Counted, Included: Using data to shed light on the well-being of children with disabilities.

[7] WHO. (2011). World report on disability.

[8] Marimuthu, S., & Cheong, L. S. (2015). Inclusive education for social transformation. Procedia-Social and Behavioral Sciences, 172, 317-322.

than the creation of a new educational form.[9] This approach embraces the unique differences and learning requirements of each student, striving to offer the necessary support for every student to fully benefit from the educational process.[10]

Inclusive education offers several advantages, such as fostering collaboration between general and special education teachers to address student needs effectively, providing essential support to enable students with special needs to learn in the least restrictive environment, and employing additional resources and support techniques that benefit all students.[11]

Digital transformation signifies the profound changes taking place in education systems due to the widespread adoption of information and communication technologies. This evolution involves restructuring learning, teaching, and administrative practices using digital tools. Digital transformation includes activities such as digitizing learning materials, utilizing virtual learning environments, integrating student information systems, and implementing data analytics applications for education management.[12]

The integration of inclusive education and digital transformation is underpinned by diverse theoretical frameworks. Universal Design for Learning (UDL), for instance, advocates principles aimed at enhancing learning experiences through multiple methods of representation, engagement, and expression.[13] Similarly, socio-cultural theory highlights how technology can reshape students' language and cognition, fostering collaboration and interaction among students.[14]

The integration of inclusive education and digital transformation holds promise for enhancing educational equity and enriching learning experiences for all students. This combined approach has the potential to enhance the overall effectiveness of education systems by more effectively addressing individual student needs.

The Impact of Digital Tools on Inclusive Education

The integration of digital tools in inclusive education enhances learning materials and improves students' access to course content. Technologies like online resources, video platforms, and collaboration tools offer content in diverse formats, enabling customization to align with individual learning styles and paces.[15] This

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[9] Asatovna, N. D. (2021). Issues of Involving Children with Hearing in Inclusive Education. European Journal of Agricultural and Rural Education, 2(12), 149-151.
[10] UNESCO. (1994)
[11] Hamburg, I., & Lütgen, G., 193-206.
[12] Schumacher, A., Sihn, W., & Erol, S. (2016). Automation, digitization and digitalization and their implications for manufacturing processes. In Innovation and Sustainability Conference Bukarest (pp. 1-5).
[13] Meyer, A., Rose, D. H., & Gordon, D. (2014). Universal design for learning: Theory and practice. (No Title).
[14] Vygotsky, L. S., & Cole, M. (1978). Mind in society: Development of higher psychological processes. Harvard university press.
[15] Kim, H. J., Yi, P., & Hong, J. I. (2021). Are schools digitally inclusive for all? Profiles of school digital inclusion using PISA 2018. Computers & Education, 170, 104226.

approach empowers students to develop skills in researching, organizing, and presenting information, fostering greater autonomy in their learning processes.[16] Digital tools are instrumental in creating various materials such as infographics, presentations, videos, animations, tests, assessments, quizzes, and more.[17]

Moreover, the term "supportive technology" is commonly encountered in inclusive education. Assistive technology encompasses the organized application of expertise and techniques related to assistive products, systems, and services. This technology constitutes a specialized subcategory within the wider domain of health technology. A supportive product denotes any external item (including devices, equipment, tools, or software) specifically designed or generally accessible to maintain or enhance an individual's functionality and independence, thereby fostering their overall well-being. Supportive products also play a role in preventing disabilities and secondary health conditions.[18]

The implementation of assistive digital technologies for students with special needs addresses various barriers:

- Removing physical obstacles;
- Providing access to previously inaccessible content and materials;
- Mitigating cognitive challenges for individuals with intellectual disabilities or specific learning difficulties;
- Addressing content barriers resulting from language mismatches between device/software and the student's native language;
- Overcoming pedagogical barriers stemming from inflexible teaching methods and inadequate teacher support for inclusive education;
- Reducing financial barriers associated with the costs of devices and software.[19]

The utilization of digital tools enhances students' social integration by fostering self-confidence and independence. Furthermore, these tools enable teachers to monitor students' progress in real-time and intervene promptly as needed. In inclusive settings, digital tools promote collaboration and interaction among students, facilitating learning between students with varying abilities. Digital tools have become essential in projects aimed at nurturing students' creativity and problem-solving abilities.[20]

The criteria established for assessing the effectiveness of digital technology in inclusive education include the frequency of technology use, user accessibility, and satisfaction with interaction. Recommended criteria involve devices aligning with users' expectations and lifestyles, being affordable and cost-effective, and user-

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[16] Hamburg, I., & Lütgen, G., 193-206.
[17] Thanavathi, C. (2020). Digital tools with inclusive education. Inclusive Education Inclusive Education, 320.
[18] World Health Organization, & United Nations Children's Fund. (2022). Global report on assistive technology. World Health Organization.
[19] Hamburg, I., & Lütgen, G., 193-206.
[20] Burke, A., & Hughes, J., 183-198.

friendly. Additionally, these devices should be easy to maintain with minimal resources and repairable using local means, ensuring that students with special needs can fully participate in education on an equitable basis.[21]

Integrating Digital Tools and Platforms within Organizational Settings

Incorporating digital tools and platforms into school organizational structures has the capacity to revolutionize educational processes. This integration not only facilitates the modernization of teaching methods but also enhances learning environments by boosting student engagement and achievement.

Strategies for successful digital integration in education include:

1. Access and Diversity: Schools should offer access to a range of digital tools that cater to the needs of both students and teachers. Embracing diversity in technology usage mirrors real-world scenarios more effectively than relying on a single technology. Additionally, internet access should not be unnecessarily restricted.

2. Expansion of Learning Environments: Learning should extend beyond the confines of school buildings and hours. Students should be empowered to play an active role in selecting and using technology.

3. Supportive and Sustainable Learning Environments: Establishing supportive, flexible, and enduring learning environments for students and teachers is crucial. This includes faculty development, administrative and curricular support, technical assistance, and enabling students to pursue independent studies.

4. Social Participation: Successful technology integration requires active participation and support from society and parents. Engaging the broader community can promote technological adoption and foster a more extensive support network within society.[22]

Cloud-based solutions play a crucial role in organizational integration within educational settings. Nowadays, many schools utilize platforms like Google Classroom and Microsoft Teams for document management and student information storage, which facilitate assignment distribution, teacher-student communication, and centralized management of educational resources. Additionally, Learning Management Systems (LMS) such as Blackboard or Moodle enable the centralized management of

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[21] Ahmad, F. K. (2014). Assistive provisions for the education of students with learning disabilities in Delhi schools. International Journal of Fundamental and Applied Research, 2(9), 9-16.

[22] Linnhoff-Popien, C., Schneider, R., & Zaddach, M. (Eds.). (2018). Digital marketplaces unleashed. Singapore: Springer.

educational processes by combining functions like organizing teaching materials, conducting exams, and evaluating student performance.

Furthermore, adaptive learning platforms such as Knewton or DreamBox provide personalized learning experiences by adapting to students' unique learning styles and paces. These platforms automatically deliver content based on individual student progress, enhancing the effectiveness of education delivery.

Specifically, educational institutions widely utilize platforms like Kaltura and Brightcove. Kaltura provides a dedicated video platform tailored for educational settings, allowing seamless management and sharing of teaching materials in video format. Kaltura enhances the learning experience through interactive video lessons, distance learning modules, and other features that enhance student engagement. On the other hand, Brightcove empowers content creators in education to broadcast high-quality video and deliver content to large audiences. It offers customized solutions for educational institutions, facilitating the easy publication of course materials, conferences, and other educational events.[23]

Conclusion and Recommendations

In conclusion, the integration of inclusive education and digital transformation holds promise for creating more accessible and effective learning environments for all students. This integration can significantly enhance educational opportunities, particularly for students with special needs, and foster greater equality of opportunity in education. Digital tools facilitate the individualization of learning materials and enable students to learn at their own pace, empowering each individual to reach their full potential.

For this integration to succeed, it is imperative to update education policies, provide training for teachers on new approaches, and strengthen technological infrastructure. Additionally, continuous research and implementation efforts are needed to assess the impact of this integration and identify best practices.

We urge educators, researchers, and policymakers to actively contribute to ongoing research and practice in the realm of inclusive education and digital transformation. By doing so, we can gain deeper insights into how this integration can yield better outcomes for all students and shape our practices accordingly. These collective efforts will lead to more equitable, accessible, and effective education systems, ensuring that every student succeeds in their educational journey.

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