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EQUIPPING STUDENTS FOR A DYNAMIC FUTURE

David Ramamonjisoa

Faculty of Software and Information Science, Iwate Prefectural University, Japan
david@iwate-pu.ac.jp

Abstract

The ever-changing landscape of the 21st century requires a shift in educational focus beyond traditional subject knowledge. This paper explores key considerations for designing effective curricula, emphasising the crucial role of basic skills and 21st-century competencies, fostering a lifelong learning mindset, and preparing students for an increasingly interconnected world.

Building strong literacy, numeracy, and digital skills is the foundation for communicating effectively, thinking critically, and navigating the digital world. Developing key 21st-century skills such as critical thinking, problem-solving, collaboration, and communication will enable students to tackle complex challenges, work effectively in teams, and express themselves clearly.

Encouraging creativity, innovation, and adaptability enables students to think outside the box, embrace new ideas, and thrive in an unpredictable future. Fostering a growth mindset and self-directed learning skills empowers them for lifelong learning and continuous skill development.

While subject-specific knowledge remains valuable, this paper emphasises the need for a holistic approach that integrates these essential skills and mindsets. In addition, recognizing the importance of social-emotional learning and global citizenship highlights the need to prepare well-rounded individuals for success in an interconnected world. This includes understanding diverse cultures, promoting responsible global citizenship, and encouraging sustainable practices. By incorporating these elements into curriculum design, we can equip students with the skills and attitudes necessary to navigate the complexities of the future, become responsible, engaged, and lifelong learners, and contribute meaningfully to a globalised society.

Keywords:

Essential Skills, Lifelong Learning, Global Citizenship

1. Introduction

Japan has embarked on a comprehensive reform of its school education system to better prepare students for the challenges of the 21st century (Yamanaka & Suzuki, 2020). This shift includes revised national curriculum standards, new evaluation methods, updated teacher training, and adjustments to university entrance policies. The reforms began in the 1980s, fueled by a desire to move away from rote learning towards fostering independent thinking and adaptability. Despite initial setbacks, like concerns raised after lower PISA scores, Japan maintained its course, leading to later improvements in student performance. Current reforms emphasize active learning, broader skill assessment, enhanced teacher training, and greater collaboration between schools and their communities. These ongoing adjustments reflect Japan's commitment to an education system that aligns with both its own evolving societal needs and the demands of a rapidly changing, interconnected world, including the anticipated impact of technological advancements like the development of information and communications technology (ICT) and artificial intelligence (AI).

A core issue within Japanese higher education is that knowledge creation and human resource development ecosystems need more effective government support (Yonezawa, 2023). This prevents the establishment of a virtuous cycle where knowledge acquisition, skill development, and knowledge creation can reinforce each other. To address these challenges, Japanese society must work to broaden citizen perspectives to encompass a more global mindset a goal that higher education institutions can significantly contribute towards. Additionally, open, international discussions on university leadership are crucial for progress. Ultimately, government

initiatives seeking to develop university leadership can only succeed if they demonstrate respect for university autonomy while fostering meaningful coordination between the two ecosystems.

The 21st century is characterized by rapid technological advancements, globalization, and complex challenges. This dynamic landscape necessitates a fundamental shift in how we prepare students for their future. Moving beyond the traditional emphasis on subject-specific knowledge, effective curriculum design must now encompass a broader range of essential skills and mindsets.

This paper explores the crucial transformation required within educational systems to prepare students for a rapidly evolving future successfully. The motivation behind this research stems from the recognition that traditional educational models may no longer sufficiently address the complex challenges of the 21st century. The background section examines the historical context of education and identifies limitations in current approaches. The paper then delineates essential skills for navigating a dynamic future and discusses various kinds of education, including formal, informal, and non-formal models. It delves into learning development, analyzing effective methodologies and the factors influencing the learning process. The discussions section critically evaluates the strengths and weaknesses of different educational approaches. Finally, the conclusions recommend optimizing educational systems to foster adaptable, well-rounded individuals equipped to thrive in an uncertain future.

2. Motivation

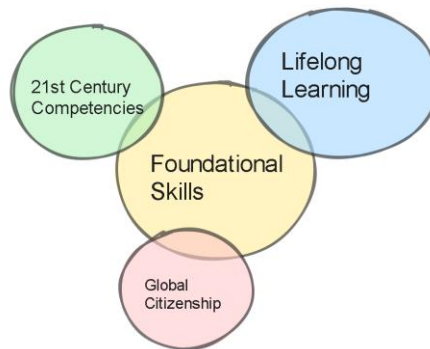
The rising influx of international students in Japanese higher education presents ~~both~~ challenges and opportunities. Japanese universities are now poised to increase tuition fees for foreign students, potentially impacting enrollment trends ("Japanese universities set to raise foreign student tuition") (Omoto Y., 2024). Simultaneously, colleges are enhancing support systems to attract global talent, and the Education Ministry has set ambitious targets for the full recovery of foreign student enrollment by 2027 ("Now admitting: Japan aims to regain 300,000 foreign students") (Shimokawa, M. 2022). Faculty increasingly find themselves responsible for diverse student populations, necessitating a shift towards a more internationalized curriculum to ensure the academic success of all learners. Internationalization of curricula can be achieved through integrating global perspectives into existing coursework, facilitating cross-cultural collaborative opportunities for students, and utilizing a broader range of educational resources with

international origins. Attracting more exchange students makes Japanese universities more competitive internationally, while sending Japanese students abroad helps to nurture global talent. These adaptations are crucial in fostering an educational environment that adequately prepares all students for the realities of a deeply interconnected global society (White O., 2023).

3. Essential Skills

This paper explores key considerations for crafting contemporary curriculums, emphasizing the critical role of the four fundamental concepts depicted in Figure 1.

Figure 1: *Essential skills for Dynamic Futures*



(Source: Author's Own Illustration)

- Foundational skills: Literacy, numeracy, and digital literacy form the bedrock for effective communication, critical thinking, and navigating the complexities of the digital world.
- 21st-century competencies: Cultivating essential skills like critical thinking, problem-solving, collaboration, and communication empowers students to tackle complex challenges, work effectively in teams, and express themselves clearly.
- Lifelong learning: Fostering a growth mindset and self-directed learning skills equips students for continuous learning and adaptation in an ever-changing world.
- Global citizenship: Preparing students to thrive in an interconnected world requires nurturing an understanding of diverse cultures, promoting responsible global citizenship, and encouraging sustainable practices.

3.1 Foundational skills

Building strong literacy, numeracy, and digital literacy skills forms the foundation for success in the 21st century. Literacy skills empower students to communicate verbally and in writing effectively, allowing them to express themselves clearly, comprehend complex information, and engage in meaningful discourse. Numeracy skills equip students to analyze data, solve mathematical problems, and make informed decisions. Digital literacy, encompassing information literacy, technology fluency, and responsible online behavior, is crucial for navigating the digital world effectively, critically evaluating information, and utilizing technology for learning and communication.

3.2 Developing 21st-Century Competencies

21st-century competencies refer to skills and dispositions essential for thriving in a rapidly changing world. Critical thinking and problem-solving skills empower students to analyze information, identify problems, and develop creative solutions (Paul, R. & Elder, L. 2006). Collaboration and teamwork skills enable them to work effectively with others, build consensus, and achieve shared goals. Communication skills, both written and verbal, are crucial for expressing ideas clearly, persuading others, and fostering strong relationships. These competencies equip students to adapt to new situations, collaborate effectively in diverse environments, and contribute meaningfully to society.

3.3 Fostering Lifelong Learning

Continuous learning is essential for success in an era of constant change and innovation (Irving, C. Hall, H. & Brett, A. 2015). Fostering a growth mindset, where students believe in their ability to learn and grow, encourages them to embrace challenges, persevere through setbacks, and seek new knowledge. Developing self-directed learning skills empowers students to take ownership of their learning journey, identify their learning needs, and utilize various resources to acquire new knowledge and skills. By nurturing these qualities, we equip students with the tools and motivation to become lifelong learners capable of adapting to new technologies, evolving demands, and unforeseen challenges.

3.4 Preparing for a Globalized World

The world is becoming increasingly interconnected, necessitating a shift in educational focus to prepare students for responsible global citizenship (Ryan, J., 2013). This involves fostering an understanding of diverse cultures, perspectives, and values. It also requires promoting

responsible global citizenship, encouraging students to think critically about global issues, engaging in intercultural dialogue, and contributing to sustainable solutions for the planet. By integrating these elements into the curriculum, we prepare students to become informed and engaged global citizens, capable of collaborating effectively with diverse individuals and contributing to a more just and sustainable world.

4. Various Kinds of Education

Education extends far beyond the traditional classroom setting, encompassing a diverse range of models, each with its strengths and weaknesses (Husen, T. & Coombs, P. 1986). Formal education, characterized by structured curricula, assessments, and credentialing within institutions like schools and universities, provides a systematic foundation of knowledge (pro). However, it can be slow to adapt to evolving knowledge and job markets, with systems and examinations proving difficult to change (cons). Informal education arises from everyday experiences, interactions, and self-directed learning. It offers a more organic, personalized, and innovative approach (pros) while potentially lacking oversight on the accuracy of information learned (con). Non-formal education encompasses organized programs outside the formal system, such as vocational training, workshops, and community courses. It bridges the gap by providing targeted skills and knowledge (pros) and being more responsive to learner needs and changes in knowledge (pros). While potentially less restricted and controlled by examinations, non-formal programs may also lack the same rigor or accreditation as formal education (cons).

4.1 Formal Education

- **Pros:**
 - **Structured Curriculum:** Provides a clear roadmap for learning, ensuring comprehensive coverage of key concepts.
 - **Expert Guidance:** Students benefit from knowledgeable teachers and professors offering instruction and mentorship.
 - **Recognized Credentials:** Degrees and diplomas hold value in the job market and for further academic pursuits.
- **Cons:**
 - **Limited Flexibility:** Rigid schedules and standardized pacing may not suit all individual learning styles.

- Theoretical Focus: May emphasize theory over practical applications.
- Cost: Tuition fees can be a significant barrier.

Examples: Traditional schools, universities, vocational colleges

4.2 Informal Education

- **Pros:**

- Self-Directed: Allows students to pursue their interests at their own pace.
- Practical Approach: Often focuses on hands-on learning and immediate application of knowledge.
- Cost-Effective: Many resources are free or low-cost (libraries, online tutorials, podcasts).

- **Cons:**

- Lack of Structure: Requires self-discipline and motivation.
- Variable Quality: Information accuracy and depth can be inconsistent.
- Limited Recognition: This may not carry the same weight as formal credentials.

Examples: Reading books, watching documentaries, learning from mentors, YouTube tutorials, MOOCs (Massive Open Online Courses)

4.3 Non-Formal Education

- **Pros:**

- Targeted Skill Development: Focuses on specific competencies relevant to career advancement.
- Flexible Format: Often offered in shorter workshops or part-time courses, fitting well alongside work or other commitments.
- Industry-Relevant: This may be designed in collaboration with businesses, ensuring up-to-date knowledge and practices.

- **Cons:**

- Narrower Focus: Less emphasis on a broader knowledge base and critical thinking skills.
- Variable Cost: Fees can vary depending on the program provider and type of training.
- Mixed Recognition: Credentials may be more valuable in specific industries than in more comprehensive academic settings.

Examples: Professional development courses, technical certifications, language classes, coding boot camps, and AI tools like ChatGPT (LLMs) for targeted learning and writing assistance. I have dedicated a special section to this topic in the following section.

4.4 Emerging AI as an Education Aid System

ICT (Information and Communication Technology) and AI (Artificial Intelligence) are often compared to the transformative power of electricity, revolutionizing the modern world and reshaping virtually every aspect of our lives (Makridakis, S. 2017). Just as electricity brought widespread modernization, ICT and AI have become indispensable tools for driving innovation, efficiency, and connectivity on a global scale. From revolutionizing communication and information exchange to optimizing industrial processes and enabling intelligent decision-making, the impact of ICT and AI is profound and far-reaching. Their integration into sectors as diverse as healthcare, finance, transport, and education (Luckin, R., & Cukurova, M. 2019) has ushered in a new era of technological progress, fundamentally changing the way we work, interact and perceive the world around us (Lund, B. D., & Wang, T. 2023).

Moreover, the emergence of an AI-based society is becoming increasingly apparent, with AI systems playing a central role in shaping our daily experiences and societal structures (Wamba, S. F., Bawack, R. E., Guthrie C., Queiroz M. M., & Andre Carillo K. D. 2021). These systems, powered by advanced algorithms and machine learning techniques, can analyze vast amounts of data, identify patterns and make predictions with unprecedented accuracy. In areas such as healthcare, AI is facilitating early disease detection, personalized treatment plans, and drug discovery, revolutionizing the way we approach medical care (Lee, P., Goldberg, C.& Kohane, I 2023). In finance, AI algorithms enable real-time market analysis, risk assessment, and fraud detection, improving financial stability and security. And AI-driven transport, agriculture, and urban planning advances will revolutionize infrastructure management, resource allocation, and environmental sustainability. As we transition to an AI-enabled society, ethical considerations around data privacy, algorithmic bias, and the equitable distribution of benefits and opportunities will become increasingly important. However, with responsible governance and ethical frameworks in place, the transformative potential of AI to improve lives, drive innovation, and promote sustainable development remains unparalleled.

In exploring the potential benefits and limitations of integrating Large Language Models (LLMs) into educational settings, it is clear that these sophisticated tools hold great promise but

also raise essential considerations (Lo, C.K. 2023) (Meyer, J.G., Urbanowicz, R.J., Martin, P., O'Connor, K., Li, R., Peng, P., Bright, T.J., Tatonetti, N.P., Won, K., Gonzalez-Hernandez, G., & Moore, J.H. 2023), (Wang, L., Ma, C., Feng, X. et al. 2024). In terms of benefits, personalised tutoring emerges as a key advantage, allowing explanations, examples, and practice questions to be tailored to individual student's needs and learning styles. In addition, LLMs are a boon to educators by streamlining content creation processes, facilitating the creation of lesson plans, worksheets, and assessments, saving valuable time, and potentially inspiring innovative teaching methods. In addition, these models serve as invaluable resources for language practice, providing students with a platform to improve their communication skills, which is particularly beneficial for non-native speakers. Furthermore, LLMs are excellent research tools, efficiently synthesizing information and providing a solid starting point for academic endeavors. Above all, their accessibility, with round-the-clock availability and support, extends learning opportunities beyond traditional classroom hours. However, amidst these promising prospects, it is crucial to recognise and address the significant limitations of LLMs, such as their inherent lack of critical thinking skills, the potential for the dissemination of misinformation, the risk of over-reliance leading to diminished student autonomy, and ethical concerns regarding plagiarism and misuse. A full understanding of both the benefits and the limitations of LLMs is therefore essential to effectively harness their potential in educational contexts (Li, Q., Fu L., Zhang, W., Chen X., Yu J., Xia W., Zhang W., Tang R.& Yu Y. 2023), (Silva, C.A., Ramos, F.N., de Moraes, R.V., & Santos, E.L. 2024).

4.4.1 Potential Benefits:

- **Personalized Tutoring:** LLMs can provide tailored explanations, examples, and practice questions, adjusting to individual student needs and learning styles.
- **Content Generation:** Teachers can use LLMs to create lesson plans, worksheets, and assessments, saving time and potentially sparking new ideas.
- **Language Practice:** Students can interact with LLMs to improve their communication skills, especially for non-native speakers of a language.
- **Research Assistance:** LLMs can efficiently summarize information and provide starting points for research projects.
- **Accessibility:** LLMs offer 24/7 availability and can support students outside of classroom hours with questions or practice.

4.4.2 Important Limitations

- **Lack of Critical Thinking:** LLMs primarily work with existing information, limiting their ability to foster original thought or deep analysis.
- **Potential for Misinformation:** It's vital to verify LLMs' information, as even advanced language models can sometimes generate inaccuracies or biases.
- **Over-reliance:** Students shouldn't use LLMs as a substitute for their work and thinking; they are the best supplementary tools.
- **Ethical Concerns:** Plagiarism and potential abuse of the technology to complete assignments require careful monitoring.

4.4.3 Where LLMs Fit Best:

LLMs excel in providing factual information, generating basic text formats (like summaries or translations), and assisting with targeted practice. They are most effective as supportive tools for educators and students when:

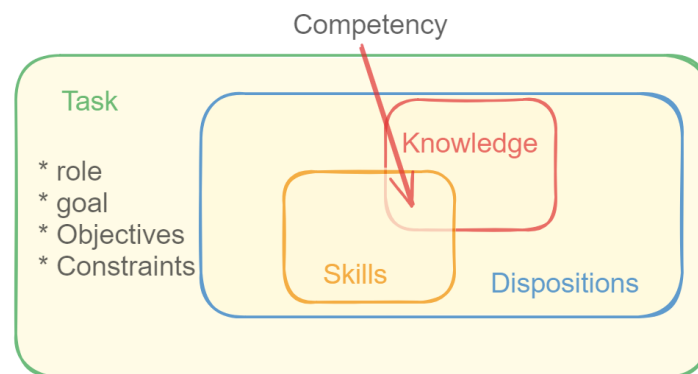
- **Teacher Guidance:** Educators must guide students in effectively using LLMs, setting clear expectations, and fostering critical evaluation of their output.
- **Integrated into Learning:** LLMs work best as one tool within a broader learning experience emphasizing independent thinking, creativity, and complex problem-solving.
- **Focus on Process:** Using LLMs should encourage students to think about *how* they arrive at answers, not just the final product they generate.

5. Case Study on my Faculty

The four-year curriculum offered by our Faculty for undergraduate students is carefully designed to provide students with a comprehensive educational journey to equip them with the necessary skills and knowledge to thrive in the dynamic field of computing. Beginning with a foundation in literacy, numeracy, and digital literacy, coupled with personal development components including sport, health, and gender education, the first year provides students with a solid foundation. In the second year, the curriculum delves deeper into specific areas of knowledge, such as the fundamentals of computer architecture, physics, and information processing, as well as developing advanced English communication and critical thinking skills. In the third year, students study core computer science courses in data structures, algorithms, programming languages, and operating systems, complemented by electives in artificial intelligence, machine

learning, cybersecurity, and software engineering. In addition, in the third year, students embark on project-based learning, working in teams to tackle real-world challenges and consolidate their theoretical knowledge through practical application. Finally, in the fourth year, students can specialise further by selecting advanced courses tailored to their interests, culminating in a capstone project in which they demonstrate their expertise by developing sophisticated software applications or addressing specific issues within the field. Through this carefully crafted curriculum, our faculty strives to produce skilled and innovative computer scientists prepared to contribute significantly to the ever-evolving technological landscape.

Figure 2: *Competency based Curriculum Design*



(Source: Author's Own Illustration)

The diagram in Figure 2, the Faculty Curriculum Diagram, designed to align with the Computing Curriculum Standards CS2020 and CCDSC2021 emphasises a holistic approach to competence development for graduate-level computing education. At its core is the understanding that competence arises from the intersection of knowledge, skills, and dispositions - theoretical learning, practical skills, and professional attitudes - all applied in the context of real-world tasks. The Graduate School offers domestic and international students the opportunity to pursue advanced degrees. While English-speaking students with computer science backgrounds are a strong fit, the programme also welcomes applications from international students who have achieved a minimum score of N2 on the Japanese Language Proficiency Test (JLPT). This broadened admissions policy reflects the programme's commitment to fostering a diverse learning environment. The diagram highlights the need to combine a theoretical foundation (the 'knowledge' domain) with developing practical skills to enable students to tackle complex

computational tasks. In addition, by emphasising 'dispositions,' the curriculum recognises that successful computer scientists must cultivate professional attitudes such as adaptability, ethical awareness, and a willingness to collaborate - crucial qualities when navigating the dynamic and potentially cross-cultural workplaces of the field. The presence of 'constraints' underlines the importance of preparing students to solve problems within realistic resources, time, or technology constraints.

6. Towards Global Citizenship

Global citizenship is a recognition of our interconnectedness with people worldwide and a commitment to work together to address global challenges. It involves promoting empathy, tolerance, and sustainable development to create a more just and peaceful world. The internationalisation of higher education is a means of achieving global citizenship goals. Eric Bray explained the early stage of the Japanese Higher Education Internationalisation Policy during from 1980 to 2003 (Bray, E. 2004). Japan's goal of increasing the number of international students in higher education faces obstacles due to a lack of integration on campus and potential conflicts in internal policies. A perceived cultural distance between Japanese nationals and foreigners contributes to this limited integration. Promoting greater integration could include encouraging foreign students to join campus clubs, offering buddy programmes, diversifying the student body, and providing language support in addition to English classes. The Japanese government has conflicting views; some policies welcome international students, while others, such as tighter immigration controls, could hinder progress. This tension highlights Japan's struggle to balance maintaining its national identity while benefiting from participation in the global economy through internationalisation. In a recent survey by K. Saito and S. Kim (Saito, K. & Kim, S. 2019), Japanese higher education has made significant strides in internationalisation, with many institutions now boasting well-defined leadership teams.

The internationalisation of our Faculty is progressing gradually. Some efforts are being made to admit Chinese students with JLPT N2 at the undergraduate level from the third year onwards. It is challenging for foreign students to enter the first year of the undergraduate programme, as the entrance examination is designed only for native Japanese speakers who have studied in Japanese high schools. Efforts are also being made to encourage Japanese students to study abroad for a semester or a full year by recognising the host university's credits. Our

curriculum design relies heavily on the mathematics programme (Lehman, E., Thompson Leighton, F., & Meyer, A. R. 2017). A curriculum built on a solid foundation in mathematics provides a unique advantage in the ever-evolving world of technology. Imagine a world where complex ideas can be communicated precisely, regardless of the spoken language. Mathematics acts as a universal language, using symbols and logic to express concepts in a way that anyone with a mathematical background can understand. This makes it an essential cornerstone of computing. As a builder needs a blueprint to build a house, computer scientists rely on mathematics to design and develop the complex algorithms and software that power our digital world. From the intricate calculations behind encryption to the efficient data structures that organise information, mathematics provides the core principles that make computers work.

In information gathering, individuals use a multifaceted process to acquire knowledge from multiple sources. This involves not only seeking out information but also critically assessing its reliability and relevance. Flexibility of thought is essential in this endeavour, allowing individuals to adapt their approaches and perspectives as they navigate through a plethora of data. Similarly, identifying sources of cultural data requires a keen awareness of different media, ranging from literature and art to social practices and historical contexts. Understanding unfamiliar behaviour requires a deep curiosity and empathy that encourages individuals to look beyond superficial observations and explore the underlying motivations and cultural nuances that drive human actions. Maintaining an open mind throughout this process is paramount, fostering receptivity to different points of view and facilitating meaningful cross-cultural interactions.

In language learning, individuals embark on a journey of linguistic exploration, seeking to expand their communicative skills and cultural understanding. Remembering words and phrases requires not only memorisation but also contextual learning strategies, such as associating vocabulary with vivid mental images or personal experiences. Practicing with native speakers provides invaluable opportunities for language immersion, allowing learners to refine their pronunciation, intonation, and comprehension skills through authentic interactions. Furthermore, fostering a sense of adventure in language learning means embracing the challenges and joys of navigating a foreign linguistic landscape with enthusiasm and resilience. Cultivating a positive attitude towards new experiences fosters a sense of openness and curiosity, enabling individuals to approach linguistic and cultural encounters with optimism and adaptability. Developing a tolerance for ambiguity is also crucial in this process, as language learning often involves grappling

with unfamiliar grammatical structures, idiomatic expressions, and cultural nuances, requiring patience and flexibility in interpretation. Through these efforts, individuals expand their linguistic repertoire and cultivate a deeper appreciation for the rich tapestry of human communication and cultural diversity.

7. Conclusions

In response to the ever-evolving landscape of global interconnectedness, educational paradigms are transforming to equip students with the skills and perspectives needed for responsible global citizenship. Various forms of education have emerged to address this imperative, aiming to empower students to navigate and contribute meaningfully to an interconnected world. Academic disciplines, particularly computing, have recognised the importance of preparing students for this dynamic future. By integrating principles of lifelong learning and competency frameworks that promote intercultural knowledge and skills, academic activities in computing are at the forefront of fostering a generation of adaptable and culturally aware individuals. Through initiatives that emphasise intercultural collaboration, ethical decision-making, and technological innovation, educational institutions are producing students who are proficient in their chosen fields and equipped to engage with diverse communities and address complex global challenges. By embracing this holistic approach to education, students are empowered to become conscientious global citizens capable of making a positive difference in an increasingly interconnected world.

Equipping students with the essential skills, attitudes, and knowledge outlined above is critical to their success in an increasingly complex and interconnected world. By prioritising basic skills, cultivating 21st-century skills, promoting lifelong learning, and preparing students for global citizenship, we empower them to become successful individuals and responsible and engaged members of a global society. This paper highlights the need for a holistic approach to curriculum design that goes beyond the traditional transmission of knowledge and equips students with the tools and mindsets necessary to navigate the complexities of the 21st century and beyond.

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