Transforming Emergency Into Opportunity: Unleashing The Creative Potential To Better Education And Out Of Middle-Income Trap

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Abstract

We live in a changing and connected world and face dynamic situations, such as poverty, income disparities and environmental crises. The most important is the nature of innovation that it should lead to problem solving and competitiveness, with education playing a key role. The problem of determining future skills becomes acute, so that the development of a promising educational policy becomes a priority area of research. The local communities can not improve the quality of education is an important factor in the emergence of the middle-income trap. The way out of the middle-income trap is through R&D and innovation with the support of a competitive and high-quality education. People should instead take this moment as an opportunity to reconsider some goals for education. The paper will define the connection between three critical elements of educational innovation, namely pedagogy, space and technology. The purpose of the study is to address the following questions: "Digital Technologies", "Hybrid/Blended Learning Spaces", "Sustainable Development Goals", "Uncertainty and Pedagogy", "Educational Transformation--Compulsory Education, Higher Education, Vocational Education and Training, and STEM". This study requires a multi-methods approach composed of a combination of different research methodologies that involves the mixing of qualitative and quantitative data.

Keywords: *pedagogy, space and technology sustainable development goals key competencies uncertainty and creativity*

I. Introduction

Digital Technologies

Globalisation has been linked to the information technologies that contributes to the integration of economic space and provides conditions for the sustainable development (Zajda & Vissing, 2022:6; Solloway

& Stahl, 2022:117; Kurchenkov, Fetisova, Koneva & Kurchenkova, 2022:23,24; Russkova, Ponomareva, Sokolov & Yakhtin, 2022:123; Dozhdeva, Franchyzenko & Nikolashina, 2022:621,622; Ermakova, 2022:237,238; Proskurina, Davidyan & Zorina, 2022:699）. The digital transformation of education creates a multidisciplinary educational base and ensures that the education system meets the challenges and opportunities （Alzhanova, Guzev, Loginova & Polkovnikov, 2022:100; Shor, Shelestova & Galamyan, 2022:251; Alontseva, Cherkasova & Kozlov, 2022:423,424; Volkodaeva, Balanovskaya & Rustenova, 2022:583,584; Anisimova & Efremova, 2022:774）. Students will expect experiences empowered through technology, such as mobile technologies, virtual and augmented realities, simulations and immersive environments, and more（Amos, 2022:56,57）. New technologies change those skills that graduates may need for work in the future, and that leads to changes in the labor market（Hong, 2022:3; Koropets, Detkova, Leontyeva & Ovchinnikov, 2022:378; Gourari, Raoufi & Skouri, 2022:127; Dennen & Bong, 2022:110）. While the research landscape provides much evidence on how digital technologies contribute to the pedagogical design and the quality of education, it is of interest to understand how learners work and how educators orchestrate their classrooms（Domalis, Karacapilidis, Karachristos, Komis, Manta, Misirli, Tsakalidis & Filippidi, 2022:88）. This paper aims to give insight into the impact of the COVID-19 pandemic on education, the benefits of digital technologies and the literature review on similar topics（Bhattasali & Savarimuthu, 2022:196; Raja & Priya, 2022:468; Hassan, 2022:591）.

Hybrid/Blended Learning Spaces

Learning facilities can be digitalised; technology can be inserted into the space, and help to create new hybrid learning processes（Manciaracina, 2022:85,86）. Due to lockdowns imposed by Covid19, our life has been hybridized, while technology enables us to interact with peers in other spaces and times（Gil, Mor, Dimitriadis & Köppe, 2022:1）. Education requires information and communications technology (ICT) to facilitate learning needs for social and economic development（Kommers, 2022:294; Alfayez, Shirawi, Karam & Hamdan, 2022:37）. The increasing intertwining of natural and machine intelligence creates new opportunities and risks for knowledge transfer, which will be characterized by the application of artificial intelligence (AI), Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR), open educational resources (OER), big data and the Internet of Things (IoT)（Schumann, Nitsche, Tittmann & Reuther, 2022:322）. Learning is expanding in blended learning, i.e. a combination of traditional offline and online teaching via these digital technologies（Belyakova, Pyrkina & Chuikova, 2022:784; Repina, 2022:883,884; Soliman, 2022:285）. This was due to the desire of the competitive advantages, diversification of the forms of educational activity, and the expansion of educational opportunities（Sevastyanova, 2022:889; Mantulenko, 2022:923; Suoranta, Teräs & Teräs, 2022:374）. This Covid-19 provided the opportunities and demonstrate the necessities of improving our education system（Verma & Soni, 2022:19,20）. However, even with the integration of educational methods into a hybrid learning model, it is still challenging to achieve the learning outcomes through learning activities（Pang & Hou, 2022:367,368）.

Sustainable Development and Education

Learners are expected to acquire the knowledge and skills necessary to promote sustainable development （İnce, Dayıoğlu-Öcal, Soysal, Albayrak-Sarı, Bağcı & Öztürk, 2022:3-4; Erin & Alison, 2022:15; Parsons & MacCallum, 2022:6）. Future engineering environments are embedded into socio-technical manufacturing systems. This implies the need to adapt and create educational systems based on the updating of competencies. The change determines the combination of the digital transformation under the achievement of the Sustainable Development Goals (SDG) of the 2030 Agenda （Suárez, Aguayo & Ávila, 2022:32,33）. This paper focuses on ways to create activities that coincide with the United Nations' SDGs, with the goals to (1) raise awareness about the SDGs so that learners could use a critical lens to impact their learning and (2) internationalize the higher education curriculum through virtual exchange （Lenkaitis, 2021:210）. The development of technologies has been one of the promoters of transition that artificial intelligence and augmented reality are the examples （Pozzo, 2022:575; Costin & Coutinho, 2022:40）. The paper gives an overview of what might be called the "crisis pedagogies" of the Covid-19 pandemic in the local communities （Heinemeyer, 2022:110; Reimers, 2022a:3）.

Uncertainty and Pedagogical Challenges

Covid-19 has caused disruption to education, and students faced multiple challenges that affected their ability to focus on their education （Ralls, Lahana, Towers & Johnson, 2022:2; Gaufman & Möller, 2022:39; Vare, Lausselet & Rieckmann, 2022:195; AL-Hashimi & AL-Sayed, 2022:635; Allendoerfer, 2022:127; Ali & McKenna, 2022:47）. We are living with uncertainty over how face-to-face teaching will be disrupted during this global pandemic. Will online teaching become the new normal （Kaempf, 2022:189）? Being able to adapt well, and pursue new opportunities will be central to one's ability to successfully navigate an uncertain future （Barr, Hartley, Lopata, McFarlane & Mcnamara, 2022:342,343）. The outbreak of the Covid-19 pandemic has raised significant concerns about the online learning that requires access to technological equipment and Internet connectivity. The digital divide and educational inequalities have been further deepened during the Covid-19 pandemic （Papaioannou, 2021:177; Waly, 2021:575; Basuny, Abdel-Hady & Fayed, 2021:197）. This paper aims to evaluate the digital transformation of education on the social innovations （Kaputa, Loučanová & Tejerina-Gaite, 2022:62; Jandri´c & Hayes, 2022:321）. This paper provides a brief analysis of the different aspects of the impacts of Covid-19 on the education and highlights some of the new opportunities and potentials it beings to address the changing global risk landscape （Shaw, Izumi & Pal, 2022: 256）.

Educational Transformation

The local communities became connected due to the reasons such as economic exchange and new techniques of communication. We should study the effects of globalization within the performance of education institutions. The goals such as quality of education, employability and lifelong learning started to dominate the policy agenda, suggesting education as a workforce tool （Pagliarello, 2022:5）. Education plays a crucial role

in transforming society, and develops a capacity to engage in an unpredictable economy（White & McCallum, 2022:150; Ebner, 2022:3）. Besides understanding the capacity of technology to reconfigure the educational paradigm, it is important to realize that educational change and innovation, can be very complex（Roy, 2022:45）. The education and policy reforms target education quality and global competitiveness（Zajda, 2022d:2,3）. Taiwan has witnessed a rapid development of polytechnic and university education. Given the prioritising of economic development, higher education is used as a tool of economic development（Lee, 2022:86）. Taiwan implements a knowledge-based economy, with education considered an essential tool to promote economic competition and employability.

(1) Compulsory Education

Education is a means to shape the future. The origin of state-regulated compulsory schooling argues that culture cannot be ignored as a driving force behind the diffusion of social policies. Compulsory education corresponds with the reproduction and change of a country's culture（Seitzer, Besche-Truthe & Windzio, 2022:38,39）. UNESCO committed to ensuring access to free and compulsory primary education that the world is pledged to "Education for All" (SDGs). One can assume that "making education mandatory would constitute a viable first step toward achieving these goals", and "extending the duration of compulsory education would be the second step". The extension can be targeted by either raising the school-leaving age or lowering the school-entry age, thus making pre-primary education compulsory（Besche-Truthe, 2022:65,66）. Compulsory education became an imperative trait of state education.

(2) Higher Education

Participation in higher education (HE) offers the opportunity of social mobility and, the technical and vocational purposes of higher education become more important（Wheelahan, 2022:272）. HE will need to innovate if it is to provide flexible opportunities for more diverse student cohorts（McDonnell-Naughton & Păunescu, 2022:10; Thompson & Amaral, 2022:7）. The study has set its purpose to examine how higher education institutions has been transformed through the pandemic into the new normal, to shed light on the higher education to make them more adaptable to changing environments（Pal, Dhungana & Pal, 2022:15,16; Sadiq & Malik, 2022:221）. More skilled occupations require higher education qualifications. We discuss some challenges of digital transformation and provide suggestions on how this move to online learning can become a component of higher education（Wang & Xu, 2022:114）.

(3) Enhancing the Standing and Status of Vocational Education

In an era defined by digitalisation, there are high expectations for vocational education and training（Rintala & Nokelainen, 2022:160; Papier & Needham, 2022:81）. Higher education and professional and applied education co-existed in two systems -- academic versus vocational. The vocational education and training and applied education aimed to equip graduates with professional qualifications（Yuk-Kwan Ng, Wells

& Lam, 2022:54）. The development of higher vocational education is presented as a necessary means to achieve greater economic competitiveness and raise productivity through increasing human capital. Social inequalities are thought to be exacerbated for those deemed underqualified for work; therefore, new opportunities are needed to widen participation in higher education. The aim is to contextualise the country-specific experiences of the growth of higher vocational education（Webb, 2022:10; Bathmaker & Orr, 2022:59; Graf & Powell, 2022:125）.

(4) STEM, Creativity and Critical Thinking

There are sustained changes that the education providers must support. These include how educational content is prepared, and how to support diversity with changes to student engagement. Such changes require the inclusion of suitable technologies（Grout, 2022:189,190）. Critical thinking in Science, Technology, Engineering, and Mathematics (STEM) pedagogy provides a better understanding of the learning skills （Babaci-Wilhite, 2022:283）. STEM, criticality and creativity remain key to the recovery that the local communities will need moving forward（Buntting, Gunstone, Berry, Corrigan & Jones, 2021:1-2）. The paper would offer a perspective of STEM education that STEM education can contribute to a better global society and its citizenry, through preparing students who can effectively respond to multi-faceted economic, social and environmental challenges（Berry, 2021:177）.

Related Researches

Scholars do researches into the theme "Pedagogy, Space and Technology", and come to the conclusions as described below: (1)The low standing of vocational education and training and the occupations it serves are emerging as a concern（Stalder, Choy & Le, 2022:3,4）, (2)The higher education should be more flexible, creative, focused on critical skills, and can help prepare students for the challenges（Barr, Hartley, Lopata, McFarlane & Mcnamara, 2022:337）, (3)The COVID-19 pandemic is an opportunity to restructure and rethink the educational model（Cerdio, 2022:35）, (4)The relationship between space, pedagogy and technology is at the heart of the research. The distance teaching led the research to reflect on hybrid learning contexts （Manciaracina, 2022:1）, (5)Blended learning is a common mechanism for introducing digital learning technologies to education（McKay, Trowsdale, Carrie, Duff & Goodburn, 2022:77）, (6)Open educational resources can play an important role in improving access and quality in higher education（Ouahib, Kharki, Bendaoud, Burgos & Berrada, 2022: 31-32）, (7)Massive online open courses could be one of the flexible ways to provide equal access to education（Margoum, Machwate, Alaoui, Bendaoud, Landry, Masse, Bennis & Berrada, 2022:75）, (8)Investment in digital skills comprises a combination of skillsets and makes workers adaptable to technological change（Hong, 2022:1）, (9)Education today is undergoing change, supported by relevant technologies（Grout, 2022:189）, (10)With the availability of virtual reality, new possibilities of learning are created（Soliman, 2022:285）, (11)The COVID-19 emergency lockdown presented an unprecedented challenge that brought technology to the foreground（Appel & Fernández, 2022:581）, (12)To

destroy a nation only requires lowering or destroying the educational standards. The growth or collapse of a nation depends on her educational system（Ogbujah, 2022:77）, (13)Because of the nature of STEM, the integration of the core competencies of creativity and critical thinking has grown rapidly（Ellerton & Kelly, 2021:9）, (14)Under the pandemic, "Blended Education"—a combination of face-to-face and online modes was established（Woo & Ngai, 2022:317）.

II. Aims, Underlying Assumptions & Method

Given the need to comply with the SDGs proposed by the UN, as well as the trends and drivers of digital transformation and the acquisition of competencies to operate in Industry 4.0 environments, a new model of educational practice is required. Life skills are critical to learning and living life well, particularly in precarious times. It is important to investigate how these aspects interact with the social context of policy developments. The middle-income trap refers to a situation whereby a middle-income country is failing to transition to a high-income economy due to rising costs and declining competitiveness. Few countries successfully manage the transition from low to middle to high income (World Bank Group -eLibrary, 2023). There is growing evidence that the inability of middle-income countries to improve the quality of public education is an important factor in the emergence of the middle-income trap. This has resulted in large learning losses. The claim is made that not only did the pandemic heighten pre-existing disparities, but it also exposed the local communities with previously successful public education policies to the risk that their former advantage could disappear if they fail to offset the effects of the pandemic. This can be avoided through appropriate educational policy responses, to which the paper offers some suggestions（Lannert & Varga, 2022:465）. This paper argues that the way out of the middle-income trap in which the local communities seem to be stuck is through R&D and innovation with the support of a competitive and high-quality education. The author shows how this creates opportunities for economic growth and structural changes that could help the local communities navigate out of the trap（Mátyás, Bőgel, Knell, Odor & Weresa, 2022:515）.

Our approach addresses in an integrative way a series of pedagogical, technological and social issues. Specifically: (i) Pedagogical issues concern strategies which may effectively guide the learning activities; (ii) Technological issues concern the development of innovative services that may improve the educational outcomes; (iii) Social issues concern the development of activities held in diverse learning communities. The paper will define the connection between three critical elements of educational innovation, namely pedagogy, space and technology. The aim of this paper was to confront the forecasts on the development of teaching and learning at schools with the changes that have occurred in the COVID-19 pandemic, including the following research topics: "Digital Technologies", "Hybrid/Blended Learning Spaces", "Sustainable Development Goals (SDGs)", "Uncertainty and Pedagogy", "Educational Transformation--Compulsory Education, Higher Education, Vocational Education and Training, and STEM". This design, which is shown in Figure 1, shows that the results should provide decision-makers in education policy and reforms with a better understanding of potential development trends. Technologies can make a contribution to innovative pedagogical design. The digital

economy is linked to many areas of human life that it led to the need for an interdisciplinary approach to our work. This study requires a multi-methods approach composed of a combination of different research methodologies that involves the mixing of qualitative and quantitative data.
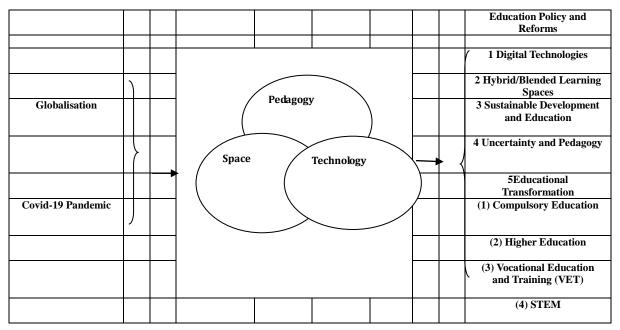

Figure 1. Research Framework

III. Theoretical Framework

Digital Technologies

    Digitalization is a process of using digital platforms and equipment（Singh, 2022:19; Chavali & Biradar, 2022:35; Choudhury, Roychowdhury, Singh & Singh, 2022:2; Van Dam, 2022:68）. Digital transformation refers to the changes experienced by institutions as a consequence of the use of new digital technologies（Kaputa, Loučanová & Tejerina-Gaite, 2022:63）. Through these advancements in digital technologies, such as artificial intelligence (AI), extended reality (XR) and smart materials, the education institutions have been able to reach a more diverse student population, and leverage the traditional experience by offering hybrid learning environments（Leahy, Scragg & Mishra, 2022:326,327; Ahmad, Kharki, Burgos & Berrada, 2022:65; Iliško, Kaˇc¯ane & Badjanova, 2022:350; Setati-Legodi & Goosen, 2022:57）. COVID-19 hampers the normal mode of teaching and learning, so that, a smooth way of conducting the process in online mode is necessary. Various types of platforms like Zoom, Google Meet, Google Classroom, MS Teams and many more are under research for smooth progress（Ghosh & Das, 2022:9; Butler, Rorich, Sparks & Wadasinghe, 2022:26）. Globalisation has been described as an "ongoing process of intensifying economic, social, and cultural exchanges that have a profound effect on education"（Lee, 2022:542; Seitzer & Windzio, 2022:97; Boccardelli, 2022:16; Zajda, 2022a:3）, and the global pandemic catalyzed digital acceleration（Alzhanova, Guzev, Loginova & Polkovnikov, 2022:101）.

Hybrid/Blended Learning Spaces

The terms hybrid and blended have focused on the place and time dimensions of learning, and refer to the varying ratios between f2f, physical meetings, and online learning via digital platforms/resources（Eyal & Gil, 2022:12-14; Kohls, Dubbert & Münster, 2022:250,251）. In the COVID-19 crisis, institutions added technological platforms that allow f2f and remote participants to join in online（Bülow, 2022:139）. Blended learning is widely used to introduce digital learning technologies（McKay, Trowsdale, Carrie, Duff & Goodburn, 2022:78）. Hybridity has become the standard in post-COVID19 educational systems, but in the sense of blended classrooms / hybrid synchronous instruction（Mor, Gil, Dimitriadis & Köppe, 2022:316）. The creation of learning spaces promotes creative pedagogical strategies and environments through digital technologies. The connection between pedagogy, technology and learning spaces in educational innovation processes is increasingly recognised as an approach to learning and teaching（Rocha & Michel, 2022:233）. The Covid-19 pandemic has accelerated the digitalization of education, as well as the shift to online or hybrid education（Manzoni, 2022:247; Jugo, 2022:266）. Those educators not just to digitize their curriculum but also to bring more competency-based mindsets into their teaching（Dubuc, 2022:289）.

Sustainable Development and Education

Sustainable Development Goal 4 (SDG4) aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all", in doing so it states that education enables upward socioeconomic mobility and is a key to escaping poverty（Kadji-Beltran & Zachariou, 2022:71; Millican, 2022:39; Farioli & Mayer, 2022:85; Lozano & Barreiro-Gen, 2022:140; Mulà, Cebrián & Junyent, 2022:185; Drew, 2022:196）. The key competencies and skills equip students with qualities to adapt to the work environment and rapidly-changing world（Brush, Jones, Bailey, Nelson, Raisch & Meland, 2022:47; Erin & Alison, 2022:23; Schmidt, 2022:268,269; DeJaeghere, 2022:76,77）. The new normal accentuates two ideas: competency-based education and digital technologies（Yuk-Kwan Ng, Wells & Lam, 2022:56,57）. Pedagogy includes virtually strategy that enhances the learning experience, and emphasizes the context of the teaching and learning dynamic（Struthers, Allsop, Kalelio˘glu & Rzyankina, 2022:368; Cranmer & Lewin, 2022:70）. Open Educational Resources (OER) was defined as "teaching, learning and research materials, digital or otherwise, that have been released under an open license". The massive online open courses (MOOCs) provide opportunities to improve the quality of life of people by facilitating lifelong learning（Nemme, Pandolfo, Walden & Lie, 2022:320; Mseer, 2022:137; Kommers, 2022:293; Verma & Soni, 2022:21,23）. Education has a critical role to play in the sustainable socio-economic pathway（Vare, 2022:15; Wiek & Redman, 2022:27）.

Uncertainty and Pedagogy

Encounters with uncertainty can orient us toward new possibilities and futures and the educational efforts are preparing people for uncertain futures（Beghetto & Jaeger, 2022:4; Yamada, 2022:96）. Uncertainty is inherent in creative efforts（Runco, 2022:24）. Curiosity and creativity together can prepare a person to be

open-minded to alternative ideas. Critical thinking encompasses a range of processes and skills, and like curiosity, is included as an important 21st century skill（Jirout & Matthews, 2022:257,259）. Creativity is the ability to solve problems by using innovative strategies, and see new opportunities. The relationship between creativity and technology is important to educators to discover how creativity can be integrated into teaching and learning（Domalis, Karacapilidis, Karachristos, Komis, Manta, Misirli, Tsakalidis & Filippidi, 2022:89; Henning, 2022:88）. Pandemic pedagogies have become the focus of the education technology. Education for the emerging societies requires ICTs to facilitate the learning needs for social and economic development（McKay & Mabunda, 2022:296; Mazzucato, Babaee, Kazemi, Daeizadeh, Kaur & Sode, 2021:297）.

Educational Transformation

The EDU 2.0's components align with the strategic education objectives: new demands for job skills in an increasing competitive world, and alignment with international educational standards and goals. Investment in education is motivated by social and economic development and is intended to facilitate a labor market shift toward high-skill jobs. The new curriculum aims to encourage teachers to transition from content development to the development of competencies, and from a "knowledge-based curriculum" to a "competency-based curriculum"（Moustafa, Elghamrawy, King & Hao, 2022:57; Reimers, Amaechi, Banerji & Wang, 2022b:194）.

(1) Compulsory Education

Compulsory education is a divisive political issue that extending mandatory schooling drains governments' monetary resources. That is why an extension of the right to free and compulsory education from the ages of six to fourteen to the ages of three to eighteen has been praised from the education policy change, specifically because of the financial burden the state would have to bear（Besche-Truthe, 2022:68）. The compulsory character of mass education indicates the extent to which education is the one basic right that is also an obligation. The Education for All movement enters into the contemporary lists of Sustainable Development Goals (SDGs)（Meyer, 2022:277）. Education has been envisaged along a continuum ranging from a human right to be enjoyed by everyone irrespective of the cost and the return on investment, to a tool aimed at responding to market demand in support of economic growth（Weidman, 2022:20; Lannert & Varga, 2022:477）.

(2) Higher Education

Higher education is associated with higher living standards, being a key factor of economic growth of societies. Equity of access to higher education has become a prominent concern of education policies（Amaral, 2022b:23）. A decrease in learning will have negative long-term impacts on productivity and economic growth（Taylor, 2022:424）. Globalizations established trade networks and a knowledge-based economy that led to human capital mobility（Yamada, 2022:95）. The 2020 global pandemic created unparalleled societal challenges. Many higher education institutions (HEIs) had to embrace digital technology that teaching remotely

become the norm for HEIs（Thompson, Schröder & Wrana, 2022:220）. This unpredictable context, will require the workforce to be better-educated. Lifelong learning turns out to be more likely essential for students that their knowledge and skills can be most updated to cope with new developments of the economic restructuring（Yamada, 2022:98）.

(3) Enhancing the Standing and Status of Vocational Education and Training

The preference for participating in higher education over vocational education and training (VET) is leading to skill shortages, and poor employment outcomes for university graduates. The perceived low standing of VET is an impediment to education（Billett, Hodge & Aarkrog, 2022:20; Deissinger, 2022:84; Hiim, 2022:213; Stalder & Lüthi, 2022:261; Billett, Choy, Hodge & Le, 2022:322）. The "Skills Agenda" draws on active labour market policies as well as on the education and training strategy. The primary and secondary schools may learn essentials from VET. VET is the main supplier for the job market and is typically seen as underpinning foundation of the economy and societal backbone（Rambla, 2022:168; Moodie, 2022:242; Reeve & Gallacher, 2022:154）. As VET is aligned with occupations, making it more interesting and attractive to young people is linked with the standing of occupations（Billett, Hodge & Aarkrog, 2022:19）. Improving the standing of VET has confounded governments globally（Relly, 2022:49）.

(4) STEM: A Phenomenon of Global Interest

Science, Technology, Engineering, and Mathematics (STEM) education, arose in response to match the growing human capital demand, has been a worldwide movement, and rapidly expanding attention from educators（Tan, 2021:160）. An education in the STEM disciplines was important for economic competitiveness, so that STEM education is cited in political and policy domains as being important for economic growth（Babaci-Wilhite, 2022:285; Ellerton & Kelly, 2021:11）. STEM education would address future workforce demands and increase achievement resulting from high-stakes international testing (e.g., TIMSS and PISA) that results act as a proxy for quality education. STEM as a global education policy is now further explored（Berry, 2021:178）.

IV. Local Community in Global Context: Taiwan Experience

Status Quo

Education Policy and Reforms

Globalisation is featured by the global action for talent. This is relevant for the local communities, Taiwan where there is few natural resources except for human capital for propelling the economic development. Taiwan has used the regional hub and internationalization strategy, both in terms of the recruitment of a proportion of international students and the forging of partnerships between local universities and internationally renowned higher education institutions. Those economic and political projects of building a new society rely on the introduction of ICTs into education. The design and the implementation of this reforms take place in the

educational system of the 3–16 years old, and are competency-based. In addition to universalizing access to education, the 12-Year Basic Education reform in Taiwan aims to develop 21 century skills, aligned with economic participation, civic engagement, and lifelong learning. Building on the goals of the articulated curricular reform, the 12-Year educational reform refines the set of competencies in the 9-Year reform curriculum, to support lifelong learning.

The COVID-19 pandemic presented a crisis for both students and educators. Facing the lockdown and the online switch, schools have moved services and resources, transferring them to online platforms and activating resources. The classroom has extended past four walls into the virtual space allowing for learning to happen virtually anywhere and anytime. The leap to online learning as a response to Covid-19 has seen the shifting of learning from a blend of online and face-to-face, framed by the affordances of institutional virtual learning environments. A videoconferencing platform (e.g. Zoom, Go-to-meeting, MS Teams, Zoom, Google Meet, CISCO Webex or Skype) has transformed the underpinning pedagogies and is facilitating active student-centred learning. The educational institutions shifted toward blended learning and pushed teachers and students to become tech-savvy. Smart technology, online, webinars, virtual meeting room, and teleconferencing became commonplace. Education has a key role to play in critical thinking in a world facing significant global challenges such as pandemics, an ageing society, and unsustainable economic development. The government rethinks the means of instruction, advocating for mixed approaches to teaching and learning at different stages of education.

Impact of COVID-19 Pandemic on Education

Despite the uncertainty and anxiety posed by the outbreak, the MOE promptly announced policy initiatives and took various supportive measures. Schools took responsibility for their daily operations and strove to ensure student learning opportunities. The beginning of online teaching and learning was a very sudden transition, and most of the teachers were caught unprepared. They did not get sufficient time to prepare their best lessons and so their instruction may have been compromised in certain areas. Nevertheless, teachers should be commended for their efforts to increase their skills and bring out the best of themselves and their students. The experiences from Covid-19 and future technology both having strong relations for laying the foundation of the future education system. Taiwan has deployed tracking technology to enforce quarantine measures. Advanced digital infrastructure and engineering capabilities of Taiwan enables the government to tackle COVID-19 outbreak quickly.

To reduce the spread of Covid-19, Taiwan decided to temporarily close educational institutions. Nevertheless, learning and teaching did not stop, though they were in part or in full taking place online or with the use of other distance teaching solutions. Some experimented with more advanced solutions where they tried to create virtual learning spaces using some software (e.g., Microsoft Teams, Google Classroom, Zoom, etc.) or other existing school digital platforms. In addition to online platforms, Taiwan used different remote teaching solutions: TV broadcasts with video lessons. The applications of ICT, Virtual Reality (VR), Augmented Reality

(AR), and Mixed Reality (MR) are enormous that there will likely be a convergence between a smartphone, mobile VR headset and AR classes into a single XR wearable. The shift to emergency remote online learning has provided opportunities for effective and innovative solutions to be created. These technologies have a greater potential to increase education standards, and most schools are coming forward to adopt them. Schools have shifted away from traditional learning techniques since the emergence of the COVID-19 virus and shifted towards online education. Majority of the institutions have encouraged teachers and students to use e-learning platforms. Educators have changed their teaching methods by giving students innovative and skilled projects that can meet their learning needs and keep them engaged throughout online sessions.

Geopolitical Shifts and Higher Education

The higher education system has been facing even more challenges to make adjustments to the changing socio-economic contexts. The rise of global market competition and the emergence of the Industrial Revolution are crucial determinants on how the higher education system will evolve. What is more important is concerned about how to enable students to equip themselves with skills which are necessary for them to stay competitive in the global employment market. Therefore, the future of higher education development is about the diversification of learning pathways for students to update skills and knowledge and to improve their employability. One of the triggers for innovating STEAM (Science, Technology, Engineering, Arts and Mathematics) is the arrival of new technologies that need to penetrate primary and secondary school curricula. In the decades since the 2000s, Taiwan has witnessed a rapid development of polytechnic and university education. Given the prioritising of economic development, higher education is used as a tool of economic development. With more emphasis placed on high value-added industries, such as technological and service industries, qualitative but not merely quantitative growth and diversification in the higher education has been the response.

Standing of Vocational Education and Higher Education Workforce

Vocational and educational training (VET) offers high quality learning with working life orientation. Characteristics of the VET includes: work-based learning, employment prospects, flexible learning pathways and qualifications structure of lifelong learning skills. Taiwan is realigning and reforming post-secondary higher education systems with a focus on the development of applied skills and lifelong learning. Taiwan is undergoing educational reform as it looks to accelerate the digital transformation and address the challenges of the skills mismatch and the reskilling agenda. Taiwan has instigated skills future a national movement to drive the development of an advanced economy and inclusive society. But Taiwan is experiencing declining levels of participation in courses for advanced technical skills required for emerging economic needs. The relatively low standing of VET is of people concern. As a result of this diploma inflation process, enrolments in these courses are increasingly from those who failed in general educational courses, thereby making VET a second-class education choice.

The employment challenges confronted by young people in Taiwan, including high unemployment and limited job offers, extended skill or employment mismatches, and promotion of new forms of employment, make youth transition to the labor market more difficult and increase the danger of their social exclusion. Certain proportions of young people are neither in employment nor in education or training, which may probably have a detrimental effect on their employability. Besides early school leaving and other family or individual reasons, education policy plays a role, if the educational system does not have any second-chance programs for dropouts. Many of the youth projects engage the young in training programs to update their skills and competences or to develop new ones that match the market needs, while Taiwan promotes specific actions for the re-activation of the young who are inactive. Taiwan who is interested in pursuing high-skilled technical occupations, whether they require a bachelor qualification, have a wide range of training and education options. Taiwan VET has relatively good status and specific strengths in tradition. These strengths included flexibility, cooperation with the labour market, and an inclusive and integrated approach in relation to skills development for the working age population.

These imperatives in educational policy play a hegemonic role within the framework of economic and political hybrids of globalisation. The analysis of education policy and reforms shows a complex nexus between globalisation and education reforms – where pedagogy is equated with inclusion, equity, tolerance and human rights. Taking such a critical stance opens up for us the space to rediscover some of the alternative discourses that shift the educational agenda towards engaging in inquiry for creative transformation, and empowering individuals in a process for becoming happiness. Then, educators are positioned to provide a more socially just and inclusive experience of education for learners. Table 1 shows "R&D Personnel", Table 2 shows "R&D Expenditure as a Percentage of GDP", Table 3 shows "Government Expenditure on Education as a Percentage of Total Public Expenditure", and Table 4 shows "Expenditure on Educational Institutions per Student Relative to GDP Per Capita".

Table 1. R&D Personnel, End of 2022

	Researchers	Technicians and Supporting Staff	Researcher per 1,000 Employment
Republic Of China (R.O.C.)	153,998	108,309	13.5
Mainland China	2,281,134	2,953,374	3.0
Japan	689,889	221,731	10.1
Singapore	42,295	6,217	11.2
United States	1,586,497	-	9.9
United Kingdom	316,296	158,797	9.6
France	321,550	149,036	11.4
Germany	450,796	283,035	10.0

Source: The Republic Of China （2023a）. Education Statistics. Ministry of Education.

Unit: Person-years

Table 2. R&D Expenditure as a Percentage of GDP, End of 2018 & 2020

	R&D Expenditure(Million current PPP$)		R&D Expenditure as aPercentage of GDP	
	Year 2018	Year 2020	Year 2018	Year 2020
Republic Of China (R.O.C.)	40,334.3	47,935.4	3.4	3.6
Mainland China	465,287.5	583,754.5	2.1	2.4
Japan	172,035.8	174,065.4	3.2	3.3
Singapore	10,270.5	-	1.8	-
United States	618,531.0	720,880.0	3.0	3.5
United Kingdom	54,185.4	-	1.7	-
France	68,654.0	74,563.3	2.2	2.3
Germany	142,320.2	144,352.7	3.1	3.1

Source: The Republic Of China （2023a）. Education Statistics. Ministry of Education.

Unit : Million current PPP $; %

Table 3. Government Expenditure on Education as a Percentage of Total Public Expenditure, End of 2019

	Primary, Secondary, Non-tertiary Education	Tertiary Education	All Levels of Education
Republic Of China (R.O.C.)	11.5	3.5	20.8
Japan	6.2	1.6	7.8
United States	8.3	3.4	11.7
United Kingdom	8.4	3.4	11.9
France	6.3	2.2	8.5
Germany	6.4	2.8	9.2

Source: The Republic Of China （2023a）. Education Statistics. Ministry of Education.

Unit：%

Table 4. Expenditure on Educational Institutions per Student Relative to GDP Per Capita, End of 2019

	Primary Edu.	Sec. Edu.			Post-Sec. Nontertiary Edu.	Tertiary Edu.
			Jr. High Sch.	Sr. Sec. Edu.		
Republic Of China (R.O.C.)			20.6	16.5	-	23.3
Japan	22.2	27.2	26.2	28.1	-	46.1
United States	21.6	24.4	23.2	25.6	25.1	55.4
United Kingdom	25.0	27.3	25.8	28.6	-	62.2
France	19.1	27.6	24.2	32.2	24.0	37.2
Germany	19.1	25.9	23.5	29.9	23.2	35.2

Source: The Republic Of China （2023a）. Education Statistics. Ministry of Education.

Unit：%

V. Discussion

This study shows, amidst the challenges caused by the COVID-19 pandemic, people found ways to support schools in sustaining educational opportunities（Reimers & Marmolejo, 2022:334; Solloway & Stahl, 2022:128）.

ICT in Education: Challenges and Opportunities

Globalization changes spheres of life（Revina, 2022:710）. For the prosperity of society, education is necessary（Kogut, 2022:659）. Globalization and technological revolution have been used to legitimate a restructuring of schooling and provide educators to propose their models of pedagogy and reconstruction of education to serve social change（Kellner & Gennaro, 2022:38; Nicolaides & Eschenbacher, 2022:6）. The pandemic COVID-19 has forced people to move to online learning that based on digital technologies makes the educational process more flexible. A new hybrid model of education will bring more benefits（Mulà, Cebrián & Junyent, 2022:190,191; Volkodaeva, Balanovskaya & Rustenova, 2022:589; Anisimova & Efremova, 2022:777; Dozhdeva, Franchyzenko & Nikolashina, 2022:625）. Open Educational Resources (OER) have emerged as a powerful alternative to provide open and flexible online education to all（Ouahib, Kharki, Bendaoud, Burgos & Berrada, 2022:35; Kozhukhova, Agaphonov & Korobkova, 2022:846; Kellner & Gennaro, 2022:35）. The digital divide remains one of the main challenges of the virtual and remote learning environment and the pandemic has exacerbated the inequal access to the technological infrastructure（Ba, 2022:116; Repina, 2022:886）. Future research will need to explore the extent to which instructors' attitudes towards online teaching and willingness to show flexibility in the classroom has been affected by their pandemic teaching experience, and to mind the technological gap and digital divide（Glazier, 2022:165; Cerdio, 2022:44; Roy, 2022:78）.

Hybrid/Blended Learning Spaces

As the usage of smartphones and electronic devices is increased, people are getting connected by the internet（Verma & Soni, 2022:25; Nørgård & Hilli, 2022:29; Kohls, Dubbert & Münster, 2022:254）. Transformational teaching is important in creating a shared vision for brave space that students share responsibility and may challenge the learning process（Brazill & Munday, 2022:168,169）. Creativity becomes one of the desired skills along with critical thinking and complex problem-solving（Mor-Avi & Scott-Webber, 2022:235）. The new learning spaces are generally visually attractive and are designed with the latest technology. A technology-enriched learning environment creates a context for enriching thinking and learning（Manciaracina, 2022:29,30; Birkinshaw, 2022:5）.

Sustainable Development and Education

The Sustainable Development Goals, especially the SDG 4, stressed that inclusive education is the most effective way to give all children a fair chance to go to school（Zajda, 2022a:127; DeJaeghere, 2022:87; Lenkaitis, 2021:214）. For Education for Sustainable Development (ESD), competence-based education is linked to a focus on improving employability（Kadji-Beltran & Zachariou, 2022:72; Réti, Lippai & Nemes, 2022:100）. Technological change, globalisation, and demographics are cited as the main drivers that change the structure of employment and the pattern of demand for skills. The education models should reflect the need for lifelong learning by enabling individuals to access learning opportunities in different ways. Especially with

the Covid-19 pandemic, the education programmes should be dynamic and adaptable to produce resilient and work-ready graduates（Butler, Rorich, Sparks & Wadasinghe, 2022:27,28）. However, the important problem is how to form soft skills or competencies, such as emotional intelligence and leadership, that are necessary in working in an uncertain environment（Vasilieva, 2022:363; Vare, Lausselet & Rieckmann, 2022:196）.

Uncertainty and Pedagogy

For education to meet the demand for industry-relevant skills oriented toward the future of work and suited to the critical creativity, it will be imperative that educators push students to critically and creatively imagine what it might be（Barr, Hartley, Lopata, McFarlane & Mcnamara, 2022:350; Galderisi, Menoni, Setti & Tognon, 2022:44; Reimers & Marmolejo, 2022:345）. Uncertainty is inherent in creative work. It is possible for the creative potential of students to mature, and to be expressed in creative performances（Runco, 2022:28; Rizvi, 2022:100; McKay & Mabunda, 2022:305）.

Educational Transformation

It is asserted that utilising the open educational resources (OER), massive open online courses (MOOCs) and the online learning courses would able to provide flexible online resources and training materials for students to generate new knowledge and skills to cope with the complexity competencies at work（Yuk-Kwan Ng, Wells & Lam, 2022:68）. There exists a consensus for the need to establishing an inclusive and equitable atmosphere in schools（Zajda, 2022a:128）

(1) From State-Centered to Market-Centered Compulsory Education

Transmission of knowledge by teaching the curricula to children in schools became a requirement of modern societies（Seitzer, Besche-Truthe & Windzio, 2022:43）. Massification was accompanied by a diversification of the systems, which governments considered an imperative to respond to the varied capacities of an increasingly heterogeneous student population. Diversity played an important role when education systems moved from elite to mass, including the offer of a number of alternative choices to students（Amaral, 2022b:29）. A shift from state- to market-centered relations of education has changed dramatically: what used to be described as state-driven is now market-driven（Amos, 2022:55; Nakamura, 2022:64; Macleod, 2022:100）.

(2) Higher Education : A New Geopolitics of Knowledge

One of the missions of higher education institutions (HEIs) is the social innovations that can take place across the higher education: learning through diversity, and facilitating digital and virtual learning（Kaputa, Loučanová & Tejerina-Gaite, 2022:68）. Investments in digital learning through development of online learning platforms, Massive Open Online Courses (MOOCs) and blending learning is of importance（McDonnell-Naughton & Păunescu, 2022:21,25; Ouahib, Kharki, Bendaoud, Burgos & Berrada, 2022:43）. The expansion

of higher education is considered necessary to participate in the global economy and realize the goals of national economic development（Rizvi, 2022:95,96; Erfurth, 2022:211,212; Taylor, 2022:415,416）. HEIs should set up in the specific goals towards digital transformation. The emerging digital technologies and the educational innovations are disrupting learning processes and structures that it is now an imperative to develop a new educational paradigm（Kaputa, Loučanová & Tejerina-Gaite, 2022:65; Amaral, 2022:42）.

(3) Enhancing the Standing and Status of Vocational Education

The missions that provide high quality technical education, and match demand in labour markets, have been an emphasis on higher education, which（Bathmaker & Orr, 2022:70; Veillard, 2022:156; Hiim, 2022:219）. The initiatives at the of VET reforms aimed at enhancing the standing of VET that more students should enrol in VET（Aarkrog, 2022:282; Veillard, 2022:156; Hiim, 2022:219）. Today's applied degree education discourse is referenced to the Industrial Revolution which is the use of modern smart technologies to automate manufacturing practices. The new technologies have become pertinent today, when the impact of Covid-19 has signalled the need to be ready for the unknown（Chigaeva-Heddad, 2022:101; Hong, 2022:7）. An entrepreneurial mindset may serve as a driver for VET（Kommers, 2022:432）. These higher vocational education credentials have the high proportions of students from historically under-served groups, and likely have the positive implications for equity (Skolnik, 2022:118）.

(4) STEM: A Phenomenon of Global Interest

Some studies indicate that digital technologies can aid learners' inquiry-based learning, and allow access to a variety of resources online. The multi-modality of digital technologies is important for student learning. Learners benefit from being able to explore concepts in a range of modalities that students are better able to learn science and mathematics concepts when they are presented in multiple modalities. STEM provides more of a real-life experience and a more immersive learning environment（Larkin & Lowrie, 2022:47; Corrigan, Panizzon & Smith, 2021:92,93; Berry, 2021:184）.

VI. Conclusions and Suggestions

Challenges and Issues

The current developments caused by the pandemic will lead to call for economic restructuring that foreground human wellbeing. This study proposes technology-enhanced learning as an innovative approach in the new normal, and unleashing the creative potential to better education and out of middle-income trap （Hewamanne & Yadav, 2022:14; Pang & Hou, 2022:379）.

Digitalization of Education for Promotion

Digital learning and distance education has emerged as a pivotal approach in disseminating social innovataion ideas（Kaputa, Loučanová & Tejerina-Gaite, 2022:69,70; Belyakova, Pyrkina & Chuikova,

2022:791; Repina, 2022:887; Sevastyanova, 2022:895; Mantulenko, 2022:930）. These initiatives of Open Educational Resources (OER) provide an efficient model that find more innovative and digitally compatible alternatives, and ensure inclusive and equitable quality education and promote lifelong learning（Ouahib, Kharki, Bendaoud, Burgos & Berrada, 2022:45; Margoum, Machwate, Alaoui, Bendaoud, Landry, Masse, Bennis & Berrada, 2022:86）. The ed-tech solutions will incorporate more tools to support education. Online learning, technology-based learning and AI models will increase in the future（Jugo, 2022:275; Van Dam, 2022:77; Gourari, Raoufi & Skouri, 2022:137）.

New Normal - Hybrid Learning Spaces

Integrating transformational teaching practices in a multicultural education course can create a brave space, an inclusive online environment that is accessible for all learners（Brazill & Munday, 2022:179）. When depicting embodiment in Virtual Reality (VR) environments, it becomes challenging to impose the requirements for achieving maximum intelligence. Such pedagogical intelligence adds to the appeal of the VR environment and makes it more motivational in an innovative learning setting（Soliman, 2022:300）. The change in the learning paradigm is needed to use educational technology effectively（Manciaracina, 2022:90）.

Sustainable Development and Role of Education

Youth is part of a generation that will grapple with rising levels of inequality and more challenges. They deserve these skills to have a fighting chance of living life（Schmidt, 2022:275,276）. By aligning life skills, education can go a long way toward achieving the goals that the SDGs, governments and people aspire to achieve（DeJaeghere & Murphy-Graham, 2022:12）. We have to keep maintaining our attempts persistently to have a sound place for the SDGs in our national policies and curricula（İnce, Dayıoğlu-Öcal, Soysal, Albayrak-Sarı, Bağcı & Öztürk, 2022:19）. It requires an interdisciplinary approach to teaching and learning that can facilitate the acquisition of skills and competencies（Butler, Rorich, Sparks & Wadasinghe, 2022:29）.

Uncertainty and Pedagogy

The experience of teaching during the pandemic should remind us of how difficult instructional environment will be（Pampinella, 2022:231）. Education has encountered pressure to change from face-to-face delivery of courses to digitally enhanced teaching for distance learning. The significant problem regarding this change is that not all students equally benefit from the various remote learning approaches（Izumi, Shaw & Zhang, 2022:46）. Policymakers need to apply this experience of COVID-19 pandemic and be prepared in advance against the next pandemic situation to avoid any type of loss. These digital technologies play a significant role to combat COVID-19 pandemic. Lifestyle of people has been transformed from offline to online mode to survive in society. Societies need to adapt to the change and design digital solutions to combat any uncontrolled disasters like pandemics（Bhattasali & Savarimuthu, 2022:208）.

Competencies of the Future: Transforming Education in the Digital Economy

As the educational practices drive improvement in economic development, education policy development becomes a research priority. The solution to the current situation in the labor market can be investments in education and training, which are seen as the basis for increasing competitiveness and progress in the economy and employment（Kozhukhova, Agaphonov & Korobkova, 2022:847）. There are many opportunities for educators to look beyond the traditional sources that can provide new creative and inspiring learning experiences for students（Parsons & MacCallum, 2022:18; Wannemacher, Lübcke, Seyfeli-Özhizalan & Graceva, 2022:29）.

(1) Main Trends in Education for National Development

Taiwan has gone a long way in addressing equity in education that started to reform the school system based on the belief that an individual's life chances could not depend on their family's socioeconomic status. The segregation between schools for the rich and the poor was gradually eliminated and compulsory education was extended already in the 2000s with the inclusion of senior-high secondary education in the 12 years' compulsory schooling, thus abolishing the selection between primary and high schooling. Policies was aimed at the expansion of higher education systems as a necessary condition for widening access to new publics. This has been achieved through the diversification of higher education provision. In addition to expanding higher education, other policies intended to create conditions to allow the democratisation of access by fostering the participation of under-represented groups. Such policies aim to promote inclusion by increasing the participation of under-represented and disadvantaged groups in higher education（Tavares, Sin & Sá, 2022:223-225）.

(2) Higher Education Reforms: Emerging Paradigms

Higher education reforms represent policy responses to globalized market ideology, which focuses on increasing global competitiveness, accountability and quality-driven policy reforms（Zajda & Jacob, 2022:14; Zajda, 2022b:205）. With the massification of higher education systems, there has been an increase in the number of students from deprived backgrounds entering higher education. As Taiwan massifies its system of higher education, assuring equity and fairness in college and university admissions will continue to be a significant policy issue（Dill, 2022:66）. Through marketization, higher education absorbed diverse resources to accommodate an emerging demand for highly educated and trained human resources to sustain their rapid economic growth. It is a good timing for higher education to reconsider its future strategy for development. The exploration of how Taiwan integrated its diversities to the variations of higher education provides us with a much more meaningful perspective to understand the process of Taiwan higher education development and its global implications（Liu, 2022:144; Lawrence & Rezai-Rashti, 2022:164）.

(3) Enhancing the Standing and Status of Vocational Education

The concept of different educational pathways leading to equally rewarding job outcomes is seen as a particular strength of the VET system（Stalder & Lüthi, 2022:262）. A major issue remains concerning the positioning of Higher Vocational Education (HVE) in the highly stratified system of higher education in Taiwan. A reformed system of HVE may turn into a high-quality route that favours the academically successful or continue to be deemed the appropriate route for certain types of students（Bathmaker & Orr, 2022:73）. However, there is still significant work ahead to bring about parity of esteem between vocational and disciplinary degree qualifications（Papier & Needham, 2022:97,98）. Articulations between vocational and academic educations provide a type of permeability essential to address persistent inequalities in higher education participation. If these students seriously consider and choose advanced work-based higher education, this may well increase the standing of apprenticeship training（Graf & Powell, 2022:140）.

(4) STEM Education Opens Up Important Opportunities for Teachers and Learners

Education should strive to give to students the greatest latitude for action in the future. The cross-curriculum capabilities need to be seen as central goals of education. Integrated approaches to STEM education can support multiple learning outcomes（Berry, 2021:190; Babaci-Wilhite, 2022:296）. While the global economy and societal needs have prioritized STEM education, students need to gain global competencies and learn other cultural backgrounds to help bridge peoples in a globalized knowledge-based society. STEM education prepares students to compete in a global market and provides opportunities to gain a broader perspective applicable towards critical thinking and problem-solving（Yamada, 2022:107; Berry, 2021:189）.

VII. Limitations and Implications

Outlook for Future Research

(1) Empower Digital Technologies

The rapid development of technology and the constant innovation and application of ICT make change of the future lifestyle and induce comprehensive changes. Potential and possibilities of this wide range of digital tools should be explored by implementation in educational contexts（Roy, 2022:58,59）. Those educational policymakers have to ensure the selected methodologies fit with the context and standards of their educational institution. It is recommended to choose the appropriate tools and practices that facilitate the use of the selected methodologies. These researchers are recommend to use the new ICTs and innovations to empower online systems（Massoud & Abdel-Latif, 2021:342）.

(2) Brave New World: New Developments in Technology-Enhanced Education

Critical self-reflection is vital to transformational learning and teaching. The student's reflection indicated the significance of having a brave space in expressing their identity but also in embracing the growth that comes from accepting diverse otherness（Brazill & Munday, 2022:171,172）. Technology should be more present in

the classrooms, and blended, hybrid and online programmes will coexist. This means that the ground is ready for virtual exchange to take the needed step of normalization. Some of the challenges that are being faced are how to scale up virtual exchange and give credit for student work in this context（Appel & Fernández, 2022:596）. Moreover, future research should systematically account for the consequences of education policy in different cultural spheres. This information should be used in future studies to assess the actual consequences of education policies in different cultural spheres（Windzio & Martens, 2022:298,299）.

(3) Uncertainty Makes Creativity Possible

The creativity of the modern age led to progress in science and technology, leading to social change. Creativity and innovation are drivers of the economy, and there is an increasing awareness of the importance of creativity（Runco, 2022:32）. Schools should be successful in promoting curiosity and associated intellectual virtues if this is supported by the alignment across educational systems. Those educators should tolerate uncertainty if they are to best support the creative potentials of their students（Runco, 2022:33,34）. Future research should further assess the efficacy of using these methods to promote curiosity, such as the role of support for autonomy in learning and making connections and meaning of what is being learned. Importantly, research should also explore what might be learned from these other education examples for supporting development of comfort with uncertainty, looking across levels of educational systems（Jirout & Matthews, 2022:263-265; Barr, Hartley, Lopata, McFarlane & Mcnamara, 2022:352）.

(4) Developing Inclusive (Digital) Pedagogies and Future Directions

The promotion of ICT education policy will enable education to present a new appearance of learning. Schools and higher education systems are continuously confronted with the growing challenges of preparing students to successfully participate in the digital age（Osorio & Banzato, 2022:291,292; Koshy, Mathew & James, 2022:97）. What will or should be the post-pandemic management of education governance remains open to discussions. But an important reflection has been noticed that the digital education cannot be neglected （Pal, Dhungana & Pal, 2022:19; Hassan, 2022:597）. It is imperative to understand the interactions of various online education components and devise tailor-made solutions. A deliberate effort to address micro, meso, and macro-level aspects of online education, especially in the local context may lead to the desired results（Sadiq & Malik, 2022:227; Tan & Chua, 2022:272）. Recent searches of the literature suggest an emerging trend towards encouraging teachers to develop inclusive pedagogies. Future policies for inclusive education need to focus on teacher education, establishing a repository of supporting information for practitioners and unlocking the potential of digital pedagogy to support inclusive education（Cranmer & Lewin, 2022:73）.

(5) A Better Education -- Learning Organizations

This paper is a plea for educational policies that promote and sustain the ICT infrastructures for schools. It signaled that schools face the need to become learning organizations. The combination of ICT infrastructures

and software facilities in schools and the participation in learning networks is expected to be the critical factor in a longer-term sustainable innovation in education. The ICT impact on education should lead toward the internal development of educational institutions as learning organizations（Kommers, 2022:313）. To maintain the high standing of VET, the quality of apprenticeship must be ensured, access to higher education and training must be facilitated, and workplaces should offer possibilities for learning and positive career development to all employees（Billett, Hodge & Aarkrog, 2022:26）.

Limitations of Study

(1) How about Learning Engagement in Technology-Enhanced Teaching and Learning

This study shares insights on learning engagement in the context of student creativity facilitated by the use of technology during COVID-19 pandemic. The types of technology used and discussed are limited. Owing to these limitations, readers should interpret the results presented with caution because results may have limited generalizability and applicability in different contexts. People may doubt how about students are willing to explore new technologies and they are ready for such learning models? whether learning engagement in technology-enhanced teaching and learning depends on how technologies are used in the classroom? how projects and activities are carried out? and whether or not these tasks are relevant to the students（Wong & Li, 2022:134）?

(2) No Prescribed Concrete Alternative Tools

A limitation of this study is that we have not prescribed concrete alternative tools that sustain the energy of teaching and learning interaction. This owes to the understanding that this work primarily serves as a conceptual framework and critique. It is significant to note that although this work is oriented towards instructional systems, we do not absolve teachers and course developers of the responsibility to re-evaluate their pedagogical practice in the context of online learning（Facciolo & Meilleur-Rivers, 2021:173）.

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