BARCELONA

THE BARCELONA CONFERENCE ON EDUCATION

OFFICIAL CONFERENCE PROCEEDINGS

DECEMBER 08–10, 2021

ISSN: 2435-9467

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The Barcelona Conference on Education 2021

Official Conference Proceedings

ISSN: 2435-9467

The International Academic Forum (IAFOR)
Sakae 1-16-26-201
Naka Ward, Nagoya, Aichi
Japan 460-0008
www.iafor.org

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Parents and Their Voices Outside the Classroom: Perceiving Freedom in Education

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Education is perceived in different ways depending on various factors. Many parents and students alike go through the process in a passive way and keep moving forward simply because the system pushes them forward. This may lead toward destinations which are not necessarily according to their wishes, nor beneficial for their future prospects. It is a requisite in this whole discourse that before expecting answers, we ought to decipher the level to which parents and students alike feel not only involved but also the owners of their own journey in education, free enough to put forward their opinions on their education, considering an attitude from parents/guardians towards the experience that student is passing through and whether the former allow the latter to walk through paths which may seem unheard of or even leading to fruitless trajectories. The discernment including different possibilities is certainly a philosophical argument which is more concerned on the freedom and liberty of the individual rather than the institution (be it the class or the school). The class or school environment should be scaffolded upon the individuals' personal perception of freedom within the system the s/he operates. Students and parents perceive freedom according to their different points of view within the context of formal education. They may or may not think they are in control of the educational journey and whether the choices made are in fact the result of their decision, reflecting their opinion within an educational system which dictates a menu of choices.

Keywords: Parental Involvement, Freedom in Education, Choice, Ownership Trajectories

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Introduction

Freedom is a concept directly linked with choice. 'Freedom and liberty in choice' are not only linked to the exact moment when choice is affected but go even beyond that moment. In order to be able to make the choice, there are decisive decisions which serve in favour for the choice to happen which includes the necessary freedom and information needed. Such a system aimed towards an informed process of freedom, needs to be scaffolded through rational, informed and voluntary choices which promotes critical thinking while analysing the key elements in the system itself.

The concept of choice is also elemental to the education systems which provide students with the opportunity to discover and develop towards "freedom and liberty in choice"[1]. Decision makers in these education systems employ the system by evaluating the possible options, also resulting into the foremost outcome in line with their assessment, with the hope of "the knowledge, skills, attitudes and dispositions that children develop"[2] for the benefit of the student/citizen as well as others in society. Students on the other hand not only choose subjects and courses but also their lives' trajectories which will eventually lead them to become active citizens in society.

In this paper I shall give consideration to the notion of freedom and its perception by parents in Malta subsequent to a questionnaire which was randomly shared amongst parents through various online platforms with a total of 500 respondents. The participants were asked about their general opinion about their own education and their choices in their educational trajectories and how their experience influences their own sons' and daughters' choices in education. I will hereby reflect on the questions and how the respondents, today's parents, answered as they look back at their own education.

Voices of Parents

The Participants

The questionnaire was put forward to a broad audience, all of whom were parents from different genders and ages. Yet it is interesting to note a few demographic points resulting from the respondents of the questionnaire. From a total of 500, only 33(6.6%) were male respondents, and 467(93.4%) were females. The ages varied from 18-25 years with 16 (3.2%) respondents; 26-35 years with 122(24.4%) respondents; 36-50 years with 293(58.6%) respondents; 51-65 years of age with 58(11.6%) respondents and 66 years and over with 11-(2.2%) respondents.

Age	
18-25 years	16-(3.2%)
26-35 years	122-(24.4%)
36-50 years	293-(58.6%)
51-65 years	58-(11.6%)
66 years and over	11-(2.2%)

Table 1. Age of Respondents

It is interesting to note that 237(46.2%) had a tertiary level of education and only the very least of the respondents only had a primary education or less. Keeping this information in mind, the respondents also answered about the type of education institution they attended up to their secondary years with 30(6%) affirming that they attended a private or independent school; 143(28.6%) attended in a Church / Faith School while 327(65.4%) attended in a public state school.

Education level	
Tertiary (PhD)	6-(1.2%)
Tertiary (Masters)	68-(13.6%)
Tertiary (1st degree)	157-(31.4%)
Up to post-secondary	148-(29.6%)
Up to secondary	119-(23.8%)
Primary level or less	2-(0.4%)

Table 2. Education Level Obtained by Respondents.

Type of Educational Institution	
Private/Independent	6-(1.2%)
Church/Faith	68-(13.6%)
State/Public	157-(31.4%)

Table 3. Type of Educational Institution Attended by the Respondents.

Note: In Malta, primary and secondary education (compulsory education) is divided into three sectors: State/Public, Church/Faith and Private/Independent.

Perception of Freedom

For a truly free choice to be performed, it is required for an agent for have a free mind, where despite the particular circumstances that the agent is living in, the context does not coerce him/her to make a particular choice because of the context itself (be it society, an institution, family etc). On the contrary, it is the deliberative process which should lead the agent toward that particular decision. Of course, there may be values and interests that may influence the process of deliberation, yet it is crucial to "analyse the source of the concept, that is to search for the original impression that generates it"[3] so that the agent is enabled to decide upon the options and the consequences of the choice/s performed.

The respondents in the presented questionnaire were interviewed regarding the influences they experienced along their own educational journey. Their own educational experience impinges, to a certain extent, upon the perception and/or experience they pass on to their children, depending on whether they had a positive or less positive encounter with education. The ownership experience is not simply a 'feeling'. Perceptions also form part of experiences and parents too have their perspectives of the educational journey based upon their own experiences. Nevertheless, ownership is felt and more importantly, expressed, when parents are fully immersed in their children's educational voyage. It is therefore of utmost importance to strive for parental involvement and ownership.

A qualitative educational system equipped with the vision of the student being a free agent, would provide the student (and his parents/guardians) with the free choice of schools, subjects, trajectories and the whole needed framework which aids him/her to follow a particular path in education. Autonomy and ownership in the process of choosing needs to allow free will to prevail. For a good prospect of lifelong learning to be engaged, the more owned does the process needs to be. The issue remains whether the educational structure permits students to opt for decisions which are free or else a type of coercion which specifically leads towards choices due to institutions' limitations as well as the national agendas that lead towards or away from specific trajectories.

Influences	
School System	152-(30.4%)
No influence/interference	149-(29.8%)
Parents/Guardians	134-(26.8%)
Friends	56-(11.2%)

Table 4. Some of the Main Influences/Interferences Mentioned by the Respondents

Ownership / Control	
YES strongly agree	51-(10.2%)
YES agree	197-(39.4%)
Not Sure	122-(24.4%)
NO disagree	112-(22.4%)
NO strongly disagree	18-(3.6%)

Table 5. The Perception of the Respondent's Control Over Their Own Educational Trajectories

When 252(50.4%) respondents state that they do not know or disagree with the statement of themselves owning the process of subject choice (Vide table 4), this suggests the ownership perception that parents of today's students had during their own experience as students. Their own viewpoint in their children's journey in education today is surely in some way influenced by their deficiency in ownership due to various basis that distinguished their schooling years.

On the other hand, it is interesting to note that when respondents replied to the identification of the possible origin of their interferences or influence, 149(29.8%) respondents answered that they had no influence / interference. This is an intriguing reply due to the fact that in the Maltese education system, different scholastic institutions provide divergent options and not all possibilities are provided in every school. Therefore, institutional limitations were not perceived as an influence or interference by the respondents. Others declared that the school system interfered 152(30.4%), while 134(26.8%) stated that it was their parents / guardians that influenced their choices in education. Only 56(11.2%) declared that they were influenced by friends and their choices, as they were in the decision-making process themselves.

Freedom Towards Flourishing

Critical minds are able to examine and process values which in/directly influence different choices yet still able to think beyond the same influences. Such an ability enables the agent to ponder upon the different possibilities, the principles and the consequences of any choices while discarding others. Undoubtedly, all students get their influence in some way or another. Nevertheless, it is also true that if any influence or constraint is purely accidental and not purposely limiting free will, a critical minded student should have the propensity for ownership of the process and follow his/her choices with an intrinsic liberty.

One important issue which education stakeholders need to have in the decision-making process is to what extent should values and beliefs be bestowed onto students. This is even more pertinent should the emanated principles and ideals be in disagreement with the principles and ideals that the students already own. The student's perception in the learning process would be ameliorated with the educator's eliciting of the information from the student's part. This eliciting from the educator accompanied by development through the elicited knowledge, would enhance the student's perception to be in favour of the input provided to and through him/her.

The blend between 'directive' and 'non-directive' teaching still is a valid pedagogical approach. The eliciting and the imparting of knowledge as a collection of elements is a crucial ingredient in education. However, false beliefs should also be part of the educator's tools so as to develop or make use of an example in order to portray a message. When an educator identifies what should be deemed an education suitable for students to prosper[4], truth and knowledge are crucial for an efficacious development. Conditioned as to what prosperity is targeted, the educational goods would differ in content as well as the intensity with which these are conferred as such decisions are often combined decision-making activity.

Conclusion

To conclude, one cannot assume that in education any stakeholder is or should be in 'a total control' or else that 'the student has a total free will' as this is against the nature of education itself. If the student were to be totally free in his/her will, it would result in the educational goods presented to him/her being completely useless, almost putting in doubt the freedom of will of the student with a limited amount of goods as well as plausible trajectories. Robert F. Dearden portrays that the evolution of "autonomy as an educational aim" in the context of the development of a person where his/her "thought and action in important areas of his life are to be explained by reference to his own choices, decisions, reflections, deliberations". Dearden is thus suggesting that the whole exercise is not only owned but also driven by the agent's "own activity of mind".[5]

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Remote Teaching and Learning: Resilience and Academic Voices

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Higher Education Institutions (HEIs) have been driven to rethink, redesign, and respond overnight in the COVID-19 pandemic. The instantaneous closure of education institutions in South Africa, and worldwide raised several questions in terms of the adaptability and readiness of the HEI sector to adapt and respond to the changes. The changes called into question issues such as in-person teaching and learning practices, digital resources, academic staff, and student readiness for learning in digital environments, and connectivity and access to internet services and facilities. The roles of academics and students have changed drastically. COVID-19 has taught us several lessons in higher education. As teacher educators, to move successfully to post-COVID-19 educational environments we need to heed these lessons by listening to the voices of role players such as students and academics. Drawing on Ungar's resilience theory, the aim of this paper is to provide the voices of academics working in teacher education during the rapid and unplanned move to remote teaching and learning during the pandemic. The research paradigm in interpretative, and the approach adopts the use of qualitative case studies. The methods include ongoing interviews with, and narratives by staff, conducted online because of social distancing rules. The author also conducted participant and non-participant observations of online classes.

Keywords: Remote Teaching And Learning, Covid-19, Academic Voices, Resilience

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Introduction

South African was declared a national state of disaster and schools and universities were closed in mid-March 2020, to contain the spread of the coronavirus. This move marked a change in education never seen to this extent before. The move caused momentous concern within the education sector, most especially regarding the way forward for teaching and learning in schools and universities. In their 2020 proposals for a post-Covid-19 era, the World Economic Forum and the World Bank, highlighted the need for a revival of educational systems. The COVID-19 pandemic has propelled Higher Education Institutions (HEIs) to rethink, redesign, and respond in real time. The dramatic closure of education institutions in South Africa, and worldwide raised several questions in terms of the adaptability and readiness of the HEI sector to adapt and respond to the changes. The challenge for universities lies in successful online teaching and learning, given the demand for the almost immediate digital transformation of courses. Teaching and learning required modification through the incorporation of technology (UNESCO, 2020). Indeed, the real challenge is the pace at which these adaptations had to be made in the context of the current pandemic (Kedraka and Kaltsidisi, 2020).

The changes called into question issues such as in-person teaching and learning practices, digital resources, academic staff, and student readiness for learning in digital environments, and connectivity and access to internet services and facilities. Given the roles of academics and students have changed drastically, this has prompted worldwide scrutiny of teaching and learning in a way never experienced. The implementation of sustainable pedagogical approaches subsequently requires broad consultation particularly with key stakeholders such as academics and students, given that lack of academic and student engagement can gravely affect the sustainability of new pedagogical models that are initiated.

COVID-19 has taught us several lessons in higher education. As teacher educators, to move effectively to post-COVID-19 educational environments we need to heed these lessons by listening to the voices of our academics. The aim of this paper is to provide the voices of academics working in teacher education during the rapid and unplanned move to digital teaching and learning during the pandemic. The research paradigm is interpretative, and the approach adopts the use of a qualitative case study. The methods include ongoing interviews with, and narratives by staff, conducted online because of social distancing requirements. The author also conducted participant and non-participant observations of online classes. The paper is organized as follows: In Section 2, the literature review is presented, under sub-sections: Emergency remote teaching, and resilience. In Section 3, the research design is presented. In Section 4, I present the research findings. Section 5 discusses the research results and their practical implications.

Literature Review and Theoretical Framework

Emergency Remote Teaching

Courses offered online in response to crisis situations are markedly different to online teaching and learning experiences that take months to plan, design and implement. In current times staff and student safety remains a priority. Institutions in South Africa opted to close in March 2020, as has remained the case into 2021, except, more recently, for staff and students working in laboratories or facilities, where access to specific equipment is mandatory. To continue teaching and learning in a fast-moving, little understood pandemic remains requisite, with staff and students having a range of capabilities to function online. Technological access remained

a priority, and universities began delivering tablets and laptops to students who did not have access to maintain a smooth flow of teaching and learning. Data was also dispensed to staff and students; however, the bulk of the data was allocated to little used late-night hours. Universities went into overdrive to conduct sessions on how to teach online, with staff and students every so often declaring discomfort at their limited ability. Technology support staff were inundated with cries for assistance.

Researchers in online and distance learning, distinguished design solutions that have been developed and implemented: distance learning, distributed learning, blended learning, online learning, mobile learning, and others (Hodges, Moore, Lockee, Trust and Bond, 2020). The authors offer discussion around the terminology and formally propose a specific term for the type of instruction being delivered in these pressing circumstances: emergency remote teaching. For Hodges et al (2020) emergency remote teaching (ERT) is a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. ERT involves the use of fully remote teaching solutions for education that would otherwise be delivered face-to-face or as blended courses that will most likely return to that format once the crisis or emergency has abated. The central objective is not to re-create a robust educational system but to provide temporary access to instruction that is quick to set up and is available. Thus, the authors distinguishing between ERT and online teaching and learning.

Resilience

Resilience examines positive development in people when faced with significant adversity. For Ungar (2008; 2018), resilience is the capacity of individuals and groups to navigate their way through the psychological, social, cultural, and physical resources that sustain their wellbeing, and their capacity to negotiate for these resources in culturally meaningful ways. The concept has multiple uses. It may describe characteristics refugee children, as an example, have when, despite being born and raised in disadvantaged circumstances, they grow up successfully; resilience may refer to competence when under stress; and resilience may be positive functioning indicating recovery from trauma (Ungar, 2008). These conceptualisations overlap. What is common is that resilience occurs in the presence of adversity. As Masten, Powell and Luthar (2003) write: “Resilience refers to patterns of positive adaptation in the context of significant risk or adversity” (p.4). Resilient people need resilient families, communities, and schools. For Ungar, this raises two important issues. First, if someone successfully develops under adverse circumstances (a precondition for us to speak of someone as resilient), different communities under stress may offer different resources that sustain their well-being. It is possible to argue that those who make the most out of whatever is available to them should be considered resilient even if their behaviour does not look like resilience when viewed by members of outside communities. Although Ungar’s work lies predominantly with children and youth, the concept is applicable to other age groups and circumstances as well. In Ungar’s (2008) work, findings from a 14 site mixed methods study of over 1 500 youth globally support four propositions that underlie a more culturally and contextually embedded understanding of resilience: 1) there are global, as well as culturally and contextually specific aspects to people’s lives that contribute to their resilience; 2) aspects of resilience exert differing amounts of influence on a people’s lives depending on the specific culture and context in which resilience is realized; 3) aspects of people’s lives that contribute to resilience are related to one another in patterns that reflect their culture and context; 4) tensions between individuals and their cultures and contexts are resolved in ways that reflect highly specific relationships between aspects of resilience.

Research Design and Methodology

This research follows the interpretivist paradigm, utilising a qualitative case study, the aim of which is to examine the experiences of academics at a university in Johannesburg during the Covid-19 lockdown. Based on definitions by Yin (1994), Knobel and Lankshear (2007) and Gillham, (2000), the case study is an in-depth, descriptive, and interpretive study that focuses on a single bounded instance. It is based on real-life contexts and relies on multiple sources of data collection. Purposive sampling was used to discern, comprehend, and gain insight; in other words, a sample was selected so that the most could be learnt (Merriam, 2002). For this study, ten academics (male and female), at various levels of their careers in a School of Education at the university participated.

Data was collected through online interviews because of Covid-19 social distancing restrictions, as well as observations of online classes I teach. Interviewing is a valuable source to access the participants' views. The main purpose of an interview, according to Henning is to provide access to people's thoughts, feelings, and practices. The interviews were voice recorded and complemented by extensive written notes. After collecting the above data, the audio recordings of the conversations were transcribed. The second component in data collection was observations, which constitute watching people's actions, listening to their conversations, and asking them questions to clarify at times (Gillham, 2000: 45). I also observed as participant of the classes I taught. I made comprehensive field notes which form the basis of the data analysis. In this study, I draw on Braun & Clarke's (2006) framework of thematic analysis. The goal of thematic analysis is to identify themes, or patterns in the data that are important, and use these themes to address the research. This is more than simply summarising the data; a good thematic analysis interprets and makes sense of it. Thematic analysis provides systematic procedures for generating codes and themes from qualitative data. Codes, which are the smallest unit of analysis, are the building blocks for themes, which are larger patterns of meaning.

Throughout the research, the privacy and sensitivity of the participants is protected. They were fully informed about the researchers' identity and background, as well as the purpose and procedures of the research. I also acknowledge my positionality as the researcher in this process, as a lecturer of the modules observed. This means that I, like my students was also grappling with the shift to emergency remote teaching and learning. Thus, this research is an attempt to understand the teaching and learning experiences of students' and colleagues' during this period.

Findings and Discussion

Academic Voices of Distress: "When One Day Ends, The Next One Starts"

"This is new to all of us. Daily, I have to sort out my schedule: teaching, housework, helping my kids with their schoolwork. We had to buy a new laptop for our kids as well…then think about where everybody works. Space is an issue. This arrangement is not ideal. What I cannot fathom is how much we need to help our students, we must be there for them daily, at all hours. They are needy, this is justifiable…they are from homes where parents have lost jobs, they are struggling financially, they have family members who are ill... How can we help, I really feel helpless? I want to do my best, but the pressure is unrelenting. When one day ends, the next one starts" (Academic A).

"For me, the university is trying to assist, I really get this, but there are too many of us who are asking questions all the time. The tech guys are inundated and sometimes they don't answer our calls and emails. Too many of us and too few of them. There is no interaction in class, and attendance is at an all-time low. The faculty expects excellence. Sometimes I feel they don't care. Our modules are online, they (managers) go into our modules…this feels like an invasion of our privacy. This is the equivalent of them being in our classes. We cannot survive with this pressure from below (students) and above (managers). Everyone has a job to do, right? But we are caught in the middle." (Academic B)

"I have to look after my career, this means there are demands to do my job on one hand, and my teaching responsibilities. For now, I am prioritising my teaching, I need to sort one thing at a time. Yet I realise I have to meet my other deadlines and obligations too, research, publications, I hope the powers that be are more considerate about this at a time like this. We will see when it is time for performance management. I am more concerned that students are not attending class, and I do not get a response from them. Some log on to Blackboard, then they get kicked out – the connections are not good at all. This cannot be fixed; this is just how it is. Like a constant game. So, we just record all our classes and hopefully they are able to access these when they have time and better connection, and data. It's a real struggle, I understand that." (Academic C).

"I am ready to give up. I have issues with my teaching every day. My connection is not always good, even with loadshedding.…we are just not winning. How can I expect my students to cope? My husband is not well. He has comorbidities, as do I. My mum is elderly, so I brought her over to live with us so I can take care of her. I have had a Covid test, it's negative, but my body is sore. My mind is sore. I don't know how much more we can take. I have already lost colleagues, friends and family members." (Academic D).

"I am quite positive; I do believe we can make this work. I enjoy working from home, I think I would even be happy to work at a distance institution. But I do think we have too many meetings, which distracts from teaching. Perhaps this means we can rethink how we teach in the future. The only issue is I get lonely, I live alone, and it gets depressing having no other form of interaction. This I miss most." (Academic E).

Several academics spoke about their distress during the pandemic and subsequent lockdown (refer also to Kedraka and Kalsidis' (2020) study in Greece). Most woman and some male participants expressed their anguish of having to maintain their academic work schedule, together with household chores, and having to oversee their children's schoolwork simultaneously. This was noted prolifically along gendered lines. They also found students needed extra encouragement and support during this time. This observation seems pervasive and is cognisant with the requirements of a humanizing pedagogy. A core responsibility of academic staff is providing support to students in need. The drive for such a pedagogy calls for a level of consistence with students during a crisis. The possibility of disadvantaged students being further disadvantaged is highly probable in shifts to ERT. Thus, such pedagogy is crucial for both teacher and student success and critical for the academic and social resilience of students. Academics demonstrated tremendous resilience when confronting the pressures of the adversity of teaching online. They did not have much choice. This is reminiscent too, of Bartoleme's (1996) call for trusting relationships. Academics spoke about students who did not have money, food or medicine, and no means of getting them. Several of the participants were assisting students financially to ensure they were not destitute (refer also to Cicha's and colleagues (2021) findings). Academics also found that in many instances, students were not

attending, or able to attend remote classes for various reasons. Class attendance dropped, which in turn affected student academic performance. This could however mean that students were listening to recorded lessons when they had access to free data.

Certain participants were also concerned at what they felt was an unappreciative university. Given the overnight move to ERT, there were calls on academics to arrange their modules for online presentation overnight. Given that online teaching usually requires months of preparation, this was cause for concern. Not all the participants felt comfortable or prepared for this move. Despite universities offering training in online teaching, they felt that the university appeared indifferent to their mental state. Programmes on mental health, for instance were only offered much later in the lockdown. While the university had to ensure adjustments were made, participants felt the demands unreasonable where it was expected that all online modules were structured in the same format, and many did not have the immediate skills to do this. “We cannot all teach the same, our classrooms do not all look the same” (Academic F). This involved added administrative work, which there was not always time to do. They felt the university could have been more compassionate and humane to what staff were going through in their personal lives. Managers had access to Blackboard modules, and this further bothered staff who felt their “privacy was invaded” (Academic F). They certainly felt underprepared for the change. Technicians who were ill-prepared for the demands on their time were available all day for queries, and they too were exhausted, and could not afford to respond to all queries timeously. Feelings of physical and mental exhaustion were unrelenting. As participant A said, “When one day ends, the next one starts”, or “We are caught in the middle” (Academic B).

Another challenge was loadshedding. In South Africa, the major power supplier, ESKOM, resorts to loadshedding, which occurs when the power supply to different areas is shut off to conserve electricity. This became a major stumbling block, when students and academics experienced irregular power connectivity. “It is ESKOM’s loadshedding or remote teaching, we cannot have both. This affects teaching, assessments, presentations, we are being held to ransom” (Academic G).

Academics were also concerned that they also had to meet their annual performance management targets during an abnormal time. The university expected them to meet obligations such as publications and research, which was difficult to maintain at this time. As Academic D said, “My body is sore, my mind is sore”. Participants felt physically and emotionally drained. Academic E referred to the loneliness she felt. She felt she could cope with the demands of work; however, the lack of emotional interaction and communication was draining.

Consequently, academics felt varying levels of exhaustion, anxiety, and loneliness, and essentially felt the university’s impetus for teaching and learning and research was relentless. Staff and students experienced illness as well: many contacted the virus and had family members who were ill, or who had succumbed to the virus. Participants experienced incessant moments of quarantine or isolation as the virus spread. They had to battle with illness themselves, as well as of family members, see to children and do household chores, and found the situation unyielding.

For most academics, the pandemic was a time of confusion, anxiety, and stress. Both groups suffered mentally and physically, and while they appeared to try to cope, often this was inconsistent. For all, the lack of human interaction was disconcerting. The pandemic impacted on their lives, and they did know if they could recoup lost time. Academics attempted to use

various platforms, as well as synchronous and asynchronous methods of teaching, and students responded differently to these methods.

Conclusion

Given the experiences of this group of academics, although not generalisable, it is important that teaching is not just about persevering as usual. Of the lessons learnt, academics must be resilient and adaptable to change. In the face of the changing nature of teaching and learning, it is the adaptable teacher who can persevere emotionally and physically. This highlights the need for resilience. Resilience is a process which demonstrates the capacity "to rebound from adversity strengthened and more resourceful" (Walsh, 2006:4). Resilience means adjusting in the wake of significant adversity. Teachers need to recognize the social and political contexts of their own and their students' lives. This involves the influence of societal power, racial identities, and cultural values. Despite the challenges, the pandemic is a portal (Roy, 2020) that has allowed us the opportunity to reinvent ourselves, as well as how we teach and learn.

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Fostering Digital Citizenship and Effective Approach to Change in Teachers

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The study presents the results of a research project aimed to foster digital skills and approach to change in teachers. In Italy, the educational system needs an urgent acknowledgment of the digital revolution underway and the training of teachers and students cannot be postponed to increase general awareness of the risks and the countless opportunities that the digital world offers. Teachers need to become digitally aware citizens and, at the same time, they are responsible for teaching this competence to their pupils; educational institutions need to ensure a physical and virtual environment conducive to learning. A radical change in teaching methods is needed, accompanied by the acquisition and integration of new languages, the pacification between tradition and innovation, and a rebalancing of change approach. Our research focused on improving digital skills in teachers, as a vehicle to spread digital citizenship and literacy to the young population. The psycho-educational protocol has been proposed to a sample of 40 teachers over 8 weeks. It works both on digital skills and on approach to change, self-efficacy and acceptance. Initial (T0) and final (T1) competencies have been assessed. The results showed a significant positive change in Digital Citizenship skills, in all areas of competence, and in teachers' perceived level of self-efficacy in teaching and their perceived ability to engage students.

Keywords: Digital Citizenship, Teacher, Digital Skills, Self-Efficacy, Change

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Introduction

The COVID pandemic that began in 2020 led to an acceleration of Digital Transformation Processes in Italy, so much so that both the Digital Agenda in the three-year plan for information technology in public administration 2020-2022 (AGID) and the Action Plan for Digital Education 2021-2027 focus on a strong digital component in everyday life.

Among the objectives of the Digital Education Action Plan 2021-2027, one of the most important says "teachers and staff involved in education and training should be familiar with digital technologies and be competent in the field". So digital competencies and skills should be developed, both basic and advanced, and therefore there should be a strong acceleration in digital knowledge to pass from Digital Migrants to Digital Natives (Prensky, 2001).

Schools are called to educate and provide to children the life skills needed to grow up in a balanced way, to acquire responsibility and critical thinking and to train in citizenship and democratic life. In recent years, the digital transformation is demanding for digitally aware citizens and the Italian Government is responding by introducing the subject "Digital Citizenship" within the school programs, reporting as main objectives those already identified by DigCompEdu.

In this context, the role of teachers is crucial. They have to be digitally aware citizens and teach this competence to their students. First of all, it is important to fill any teachers' existing gaps in the digital skills to make them able to play their role as Digital Citizens and to transfer their competence to students with innovative and effective teaching methodologies in the digital transition.

The paper presents the results of a psycho-educational program aimed at developing the digital skills as per DigicompEDU in teachers and to provide a teaching model to enhance learning and effectiveness of the training in terms of digital skills and self-efficacy but also motivation and interest in the use of technologies.

1. Teaching Digital Citizenship

- Drawing on international literature (Kim & Choi, 2018; Choi, Glassman & Cristol, 2017; Choi, 2016), we have identified some important building areas to focus on for an effective Digital Citizenship model:
- Digital Ethics, consisting in respect towards others (Jones & Mitchell, 2016), responsibility, awareness, and safety (Ohler, 2012; Hollandsworth, Dowdy, Donovan, 2011; Afshar, 2013);
- Digital Knowledge, regarding a responsible approach in accessing and using technologies and evaluating information sent and received (Moeller et al., 2011; Marcinek, 2013; Simsek & Simsek, 2013);
- Digital activism, concerning the possibility to be active in political, social, and economic aspects in the digital sphere, from a civic duty perspective (Jones & Mitchell, 2016; Raoof, Zaman, Ahmad, Al-Qaraghuli, 2013; Kahne, Lee, Feezell, 2013; Lenhart et al., 2011; Tatarchevskiy; 2011);
- Critical perspective, as critical thinking in interactions and choices within the digital world (Choi, Glassman, and Cristol, 2017).

As teachers are called to teach their students Digital Citizenship, they need to develop some more competencies, to fully perform their tasks, according to DigicompEDU (2017). They can be identified in the following six areas:

- Facilitation of learners' digital competence: responsible use of digital technologies for sharing, communication, content creation, and problem-solving activities;
- Empowering learners: using digital technologies for inclusion and active involvement of learners;
- Professional engagement: incorporate digital tools into communication and use them to collaborate with colleagues and for personal development;
- Digital resources: to be able to identify, create and share digital resources;
- Teaching and learning: digital technologies integrated into teaching and learning process;
- Assessment: reinforcing assessments through digital technologies.

According to Ribble (2008), the learning process suitable for stimulating and developing a Digital Citizenship model in students is the circular one. It focuses on providing knowledge but also skills for everyday life and consists of 4 main steps:

- Awareness: stimulating the awareness about the importance to be digitally literate, understanding needs, and distinguishing between appropriate and inappropriate behaviors;
- Guided Practice: stimulation of digital technologies experiences under adult guidance and in protected environments, with the opportunity to take risks and make mistakes;
- Modeling & Demonstration: to be a model and give a demonstration about appropriate digital citizenship behaviors;
- Feedback & Analysis: encouraging the exchange of feedback and reflections among peers and adults, to have a comparison with other experiences and feelings.

2. The Study

The field of investigation of our research project concerns the evaluation of the effectiveness of training, considering three fundamental areas (Kirschner, 2015; Sweller, 2020):

- knowledge
- skills acted competence (Willermark, 2018) within TPACK Framework (Koehler & Mishra, 2009);
- psychological reactions (Scherer and Teo, 2019), in particular, on the teacher's pedagogical belief system (Ertmer and Ottenbreit-Leftwich 2010; Hermans et al., 2008).

The research team developed the following hypothesis, based on the theoretical indications derived by the main reference literature:

- H1: A training intervention based on a mixed approach (knowledge development according to the Digicomp2 model, experiential learning and mindfulness) will produce an improvement in the participants' skills.
- H2: The nomological relationship between the constructs considered relevant based on the literature will be confirmed by the correlation model between the empirical variables found. The research team developed the following hypothesis, based on the theoretical indications derived by the main reference literature:

2.1 Materials and Methods

2.1.1 Participants

The sample was recruited via email and teachers decided to participate voluntarily. They signed and informed consent, giving authorization to privacy aspects.

37 teachers completed all the processes. They filled out psychometric questionnaires, administrated through Google Forms before the beginning of the training (T0) and at the end of the training (T1).

Teachers have a heterogeneous distribution concerning order and grade and were 81% female, 37.8% in a relationship, with an average age M = 36.35 and DS = 9, with a distribution of the degree of education asymmetrical negative (diploma 5.4%, Bachelor's degree 13.5%, Master's degree 81.1%). Among these, about 30% are teaching (24.3% non-tenured, 5.4% tenured), while the remaining 70% are waiting for an assignment or qualification or competition. 46% of the sample stated to have taken courses to learn notions, methods, or IT tools.

2.1.2 Experimental Conditions

The program was constituted of 8 meetings (90 mins each), held on a zoom platform, weekly.

The method used was based on experiential learning (Reggio, 2009), where the direct experience of teachers approaching new technologies is the cornerstone of the didactics, followed by a process of metacognition. Thanks to direct experience and experimentation with new possibilities for teaching, teachers can achieve a different view of digital technology, overcoming some mental barriers regarding effectiveness and self-efficacy.

Each meeting was based on three fundamental moments:

- argumentation of specific digital competencies, according to the model defined by DigiComp2 (Information and data literacy; Communication and collaboration; Digital content creation; Security; Problem-solving);
- experiential activities, based on the competence addressed during the meeting with post-activity debriefing to activate metacognitive processes and learning;
- mindfulness elements and practice, for increasing self-efficacy and reducing attentional biases (Flook, Goldberg, Pinger, Bonus, Davidson, 2013; Kilpatrick et al., 2011; Lutz, Slatger, Dunne, Davidson, 2008).

Between one meeting and another, researchers provided stimuli to make teachers reflect and experience the topics discussed, to maintain focus on the specific topic and develop creative thinking. Teachers had the opportunity to discuss and share opinions and experiences in professional practice through a social platform. Furthermore, in the interaction with the teachers and among themselves, the teachers were encouraged to use some digital collaboration and social sharing tools to introduce and experiment with new ways of interaction and communication.

2.1.3 Measurements

The questionnaires administrated were the following:

- Questionnaire on the Evaluation of Digital Citizenship Competences (QCCD) of Teachers
- (Piceci et al., 2021): it measures the level of digital citizenship competencies according to DigiComp2.1.
- Intrapersonal Technology Integration Scale (ITIS) (Benigno et al., 2013): it measures the;
- Self-Efficacy (SE) and Outcome Expectations (OE) in the use of technologies.
- Utrecht Work Engagement Scale (UWES) (Pisantiet al., 2008): it is a scale measuring the level of involvement with work.
- Teachers' Self-Efficacy Scale (SAED) (Biasi et al., 2014): it measures the perceived level of teachers' self-efficacy in transferring skills and maximizing students' learning.
- The Multidimensional Work Motivation Scale (WTMTS) (Gagnè et al., 2014): it measures the motivation of teachers, concerning Deci & Ryan (2000) Self-Determination Theory.

3. Results

The hypothesis has been tested through a quasi-experimental one-group longitudinal design.

In Figure 1, the detailed results of the Paired Samples T-Test are shown. It is evident that all comparisons, except for the AREA1 sub-dimension, are statistically significant ($p < .001$) and confirm the increase in mean values in the post-test (Figure 1).

Paired Samples T-Test

							95% CI for Cohen's d	
Measure 1		Measure 2	t	df	p	Cohen's d	Lower	Upper
PRE_AREA1_AID_TOT	-	POST_AREA1_AID_TOT	−1.516	36	0.069	−0.249	-∞	0.027
PRE_AREA2_CC_TOT	-	POST_AREA2_CC_TOT	−5.401	36	< .001	−0.888	-∞	−0.563
PRE_AREA3_CCD_TOT	-	POST_AREA3_CCD_TOT	−6.140	36	< .001	−1.009	-∞	−0.670
PRE_AREA4_SIC_TOT	-	POST_AREA4_SIC_TOT	−4.534	36	< .001	−0.745	-∞	−0.434
PRE_AREA5_RP_TOT	-	POST_AREA5_RP_TOT	−7.322	36	< .001	−1.204	-∞	−0.841
PRE_DigitalCitizenship_TOT	-	POST_DigitalCitizenship_TOT	−7.181	36	< .001	−1.181	-∞	−0.821

Note. For all tests, the alternative hypothesis specifies that Measure 1 is less than Measure 2. For example, PRE_AREA1_AID_TOT is less than POST_AREA1_AID_TOT.
Note. Student's t-test.

Figure 1: Digital Citizenship and Sub-dimensions PRE-POST Comparison

Furthermore, the corresponding effect sizes are very large (0.2 Small, 0.5 Medium, 0.8 Large) (Cohen, 1969). Similarly, the pre-test ($M = 24.21$, $SD = 5.46$) and post-test ($M = 25.81$, $SD = 4.21$) results on self-efficacy in teaching strategies indicate that the training intervention led to an increase in self-assessment on this task, $t(36) = -2.257$, $p = .015$. As regards the self-efficacy in student engagement, there an improvement between the pre-test ($M = 24.8$, $SD = 4.72$) and post-test ($M = 26$, $SD = 4.16$) results. It indicates that the training intervention led to an increase in self-assessment on this task, $t(36) = -1.836$, $p = .037$. In both, the effect sizes were less strong (approximately $d = .30$).

On the contrary, in the area of Motivation, as expected, there was no significant increase in the total mean UWES after the end of the training course ($M = 45.054$, $SD = 8.1$) compared to the pretest ($M = 46.30$, $SD = 6.54$), $t(36) = 1.219$, $p = .885$, and in total mean WTMST intrinsic motivation after the end of the training course ($M = 17.081$, $SD = 3.69$) compared to

the pretest (M = 17.73, SD = 3.46), t(36) = 1. 046, p = .849. In the same way, also total mean WRMST Amotivation had no increase after the end of the training course (M = 5.649, SD = 3.988) compared to the pretest (M = 5.75, SD = 4.33), t(36) = 0.166, p = .565.

Two correlation matrices between the variables measured on the pre-test and post-test were performed (Figure 2 and Figure 3). The H2 hypothesis has been confirmed. The patterns of the relationships are consistent with those expected. The low sample size has been taken into account. In particular, a strong statistically significant coefficient (r = .724 p < .001) between the total Digital Citizenship scale and the IT IS_SE in the pretest, which is duplicated in the post-test (r = .731 p < .001) has been shown. The variables related to self-efficacy in teaching facets also reported a statistically significant positive correlation with Digital Citizenship, which was most evident in the post-test. Just as expected, the absence of statistically significant or at least large correlation coefficients for indirectly correlated variables (such as UWES or WTMST) were further confirmatory evidence for H2 (in both the pre-and post-measures).

Pearson's Correlations

			n	Pearson's r
PRE_DigitalCitizenship_TOT	-	PRE_ITIS_SE	37	0.724***
PRE_DigitalCitizenship_TOT	-	PRE_ITIS_OE	37	0.137
PRE_DigitalCitizenship_TOT	-	PRE_ITIS_INT	37	0.372*
PRE_DigitalCitizenship_TOT	-	PRE_SAED_Auto-efficacia nel Coinvolgimento degli studenti	37	0.213
PRE_DigitalCitizenship_TOT	-	PRE_SAED_Auto-efficacia delle Strategie di insegnamento	37	0.366*
PRE_DigitalCitizenship_TOT	-	PRE_SAED_Auto-efficacia nelle Tecniche di Gestione della Classe	37	0.319
PRE_DigitalCitizenship_TOT	-	PRE_WTMST_INTRINSIC_MOTIVATION	37	0.124
PRE_DigitalCitizenship_TOT	-	PRE_WTMST_IDENTIFIED_MOTIVATION	37	−0.004
PRE_DigitalCitizenship_TOT	-	PRE_WTMST_INTROJECTED_MOTIVATION	37	0.043
PRE_DigitalCitizenship_TOT	-	PRE_WTMST_EXTERNAL_MOTIVATION	37	0.313
PRE_DigitalCitizenship_TOT	-	PRE_WTMST_AMOTIVATION	37	0.126
PRE_DigitalCitizenship_TOT	-	PRE_UWES_TOT	37	−0.058

Figure 2: Pre-Intervention Correlation Matrix

Pearson's Correlations

			n	Pearson's r
POST_DigitalCitizenship_TOT	-	POST_ITIS_SE	37	0.731***
POST_DigitalCitizenship_TOT	-	POST_ITIS_OE	37	0.013
POST_DigitalCitizenship_TOT	-	POST_ITIS_INT	37	0.270
POST_DigitalCitizenship_TOT	-	POST_SAED_Auto-efficacia nel Coinvolgimento degli studenti	37	0.329*
POST_DigitalCitizenship_TOT	-	POST_SAED_Auto-efficacia delle Strategie di insegnamento	37	0.385*
POST_DigitalCitizenship_TOT	-	POST_SAED_Auto-efficacia nelle Tecniche di Gestione della Classe	37	0.464**
POST_DigitalCitizenship_TOT	-	POST_WTMST_INTRINSIC_MOTIVATION	37	0.240
POST_DigitalCitizenship_TOT	-	POST_WTMST_IDENTIFIED_MOTIVATION	37	0.197
POST_DigitalCitizenship_TOT	-	POST_WTMST_INTROJECTED_MOTIVATION	37	0.121
POST_DigitalCitizenship_TOT	-	POST_WTMST_EXTERNAL_MOTIVATION	37	0.072
POST_DigitalCitizenship_TOT	-	POST_WTMST_AMOTIVATION	37	−0.059
POST_DigitalCitizenship_TOT	-	POST_UWES_TOT	37	0.254

Figure 3: Post-Intervention Correlation Matrix

Conclusion

Our study has some critical issues to be attributed primarily to the low sample size and the unequal numbers of males and females. In addition, the lack of a control group doesn't allow to isolate the interference of intervening variables. However, we can say that our two hypotheses have been confirmed by the analysis of the collected data. A significant positive change in Digital Citizenship skills has been demonstrated in all areas of competence. The combination of the three aspects (knowledge, skill, psychological approach) in training seems to be more effective, as stated by Zhao et al. (2021). The information seeking and content analysis areas seem not to be affected by the training, maybe due to a ceiling effect for the majority of the subjects and the already strong perception of knowledge of the teachers that are active in these areas in their professional and personal environments. The results support our hypothesis that a methodology involving knowledge, experience, and embodiment, in a blended way can improve teachers' self-efficacy in teaching and their level of perceived ability to motivate students. For the confirmation of the second hypothesis, the positive

correlation between Digital Citizenship and the ITIS Self-Efficacy and with the Teaching Self-Efficacy, we believe that the direct experience of tools and of a new way for digital teaching can have the primary role in the results, according to Bandura's (1996) theory (direct experience as reinforcement of Self-Efficacy). Furthermore, the mindfulness practice, with the enhancement of self-awareness and acceptance, can have facilitated the results.

We consider this study and its results a good starting point to build psychoeducational programs for teachers able to enhance Digital Citizenship, first and foremost among teachers and, consequently, among students. Furthermore, the experience of digital didactic with effective results can set a precedent for their working practice. The effective online delivery was a strength of the program because it made sustainable the teachers' participation who, in their day-to-day work, are sometimes unable to follow proposals for face-to-face interventions regularly.

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Analyzing the Benefit of Real-time Digital Translation for EFL Learners in Post-secondary Canadian Virtual Classrooms

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Canadian colleges and universities have seen a steady increase in enrolment over the past decade, driven mostly by international enrollment. If any students experience a language barrier this could pose a significant threat to classroom equity! This qualitative research study sought to understand how real-time digital language translation technology could bridge that language barrier. Professors' lectures were translated, in real-time, into students' first languages utilizing the Microsoft Translator app. Participants were post-secondary EFL students enrolled in either the Business or Hospitality Programs at George Brown College in Toronto, Canada (n=63). Data were collected in three stages, using open-ended surveys in the first and second and semi-structured interviews in the third. Data were then analyzed using thematic analyses. The technology does not only translate language it also provides English subtitles; findings suggest this combination of translation and subtitles can improve EFL students' learning experiences. Students generally thought Microsoft Translator was easy to use and accurate in actual translation. The challenges identified included i) the reliability of internet connectivity ii) some professors' inability to adapt and support the technology and iii) the technology's inability to reliably recognize context. Based on these findings, if professors integrate translation technology into their lectures students will have an optional free resource at their disposal; technology could positively affect academic integrity and classroom equity.

Keywords: EFL Learners, Equity, Innovative Teaching Strategies, Language Translation

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Introduction

Canadian colleges and universities are currently ranked third in the world of most desirable post-secondary destinations for international students. Canada's foreign student population has grown six-fold over the last 20 years (CIC News, 2020), mirroring a global trend that, in the same 20-year period, showed an increase from two to five million international students (UNESCO, 2019). If a language barrier exists and has an adverse effect on international students' ability to succeed, it poses a major threat to classroom equity!

The school involved in the study is George Brown College in Toronto, Canada. Students travel from around the world to study there; in fact, 30% of the student population is international (George Brown College, 2021). The college specializes in hands-on training for many technical professions. Faculty are constantly using industry terminology in their labs and classrooms; jargon is challenging for all learners let alone international students. A language barrier could have an adverse effect on international students' ability to succeed, posing a major threat to classroom equity.

In fact, if a student is academically disadvantaged due to a language barrier, one could argue this is a form of linguicism. It would not be the first time such a situation has been examined: a 1974 legal case involving Chinese American students in San Francisco made its way to the U.S. Supreme Court. The court agreed unanimously that students were, in fact, victims of linguicism; their civil rights were being violated by their school not offering a curriculum in a language they understood. The judges of the case explained, "Where inability to speak and understand the English language excludes national origin-minority group children from effective participation in the educational program offered by a school district, the district must take affirmative steps to rectify the language deficiency in order to open its instructional program to these students" (Lau v. Nicols, 1974). Now too old to hold relevancy to the current study, it does offer an interesting point for contemplation. Colleges benefit from international student income; are those same colleges making enough effort to ensure the education they offer is equitable and accessible?

Literature Review

A large body of research probes whether any negative consequences arise out of implementing mobile-assisted learning (M-learning) in the classroom. Whether it's M-learning at the expense of communication and confidence building (Miangah & Nezarat, 2012) or mobile technology providing an easier path to cheating (Ali et al., 2018), perhaps it doesn't have to be an all or nothing approach. M-learning can be adopted for lectures, class discussions, and group work. M-learning research presents a common theme implying there are times when mobile devices are better left aside so that other skills may be encouraged.

Some studies explore the positive impacts of multilingual learning environments on learner experience. A Canadian study looks at French language learning through iPhone vocabulary lessons (Ally et al., 2011), finding an improvement at learning vocabulary with mobile usage. Another example, a qualitative action study by Vicki Bismilla (2011), focusses on participant engagement in classrooms that encourage the use of mother tongues. The study finds students become more academically engaged when they are allowed to speak their first language in the classroom. It seems the multilingual environment lends respect to people's native culture, education, and "holistic identities" (P.86). The author posits that a welcoming attitude towards the inclusion of native language in the classroom is essential in supporting identity

and heritage. Allowing students to speak their mother tongues seems to support their prior learning; while not mentioned in the study, prior learning is an important principle of Universal Design for Learning.

Other studies focus on the technology rather than the experience. Mobile phones have been described as the most powerful communication tool of the 21st century (Elega & Ozad, 2017). Mobile technology may even encourage collaborative learning by providing a forum for interaction among students, teachers, and content (Kukulska-Hulme, as cited in Afzali et al., 2017). Technology can help increase engagement and learning, out of an interest in the technology itself (Chinchole, 2019).

The Present Study

Digital language translation is now available in real-time. Microsoft Translator, the application employed in the present study, relies on artificial intelligence to immediately translate speech into the learner's choice of over 60 supported languages. In the classroom, a professor wearing a headset or microphone may lecture in their first language. Microsoft Translator generates a QR code that allows anyone to *join* a lecture on their mobile device (laptop, phone, or tablet), receiving a translation into their language of choice.

Methodology

Overview

This study engaged in qualitative research to explore any benefits and impacts of real-time digital language translation on EFL students' academic experience. Academic experience was measured in terms of students' perceived comprehension of professors' lectures and opinions on the usefulness of translation technology.

Participants

Participants were post-secondary students (n=63) in the School of Business and School of Hospitality at George Brown College in Toronto, Canada. All participants were EFL learners with the following first languages: Spanish 38%; Chinese 27%; Korean 16%; Hindi 13%; Portuguese 5%; Azerbaijani 2%. Their mean age was 20.7 years.

Instruments

Two 10-item surveys collected students' opinions on real-time translation in the classroom. Surveys were delivered through a combination of five-point Likert scale and open-ended questions. The surveys were written in English; to ensure clarity, each question was reviewed by two professors and two international student-research assistants. Additionally, the researcher engaged in semi-structured interviews with participants. Interviews consisted of open-ended questions probing opinions on the efficacy of the technology. With participants' consent, interviews were recorded and transcribed.

Data Collection

Initially, the study involved collecting both qualitative and quantitative data in actual classrooms. With the onset of Covid19, the study adjusted to collect only qualitative data

from virtual online classrooms. The study took place during the winter semester 2021. Students had the option to receive translated text onto their laptop, phone, or tablet.

Data collection proceeded in three phases:
The first phase began before the translation technology was introduced at the beginning of the semester. An open-ended online survey was emailed to all EFL students in four different courses within the School of Business and the School of Hospitality (n = 154). The intention was to gather their initial thoughts and expectations of using translation technology in the classroom. Only 63 responded to the online survey, perhaps due to the lack of in-person explanation, another challenge of distant learning.

In the second phase, EFL students who completed the survey were invited for a semi-structured interview. At that time, the Microsoft Translator software had already been introduced, and students were encouraged to use the technology during class lessons and for their independent learning. Participant recruitment was carried out by research assistants; disappointingly, only three volunteered to take part. Due to the pandemic, interviews were also conducted virtually. The purpose of the interviews was to gain insights into EFL students' experiences and probe challenges they may have encountered while using the translation technology.

The third phase took place at the end of the semester. A second open-ended online survey was administered to all 70 EFL students in the cohort, to ascertain their final thoughts on using the translation technology. The survey was developed based on the analysis of data from the first survey and interviews. The intention was to justify and triangulate data collected in the first and second phases. Again, the challenge was finding participants; only five completed that second survey.

Results

Data Analysis

Data were examined using thematic analysis (TA). TA is a strategy "for analyzing qualitative data that entails searching across a data set to identify patterns" (Kiger & Varpio, 2020, p.2). It focuses on identifying commonalities among different data sets and making sense of those commonalities (Braun & Clarke, 2012). Thematic analysis enabled the present researcher to gain insight into the potential benefits, drawbacks, and challenges of using real-time digital language translation for learning. Although the sample is small, the data provides in-depth understanding of how translation technology impacts EFL students' learning experiences.

Findings

The main themes that emerged from the data are categorized into three sub-sections. The first sub-section discusses the benefits of real-time translation software to EFL students' learning. The second sub-section discusses the drawbacks of using translation technology. The third sub-section discusses the challenges encountered in using the technology.

Benefits to Student Learning

Aside from its primary use, another feature of Microsoft Translator is its ability to subtitle a professor's speech in real-time. Subtitles can be displayed on classroom monitors, screens, or

directly onto students' laptops or phones. Thus, it is possible for students to simultaneously listen to a professor speak, read a translation of the professor's words, and follow English subtitles.

Drawbacks of the Technology to Student Learning

Some of my colleagues have questioned whether the use of digital translation in the classroom would inhibit EFL students' ability to learn English. This is a valid concern not formally examined here though the idea did come up in my interviews with participants; from their perspective, there was no effect on English learning.

Challenges of Using the Technology

Data collection occurred during the winter semester 2021; it was the first semester the college reopened after the Coronavirus lockdown. Post-pandemic timing may have influenced student engagement and motivation levels thus reducing the participation rate. Of course, a reliable internet connection is vital when using real-time translation technology, though this wasn't an issue for any participants. Surprisingly, the biggest challenge concerned professors! I witnessed faculty who are uncomfortable using technology in general, and a common theme was their inability to learn and adopt new technology.

Conclusion

This study sought to analyze any benefits and impacts of real-time digital language translation on EFL learners' academic experience. Post-secondary learners are more inclined to embrace a technology which supports their desire for socialization (Hashim, Tan, & Rashid, 2015). Mobile translation technology can provide learners with confidence to increase classroom engagement and social interaction. EFL students might be disadvantaged when in-classroom discussion or lectures contain vocabulary they do not understand. Without asking the professor to explain, repeat, or reiterate their words, the EFL learner does not typically have instant access to translation or related information (Chang & Hsu, 2011). Mobile technology, like Translator, offers an immediate resource, in multiple forms: translation, subtitles, and saved transcript. In general, participants appreciated having such a resource available to them.

The major challenge was on the side of faculty and a common theme of technology avoidance. These findings present an interesting choice for institutions like George Brown College: Is there enough will to train faculty to use new technology? Does management have enough power to encourage technology adoption among faculty?

Real-time translation technology supports a social benefit as well; it allows people from various native backgrounds to communicate with each other, providing instantaneous feedback. If faculty do not adopt its use, perhaps students will make use of it amongst themselves.

Acknowledgements

Research was sponsored by the Ignite Fund (https://www.gbcresearch.ca/). The author would like to thank the following people, all at George Brown College, for their support: Eva

Aboagye at the Research and Innovation Centre; Nerys Rau and Mark Sear at IT Operations (IT); Michael Avis at the Teaching & Learning Exchange (TLX); Cindy Gouveia and Brent Bain at George Brown College Foundation. This project is a great example of inter-departmental collaboration.

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Development of Programming Learning Application for Smartphones Using Japanese

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Official Conference Proceedings

Abstract
In recent years, programming education has garnered attention. Programming education has been introduced in elementary schools since the fiscal year 2020 in Japan. However, conventional programming education in Japan teaches programming in English. Programming in a language that is not your native tongue is difficult. For many Japanese, it is easier to understand if you can program using Japanese intuitively. This helps beginners to start acquiring basic programming skills. Error messages are sometimes displayed in long English sentences, which is another factor that hinders beginners from learning. In this material, the program description and error message specifications are written in Japanese. This study aims to develop learning materials for Japanese students to learn programming to experience the fun of acquiring programming skills. In this research, I have developed an application that allows Japanese students to learn to program smartphones in the Japanese language. The application has been designed for Android smartphones. Android Studio is used for Integrated Development Environment (IDE) and the programming language used is Java. The layout is written in Extensible Markup Language (XML). In this application, learners can learn about variables, operators, control statements, and arrays. For example, learners can learn how to program “determining even or odd numbers,” “assigning data to an array,” and so on. Using this application, learners can learn the basics of programming that they need to understand first. This will help them advance to their next step of learning a general-purpose programming language such as Java in English.

Keywords: Educational Technology, Learning Programming, Electronic Teaching Materials, e-Learning

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1. Introduction

In recent years, programming education has been emphasized, and in Japan, programming education has been introduced in elementary schools from the fiscal year 2020. The Ministry of Education, Culture, Sports, Science, and Technology (MEXT) aims to develop qualities and abilities such as “knowledge and skills,” “thinking, judgment, and expression,” and “the ability to move toward learning and human nature. In the guide, programming education fosters “knowledge and skills” by realizing that computers are used in our daily lives and that there are necessary procedures to solve problems. In addition, programming education promotes “thinking, judgment, and expression” by encouraging programmatic thinking in line with developmental stages through attitude cultivation in using computer functions to improve life and society. To achieve that “power toward learning, humanity, etc.” are to be promoted.

In such a situation, a system to support learning programming is useful. Therefore, this research aims to develop a learning material to aid people in programming to experience the fun in programming.

2. Prior Research

2.1 Differences Between Visual and Textual Languages

In the paper “A Proposal of Educational Programming Languages Suitable for Elementary School Education,” the advantages and disadvantages of programming languages such as text-based, flowchart-based, rule-based, and block-based languages are described. In addition, some problems of block programming languages, which are often used as educational languages, are pointed out. The gap between block-type and text-type languages is mentioned in the article. Block-type languages can be used to construct programs by assembling prepared blocks. Thus, compared with text-type languages in which code must be input from scratch, block-type languages can be used to build programs easily without input. On the other hand, constructing a program differs greatly from text-based languages. Although a visual language such as a block-type language is a teaching material for cultivating programmatic thinking ability, it is difficult to make a smooth transition to learning a general-purpose text-type programming language. The reason is that its appearance and programming method are different from those of a text-type language. Therefore, this study aims to facilitate the transition to learning a general-purpose text-based programming language.

3. Proposed System

In this section, we describe the features and functions of the proposed system.

3.1 Programming in Japanese

The code description and error messages are written in Japanese. This is because a description in a language other than one's mother tongue is often a barrier to learning for beginners in programming. We aim to make it easy to understand the code contents in Japanese so that beginners do not get frustrated.

3.2 Applications That Users Can Use on Their Mobile Devices

Electronic devices such as smartphones, PCs, and tablet terminals are widely used in Japan. However, smartphones are considered the device with the highest ownership rate among individuals, including those who do not usually use computer devices. The system we propose in this paper makes it easier for people who do not have PCs to learn to program with their smartphones, easily accessible to many people.

3.3 Syntax Similar to General-Purpose Programming Languages

As shown in 2.1, the goal of this system is to facilitate the transition to learning a general-purpose programming language. Therefore, we do not want the system to focus too much on Japanese grammar, which differs greatly from the general programming grammar. Furthermore, the system uses similar syntax to the C programming language, commonly used in university courses.

4. Design and Development

4.1 Development Environment

In this study, we develop an Android application. The development tool is Android Studio, and the language is Java. XML is used for layout screen design.

4.2 Configuration

This application consists of four chapters. The contents of each chapter are summarized in Table 1.

Chapter number	Study contents
1	Basics (displaying strings, assigning to variables)
2	Operators
3	Control statements
4	Arrays

Table 1: Contents of the Study

In each chapter, students read explanations about the study contents and solve exercises related to the contents.

4.3 Example of Learning Screen

This section describes the flow of the exercise. First, the user should press the gray buttons on the input screen in the correct order. Then, press the “Run” button. If the description is right, the result will be displayed correctly. However, if the description is incorrect, an error message will be displayed, and the user will have to start typing again from the beginning.

As an example, let us illustrate the problem with a variable assignment. The problem is to assign “10” to a variable “a,” “Ya” to “b,” and “Arigato” to “c,” and output the contents. If the user can return all the three variables, a toast will be displayed, indicating the correct answer.

Figure 1 shows a program's description and execution results that assign numbers, letters, and strings to variables a, b, and c, respectively. It displays the three variables. When the program is written as shown on the left and the Run button is pressed, the execution result is displayed on the right. The toast of the correct answer is shown at the bottom of the screen.

Figure 1: Variable (successful example)

Figure 2 shows the result of example 2 without the semicolon at the end of the sentence “string c = “ Arigato ” ;.” The result is shown on the right, and the toast of the incorrect answer is displayed at the bottom of the screen.

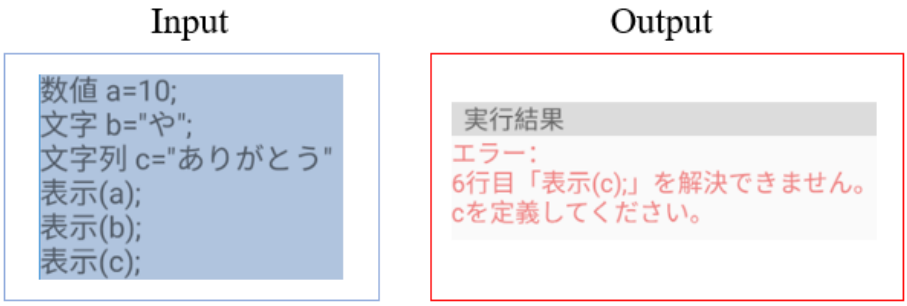

Figure 2: Variable (failure example)

Next, we explain an "if statement" problem. This problem is an exercise of assigning some numerical value to a variable x and executing a program to determine whether x is an even or an odd number. If the program is written as shown on the left of Figure 3 and executed, the result is shown on the right.

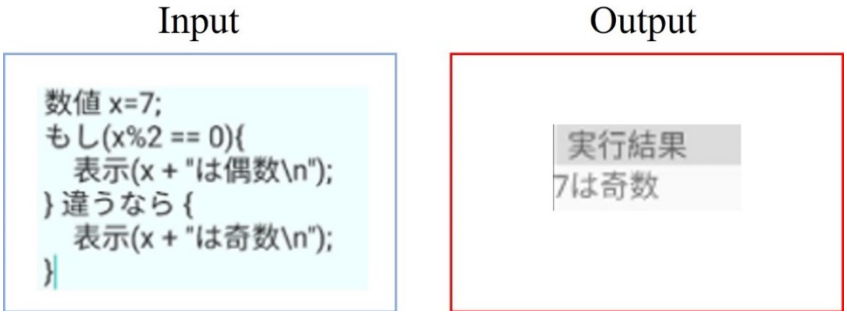

Figure 3: IF statement

Finally, we explain the array problem. This problem is to assign some numerical value to an array “a” and to display the stored value.

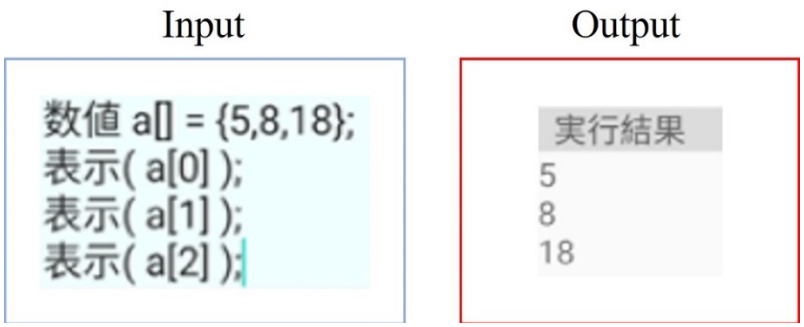

Figure 4: Array

5. Experiment

5.1 Experimental Method

The experiment was conducted with the cooperation of 18 Japanese who can handle tablet terminals, nine with programming experience, and nine with no experience. After completing the learning, we conducted a test to confirm the level of understanding and a questionnaire about the feeling of using the application. The experiment period was from October 25, 2021, to November 18, 2021.

5.2 Test Results

Table 2 summarizes the results of 18 participants used for the experiment.

Individual number	Scoring ratio (%)
1	69.57
2	18.75
3	56.52
4	6.25
5	52.17
6	60.71
7	43.48
8	14.29
9	43.48
10	26.09
11	75.00
12	34.78
13	73.91
14	62.96
15	70.97
16	88.89
17	96.30
18	62.97
Average	53.17

Table 2: Test Results

The average scoring percentage for all 18 players was 53.17%.

5.3 Questionnaire Results

First, Table 3 summarizes the results of the questions about the difficulty level of this material.

Answer	Number of people who answered
Difficult	5
A little difficult	8
Just the right level of difficulty	4
A little easier	0
Easier	0

Table 3: Responses to the Difficulty of the Teaching Materials (Everyone)

All the respondents selected "difficult," "a little difficult," or "just right," and the largest number of respondents (eight) chose "just right."

Next, Table 4 summarizes the responses of only the inexperienced students about the difficulty of the teaching materials.

Answer	Number of people who answered
Difficult	5
A little difficult	4
Just the right level of difficulty	0
A little easier	0
Easier	0

Table 4: Responses to the Difficulty of the Teaching Materials (Inexperienced People)

All of the inexperienced respondents selected either "difficult" or "a little difficult," and the largest number of respondents (five) chose "difficult.

Next, Table 5 summarizes the questionnaire results about the media used for learning programming.

Answer	Number of people who answered
PC	4
Smartphones and tablets	10
Use both together	4

Table 5: Answers to Questions about the Device Preferred for Learning (Everyone)

In this section, we asked, "Which media do you prefer when learning to program?" and provided the respondents' options, including "PC," "Smartphone/Tablet," or "PC and Smartphone/Tablet together." Table 5 shows that the largest number of respondents prefer "smartphone/tablet," and about 80% of all respondents want either "smartphone/tablet" or "both PC and smartphone/tablet together."

Device	Number of people who answered
PC	1
Smartphones and tablets	6
Use both together	2

Table 6: Answers to Questions about the Device Preferred for Learning (Inexperienced People)

Table 6 shows the responses to the same question as Table 5 only for those with no experience. "Smartphone/tablet" is the most preferred, accounting for about 90% of respondents.

The correlation between the test scores of the 18 students and preferred media for learning was examined using the uncorrelation test with a p-value of 0.047 ($p<0.05$), which indicates that there is a correlation. The data of the scoring rate for the learning medium used are shown in Figure 5.

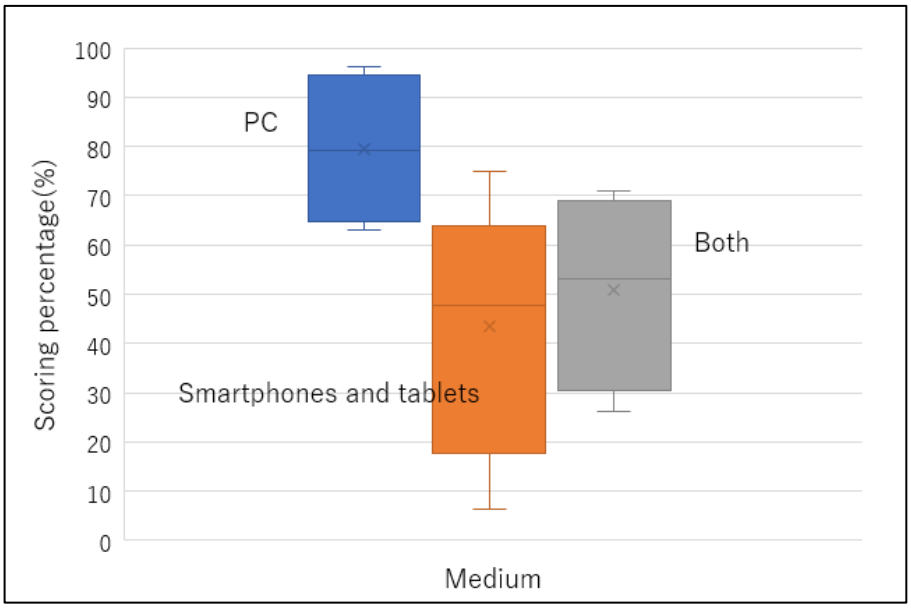

Figure 5: Percentage of Medium Scores Preferred by Users for Learning.

Next, Table 7 summarizes the responses to whether the students became interested in programming after learning this material.

Answer	Number of people who answered
Yes	15
No	3

Table 7: Answers to the Question, "Are You Interested in Programming?" (Everyone)

Fifteen respondents answered that they were "interested," and three responded, "not interested."

Next, Table 8 summarizes the responses to the same questions as in Table 7 only for those with no experience.

Answer	Number of people who answered
Yes	7
No	2

Table 8: Answers to the Question, "Are You Interested in Programming?" (Inexperienced People)

Seven respondents answered that they were “interested,” and two responded, “not interested.”

Next, Table 9 summarizes the responses to the question, "Is programming in Japanese easy to understand?

Answer	Number of people who answered
Hard to understand	0
A little confusing	4
I cannot say either way	2
A little easier to understand	3
Easy to understand	9

Table 9: Responses on the Ease of Understanding Programming Using Japanese

As shown in Table 9, the largest number of respondents (9) answered "Easy to understand” to the question of whether programming using Japanese is easy to understand. Next, four respondents answered “a little difficult to understand,” 3 answered “a little easy to understand,” 2 answered “undecided,” and 0 answered “difficult to understand.” About seven of the respondents answered either “easy to understand” or “a little easy to understand.”

Next, we asked the participants to rate five items related to the application's usability on a five-point scale. The results are summarized in Table 10.

Evaluation items	5-point scale (average value)
Interesting content	4.28
Ease of viewing screen layout	4.17
Ease of understanding of explanations and diagrams	3.94
Ease of understanding of exercises	3.61
Ease of use	3.56

Table 10: Evaluation of the App's Usability

As shown in Table 10, the evaluation of the application usability was "Interesting content,” "Ease of screen layout,” "Ease of understanding of explanations and figures,” "Ease of understanding of exercises,” and "Ease of use.”

The standard deviations of each item in Table 10 and the data on the understandability of programming using Japanese are summarized in Table 11.

Evaluation items	Standard deviation
Interesting content	0.87
Ease of viewing screen layout	0.76
Ease of understanding of explanations and diagrams	1.03
Ease of understanding of exercises	0.83
Ease of use	0.96

Ease of understanding programming using Japanese	1.23

Table 11: Standard Deviation of Application Ratings

5.4 Discussion

Based on the fact that only about 30% of the inexperienced users scored over 60% in the test results provided in Table 2 and that all of them answered “difficult” or “slightly difficult” as displayed in Table 4, we can say that the contents of this material were difficult for beginner programmers.

From Tables 5 and 6, most respondents preferred mobile terminals such as smartphones and tablets for learning programming. Furthermore, as shown in Fig. 6, there is a correlation between the scoring rate and the media preference for learning, which indicates that many students, especially beginners, want to use smartphones and tablets for learning. Therefore, we believe it is meaningful to provide content that can be learned on mobile terminals such as smartphones and tablets as teaching materials for learning the basics of programming.

Table 11 shows the largest standard deviation for Japanese programming comprehensibility, and the data varies. Many respondents felt that programming in Japanese was easy to understand, while some respondents thought it was not easy to understand. Therefore, it is necessary to explore combining a general-purpose programming language and Japanese grammar to make it easier to understand.

6. Conclusions

In this paper, we proposed a smartphone application for beginner programmers using the Japanese language. In the future, we will explore better programming materials by referring to the results obtained in these experiments.

Acknowledgments

This work was made possible by the cooperation of many people. We are very grateful to our professors at Tokyo Denki University for their guidance in our research. We are also very grateful to all the people who helped us with our experiments. Thank you very much for taking time out of your busy schedules to help us.

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Design Thinking and Embodiment for Problem-Solving and Creativity Education in the Digital World

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The emergency due to the SARS-CoV-2 pandemic has required substantial and situational changes in the living environments, relational, educational, health, and media networks. Managing complexity in emergency contexts, therefore characterized by conditions of a high individual, relational and institutional vulnerability, imposes an urgent mandate on educational agencies to rethink, adapt, reorganize and innovate their teaching methods. The interaction with the digital ecosystem has accelerated the need to draw from creative decision-making and problem-solving strategies, tinkering, attention to the design of the learning room due to distancing, and to reconsider transversal skills, necessary to promote the development of new cognitive-learning strategies. The contribution provides the results of an educational program based on design thinking and embodied approach to stimulate problem-solving and creative thinking in university students. The methodology starts from the recent evidence-based applications offered by Embodied Cognition & Design Thinking, Emotional Design in Digital Media for E-Learning and the Personal Learning Environment (personalization of learning) and directly involves the user in co-design, testing and design experiment embodied in distance learning contexts.

Keywords: Design Thinking, Problem-Solving, Embodied Cognition, Emotional Design, Distance Learning

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Introduction

The emergency scenario due to the rapid spread of the SARS-CoV-2 pandemic has required substantial and situational changes in living environments, relational, educational, health and media networks. Managing complexity in emergency contexts, thus characterized by conditions of a high individual, socio-relational and institutional vulnerability, imposes an urgent mandate on educational agencies to rethink, adapt, reorganize and innovate their educational delivery methods.

The interaction with the digital ecosystem has accelerated the need to draw on strategies of creative decision making and problem-solving, tinkering, to give attention to the design of the learning room due to distancing, and to reconsider transversal skills, necessary to promote the development of new cognitive and learning strategies.

This research contribution follows the programmatic direction of Goal 4 of the UN 2030 Agenda (UNESCO 2017), where the need to co-create didactic strategies useful to strengthen national and international educational systems, within the demand for quality, equitable and inclusive education, is compelling. The road map for achieving this goal envisages radical action that is broadly resolutive and connectivist, both in humanitarian and pedagogical terms, that is in line with 'emergent design', that is inquiry-based, and that is adaptive yet generative. The implementation of such educational-formative implementation directives, the integration of critical relational frameworks in an adaptive and complex pedagogical approach, allowed our research team to prepare an opening towards "situational expertise", thus allowing the formulation of a design with a "humanizing and transformative" (Piceci, Cancellara, 2020) approach, precisely Human-Centered through Design Thinking (DT).

DT is a methodology that is used to solve complex problems and is "a way of using systemic reasoning and intuition, to explore the ideal predictive value of organization and organizational planning" (Langenfeld, 2019).

The centrality of the research work will be focused, on reflecting the interaction of technology and its impact on human factors, the ergonomics of information processing, and connected devices.

The methodology of the experimental protocol starts from the recent evidence-based applications offered by Embodied Cognition & Design Thinking, Emotional Design in Digital Media for E-Learning, and Personal Learning Environment.

The recent IDeAL - Iterative Design for Active Learning methodology proposed by INDIRE, a learning path based on problem-solving and creative and analytical skills, which revolves around the creation of a physical, virtual or conceptual product, is a valid reflection to support this research (INDIRE, 2020).

The design activity becomes the central point of the teaching-learning process: the student and the teacher are personally involved in conceiving/making a product and evaluating possible creative solutions to a problem. Discussion, narrative focus groups, brainstorming techniques and the development of transversal skills will be promoted, in a user-centered environment (UX Designer Gray 2016 methodology).

Furthermore, this work aligns with the framework of competencies defined by the learning indicators, skills and competencies, proposed by the P21 (Framework for 21st Century Learning)[1], necessary to succeed in work, life and in the broader framework of developing active and aware citizenship, as well as supporting systems necessary to achieve 21st Century Life Long Learning outcomes. The P21 competencies are divided into 4 macro-areas:

1) Knowledge of the content and themes of the 21st century
2) Learning and innovation skills and creativity.
3) Information, media and technology skills (Computer Literacy, Media Literacy, ICT Literacy, embodied digital awareness and storytelling)
4) Life and Career Skills (Flexibility and Adaptability, Initiative and Personal Direction Social and Intercultural Skills, Productivity and Responsibility, Leadership and Accountability).

1. Design Thinking

"Design Thinking is a methodology that we use to solve complex problems, and it is a way of using systemic reasoning and intuition to explore the ideal predictive value of organization and organizational planning" (David Kelley of Stanford University). The design thinking focus for the teaching-learning process is the design activities. The students are involved in thinking about the solution and evaluating the possible solutions to a problem.

The mental design work is strongly anchored to the context and must have a resilient attitude for a transformative and flexible digital pedagogy that would be:

- HCD Human-Centered Design,
- UCD User-Centered Design,
- HCI Human-Computer Interaction.

To have a Contextualized learning, attentive to educational emergencies is active, reactive, and situated and to develop Strategic competence as core competencies for "learning to learn" (bottom-up strategies) for Life Long Learning Competence.

The distinctive factors of design thinking in media education are:

- Multidisciplinarity;
- Co-construction and collaboration;
- Creativity;
- Propensity for "Wild Ideas" innovative approach to teaching;
- Creative Problem Solving;
- Decision Making;
- Learning by doing;
- Strategic thinking for solution of complex problems;
- Critical-divergent thinking;
- Emotional engagement;
- Technological Devices & Embodied Interaction.

This methodology activates solution strategies based on cognitive skills for solving complex problems through embodied learning. Design Thinking activates all processes of creative problem solving, learning-by-doing, and decision-making strategies by requiring students to

[1] P21Framework for 21st Century Learning" at fttp://static.battelleforkids.org/documents/p21/P21_Framework_Brief.pdf [Retrived 19/04/2021]

focus on the design process and the motivations for the choice made (Cancellara, Piceci, Mariani, 2021). It invites reflection on mistakes, enhancing intrinsic motivational processes through a decision-making process that activates neuro-cognitive circuits involved in procedural logic, this is supported by the psychological and neurological model of Design Thinking by Reimann and Schilke (2011). Change occurs over time as the professional designer transforms a skill into practice. Undergraduates learn how to cope with new problems with different uncertainty factors by drawing on new knowledge by engaging in practitioner research and increasing their attention to what this process of analysis reveals. It is interesting to note that in this field we speak of Empathic Design: creating solutions through empathy that stems from the spirit of collaboration that arises in a context of teamwork that develops professional and personal expertise that involves cognitive and metacognitive processes such as reenactment (having to resume procedural knowledge or previously learned content), creating innovative solutions, self-esteem, sense of agency, self-consciousness, self-awareness (Anderson & Krathwohl, 2001). The motivational drive in Design Thinking seems to be very important and is triggered by an emotional response that in turn derives from increasing attention, increased involvement of memory and learning processes, followed by aesthetically pleasing design. There is evidence in the literature on reward, inspiration, and ideation. Kernel of Design Thinking is the social interaction between students and students and between teachers and students, as a meeting of views. Brainstorming helps in social interaction and the development of non-judgment practices. Design Thinking in the logic of team working favors the development of both personal and social skills (Cancellara, Piceci, Mariani, 2021). "Design Thinking is an individual creative process, influenced by factors at the social level (inspiration, prototyping, and low criticism) that includes attention, memory, and learning and leads to a pleasing aesthetic" (Reimann and Schilke 2012).

2. The Study

In this study, the experimental lines of DBR, Design-Based Research (Reimann 2011 - Bell, Hoadley, Linn 2004) were used to implement an educational and training intervention strategy starting from the Design Thinking Embodied Approach construct (Cancellara, Piceci, Mariani, 2021). This research aims to directly involve the user in co-designing, testing, and experimenting with embodied design experiments also in distance learning contexts.

This is a preliminary empirical study to be able to test the intervention. For this reason, a non-representative statistical sample of 12 individuals (17% male and 83% female) selected among teachers in training on a university course was used. On this sample, the intervention was tested and lasted 6 weeks with a frequency of one weekly meeting of 90 minutes. These meetings took place in the classroom in the presence of the experimenters. No subjects unrelated to the experimentation were allowed in the classroom.

2.1. Methods

The intervention was structured in 3 phases summarised below:

a. Time T0:
   - Analysis of the starting situation
   - Test administration for assessment

b. Time T1: Training Protocol on non-statistical sample

- Training Scenario 1: Digital Storytelling Embodied: self-representation, action, relationship with the body in socio-psycho-educational contexts and relation to Media Learning Education contexts
- Training Scenario 2: Digital Thinking Approach: declined to teaching-learning contexts according to an Embodied perspective
- Training Scenario 3: Self-Awareness Activities for youth, students, teacher: Self-Talk, Limiting Thoughts / Enhancing Thoughts / Emotional narrative, soft skills and metacognitive strategies, Mindfulness

c. Time T2:
- Monitoring with news test administration for post-assessment
- recalibration and readjustment of phase "Time T2" (actually in progress)

The initial analysis and monitoring were carried out with questionnaires anonymously administered through Google Form.

2.2. Measurements

The questionnaires administrated were the following:

Perceived self-efficacy scale in the management of complex problems by Farnese, Avallone, Pepe, Porcelli (Farnese et al, 2007). To observe the approach to stress and also the ability to analyze in the management of complex problems.

White Bear Suppression Inventory (WBSI), (Daniel Wegner & Sophia Zanakos 1994). To measure thought suppression. The suppression of chronic thoughts is a variable related to obsessive thinking and the negative effects associated with depression and anxiety.

Decision-making style (French, West, Elander, Wilding, 1993). To be able to analyze decision-making skills.

PSI Problem Solving Inventory, form B (Heppner 1988), in the Italian adaptation by Soresi and Mirandola (Soresi & Mirandola, 1998). To analyze the aptitude for problem-solving.

Creative personality test (Williams, 1993). To detect the emotional constructs of willingness to take risks, curiosity, complexity, and imagination. The comprehensive test is based on Guilford's theory of divergent thinking (1950) and consists of two different tools: the "Divergent Thinking Test" and the "Creative Personality Test". Only the latter was used for this research work.

Digital Citizenship Skills Questionnaire for teachers (Piceci, Mariani, Melchiori, 2021). To evaluate the digital skills about European directives and DigComp 2.1 (Carrettero, Viorukari & Punie 2017)

3. Results

The analysis carried out on the non-representative statistical sample focused above all on the analysis of the effectiveness of the intervention as the idea of the study group was to create a training course that would take into account the current educational context that requires an increasing presence in the digital environment, which requires the development of critical thinking. The results from a numerical point of view will then be analyzed by applying this research methodology in a larger area that can be representative from a statistical point of view.

The analysis of Digital Competencies tended to detect whether there were basic, average, or advanced competencies. This survey was carried out at T0 (before administering the intervention) and then at T2 (at the end of the 6 weeks of meetings). It is interesting to note the following:

Survey results T0:
Base: 33%
Medium: 58%
Advance: 9%

Survey results T2:
Base: 8% (- 25% on TO)
Medium: 67% (+ 9% on TO)
Advance: 25% (+ 16% on TO)

There has been a rise in Digital competencies towards the TOP.

Improvements were also noted concerning the following embodied DT qualities:

- Play Practice understood as rhythms of bodily and social doings related to the surrounding space;
- Bring out understood as the ideas that come up through using the technique and their unfolded embodied meaning;
- Contingency is understood as the capacity to think of ways how to meaningfully augment the sensorimotor experience through digital technology and physical space;
- Playful Engagement is understood as the capacity to stimulate interest and motivation to participate in an activity;
- Social Dialogue is understood as the capacity to promote empathy and a collaborative attitude between the participants of a design activity;
- Embody Learning and Embody Awareness and Memory understood as the produced design elements or body knowledge of people's lived Visited sensations that become personal knowledge;
- Relationality is understood as the comprehension of relationships and dependencies of situated interactions between people and the world during the use of the technique.

4. Conclusion

The analysis of the educational intervention proved to be effective on the sample examined. The proposed method operates within the framework of "on-life" learning, the focus being on the two-way teacher/student relationship mediated by a hyper-connected ecosystem. The proposal aims to answer the university's questions regarding the interdisciplinary knowledge to be transmitted, including in the project's programs both "soft skills" (World Economic Forum Report 2020) and complex problem-solving skills, critical thinking, creativity, ability to work in a team and attention to the development of emotional intelligence. The intention is to create a training proposal that can take a flexible form that is recursive and adaptable to the emerging context.

The role of emerging digital technologies in generating "embodied" learning experiences was also observed, examining, in particular, the relationship between certain individual factors (embodied attitude towards technologies, sense of agency, self-efficacy, the usability of affordances) and contextual factors (support from colleagues, technical-organizational

support) and tendencies towards the rational use of digital technologies as a function of improving teaching and learning strategies in distance learning settings. In this way, the project aims to further develop the transversal competencies of decision-making and creative problem-solving in the context of digital technologies and to better understand the role of multiple modes of representation in communication and meaning-making.
The weakness of this study is the very small sample on which the intervention methodology was applied, so in the future, it will be tested on a larger sample to verify its reliability.

The strength of this study was that it aimed to test a methodology that includes several elements that are part of today's world: a multidimensional approach to solving complex problems and digital skills.

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Higher Education and Wicked Problems: Students Engaging with Complexity and Uncertainty in Sustainability Transitions

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The challenges we collectively face, such as climate change, are characterized by more complexity, interdependence, and dynamism than is common for educational practice. This presents a challenge for (university) education. These sustainability transition challenges are often described as wicked or VUCA (Volatile, Uncertain, Complex, and Ambiguous) problems. In response, educational innovations that are inspired by ecology, such as living labs are starting to emerge, but little is known about how students engage within and with these more ecologically-inspired forms of education. This work is an exploratory study into how students navigate VUCA learning environments linked to tackling sustainability transition challenges, with a focus on the positive qualities of these experiences. This is done through interpretative phenomenological analysis (IPA) of seven students (using semi-structured interviews) of the MSc Metropolitan Analysis, Design and Engineering program, a joint degree from Wageningen University and Delft University of Technology in the Netherlands. The main findings, which are both psychological and educational, of this exploration include openness to new experiences (1), flexibility (2), a process appreciation of learning (3), a desire to create a positive impact on one's direct biophysical environment and society (4). In addition, we discuss the potential limitations of the malleability of these different qualities and propose future avenues for research into ecological learning for universities. This work closes by highlighting recommendations for educators to consider when designing or engaging in ecological forms of higher education that connect to sustainability transitions.

Keywords: Higher Education, Wicked Problems, VUCA, Complexity, Uncertainty, Sustainability Transitions, Ecological Learning

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'*But I do remember how hard it was when it was pouring rain and we had to still like pick out the weeds. That was not fun to do. But I think that helps in learning how it works. Interact with it, I think*'

1 Introduction

Today, in 2021, humanity faces a wide range of wicked challenges including an enduring global pandemic and dire climate predictions (Masson-Delmotte et al., n.d.). With the world in disarray, the need for educational transformation to adapt its approach to fit the volatile, uncertain, complex, and ambiguous (VUCA) nature of these problems is more evident than ever. However, engaging with an education that connects to VUCA transition challenges also asks different psychological qualities from students. Educational institutions need to transform their approaches and practices to prepare to deal with the wicked problems of a VUCA world and to help shift the world towards a sustainable path. One approach that has been adopted by educators in the field of sustainable development is forms of *ecological learning*.

Learning ecologies, the environments that foster ecological learning, provide a new approach towards higher education. Starting from a relational understanding of education (Biesta, 2021, Wals, 2019), the focus of learning ecologies primarily lies on creating the conditions for students (e.g., Pisters et al., 2019) to connect with and act on a particular challenge in a particular place. By critically reflecting on those experiences, students challenge their assumptions, shift perspective and engage with *transformative learning*. A range of educational shifts is at the heart of this movement, such as shifts from passing on knowledge to understanding and getting to the root of the issues, from teaching attitudes and values to encouraging values clarification, from raising awareness to changing the mental models which influence decisions and actions, from answers to asking better questions, and from seeing people as the problem to seeing people as facilitators of change (Tilbury, 2011). Examples of such learning ecologies already in practice include the Challenge Lab initiated by Chalmers University of Technology in Sweden (Holmberg & Larsson, 2017), and the MSc MADE Urban Living Lab Course at the Amsterdam Institute for Advanced Metropolitan Solutions (Bohm et al., 2020; Steen & van Bueren, 2017; Vogel, 2020). Although there is a growing body of research on how these learning ecologies can be shaped, we know little about students' experiences within them. To rethink education to be better equipped to deal with VUCA sustainability transition challenges. And so that it enables transformative learning and provides students with the necessary life skills to thrive in complexity and uncertainty, we need to acquire insights into the experiences that students gain there.

In this paper, we will focus on students' lived experiences as they unfolded while navigating uncertainty and complexity. We zoom into Amsterdam, the Netherlands, where the MSc Metropolitan Analysis Design Engineering (MADE) program provides us with a specific research context. Through seven semi-structured interviews with students in this program and an Interpretive Phenomenological Analysis (IPA) approach to the data gathered, we indicate answers to the central question in this paper: how do students navigate uncertainty and complexity in higher education that links to and co-creates sustainability transitions?

2 Theoretical Background

2.1 The Nature of Wicked Problems

The rise of higher education programs that specifically focus on sustainability transitions at the core of their curriculum such as those identified above introduces the specific nature of sustainability challenges into educational practice (Wittmayer, Schäpke, van Steenbergen, & Omann, 2014). Rittel and Webber (1973) were the first to point out the nature of these challenges and consequently coined the term *wicked problems*. According to them, wicked problems are "ill-defined, rely upon elusive political judgement for resolution" (p. 160), and include nearly all public policy issues. Recently, in the context of sustainability transitions and a wide range of fields, the nature of these problems has been defined as Volatile, Uncertain, Complex, and Ambiguous (VUCA)(Schick, Hobson, & Ibisch, 2017). Scientific theories and approaches for confronting social policy problems have fallen short because of the nature of these problems. The positivistic paradigm of science and engineering cannot be applied to these problems because they are designed to solve *tame* problems, which are definable, separable, and have findable solutions. Wicked problems are characterized by at least ten distinguishing properties such as the lack of a "definitive formulation", solutions not being "true-or-false, but good-or-bad, and not possessing "an enumerable (or an exhaustively describable) set of potential solutions" (Rittel & Webber, 1973, p. 161). Pohl et al. (2017, p. 329) identify the "purpose of dealing with wicked problems" as the factor that substantially distinguishes transdisciplinary research from standard research. Research since the 1990s has shown the need for multi-stakeholder constellations of actors and disciplines to collaborate in a process of co-producing knowledge. There is a growing consensus that transdisciplinary approaches to research and education are required (Hadorn et al., 2008). In educational practice, this means students need to learn how to think and act from the perspective of multiple disciplines simultaneously. Or even to transgress these boundaries entirely (Lotz-Sisitka, Wals, Kronlid, & McGarry, 2015).

2.2 Complexity Theory

Uncertainty and complexity are two closely related concepts. Complexity refers to systems whose aspects are connected via non-linear, dynamic interactions. As a consequence, these interactions are characterized by interrelationship and interdependency. Uncertainty relates to the paradox that "while our understanding, knowledge, and technical power continue to increase, we face greater uncertainties than we previously have" (Dovers & Handmer, 1992, p. 262-263). With our growing ability to influence our environment, more unintended and unpredictable outcomes arise. In other words, the challenges, and systems we work with are becoming more complex. Which subsequently raises the uncertainty involved. However, from a human sciences perspective, the more uncertainty is introduced the more unsafe a learning environment becomes. This represents a paradox for universities that intend to engage with transition challenges (Kaufman, 2020).

One framework that unites both concepts is complexity theory. This is a theory that has been developed and used throughout a wide range of fields and theories such as general systems (Amagoh, 2018), cybernetics (Sage, 2013), chaos (Warren, 2013), ecological (Preiser, Biggs, De Vos, & Folke, 2018), enactivist (Sumara & Davis, 1997) and autopoetic theories (Gregory, 2006). "Complexity theory examines how living phenomena (learning, for example) emerge in a web of relations that form among things, including both social and

material things, such as bodies, instruments, desires, politics, settings, and protocols" (Fenwick & Dahlgren, 2015, p. 360).

Complexity theory aligns strongly with the ecological perspective on learning. The non-linear cause-effect structure of these uncountable relations leads to the continuous development of novel possibilities and exercise multiple causal influences on what emerges. These continuously evolving and emerging structures are the reason why complexity and uncertainty are so closely related. The notion that complex systems are characterized by uncertainty also means that the effects of human actions can never be fully anticipated or predicted (Portes, 2000) and that unexpected and unintended consequences are inevitable. As a consequence, the use of words such as emerging and navigating is prominent over terms such as managing, steering, or controlling transitions (Olsson, Galaz, & Boonstra, 2014). Acknowledging that uncertainty is inherently part of the change in complex systems then leads to the question of how to thrive with these dynamic qualities of complexity, especially for students who engage with sustainability transition challenges through learning ecologies.

3 Methodology

According to Jackson (2013), an individual's learning ecology encompass their processes and set of contexts, relationships, and interactions that provide opportunities and resources for learning, development, and achievement. An ecological approach to education thus includes both iconographic and relational qualities. To investigate the lived experience of master students learning to navigate uncertainty and complexity in higher education that links to and co-creates urban sustainability transitions, a method that can explore both dimensions is required. One such method is interpretative phenomenological analysis (IPA), which we conducted on seven semi-structured interviews with students of the MSc MADE program (Metropolitan Analysis, Design and, Engineering)[1].

IPA has roots in psychology but is also frequently used in related fields such as human, social, and health sciences (Smith, Flowers, & Larkin, 2009). The phenomenological aspect of IPA describes the focus on investigating the individual experience as the central aspect, rather than trying to fit it in abstract, predefined categories. It is based on the concept of phenomenology by the philosopher Edmund Husserl (Smith et al., 2009, p. 12) who emphasized the importance of going "back to the things themselves". The goal is to break through the "hierarchy of experience" (Smith et al., 2009, p. 2) which starts with the most elemental level, the unconscious, the rather passive flow of experience. The real focus of IPA however, is to engage with the experience point when everyday events become meaningful forms of living. These more complex types of experience usually occur when something important or impactful happens to us - this can be a negative, positive or indifferent aspect. It turns from just experience into 'an experience'. This change in quality usually is accompanied by elevated levels of awareness, consciousness, and hence, the richness of details. This focus of IPA on meaningful, or transformative, experiences also explains the emergence of the method in health-related topics. For this analysis, we hypothesized that engaging with the ecologically inspired MADE course was a meaningful enough event for IPA.

[1] MSc MADE is a two-year joint-degree master program from Wageningen University and Delft University of Technology located at the Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute). The program focuses on urban sustainability by a largely challenge-based pedagogical approach. Many courses take real-life, urban challenges from the Amsterdam Metropolitan Area as a starting point of learning, and students from different disciplinary backgrounds investigate these challenges in a transdisciplinary way.

The second step of IPA is interpretation, this is done iconographically before relational patterns are sought. In this study, this step was primarily conducted by the first author. The research team discussed and an intersubjective consensus for the interpretations was sought.

4 Results

4.1 Openness to New Experience

Participants showed appreciation and enjoyment in working on openly formulated problems: *'I think for me, what was really interesting in this challenge was, again, this was fully open-ended and up to us, it was not like organized by teachers or anything, we just had to reach out to experts, to also teachers, but it was all up to us'*. They also mirrored the importance of openness for complexity: *'I think that's what I liked about the open ends (...) I think that's for the really large and complex issues, that is sort of necessary because you cannot know upfront what is the most important thing'*. Appreciating open approaches to problems mattered to the students, as well as certain freedom, or sense of agency, in their own personal and professional choices. Many of the participants enjoyed working in transdisciplinary environments because it allowed them the opportunity to keep their development as broad as possible. One student explained this as follows: *'I can have architecture in a place but change that place of the architectural designer into something that is more open. I like it because I can work in whatever. If you have a lot of works (...) it's always challenging, because you're always trying to learn new things from that'*. While this quality proved to be important for the students themselves and their own development, they also appreciated openness in the people they worked with, such as problem owners. Openness can be seen as a catalysator for new ideas and progress: *'I was actually kind of surprised. The municipality is lucky to have some people that just were like: 'Yeah, why not? Let's see where it goes. Because that's where the right innovations happen'*.

4.2 Psychological Flexibility

Being cognitively and behaviorally flexible seems to play a major role in successfully dealing with complex systems and interdisciplinarity due to the inherent multiplicity of factors and the consequent variety of possible approaches. The presence or lack of flexibility often becomes apparent in confrontation with conflict or unexpected events. When approaching a complex problem, there are multiple possible angles and perspectives to take. Often the optimal approach is not clear initially and emerges throughout the process as information is gathered. One student described it as follows: '*But that also felt in the beginning at the start, there were so many things that are happening on the housing market, and so many things that are not going that great, that it was also a bit of: 'Okay, how are we going to start ever?*''. This uncertainty of outcomes then requires a certain level of flexibility during the process. Additional options emerge while others can be ruled out or fall away: '*Yeah, and being flexible [is important]. Like yeah (...) in our group, we want to do focus groups, but if we didn't had focus groups, then we had to be flexible'*. Staying aware of this constantly changing context and adapting the action plans accordingly is effortful and can cause a considerable amount of frustration. Especially when promising routes that a student has invested time and effort into turn out to be unfruitful. The required flexibility seems to be a learnable skill to a certain degree formed by previous experience such as prior education. One student described the influence from her previous degree as follows: '*Maybe hierarchy is not the good word, more structure. And I think I liked working in that way better. Because I also really like when things make sense. And maybe that's because my technical background*'.

Switching roles within transdisciplinary teams also requires high levels of flexibility. Depending on the composition of the team and skill sets of the other members, each individual needs to find his or her place over and over. One participant described this fluency between roles: '*You're working with so many different people with all the different expertise (...) you have to find where your position fits best, and what your qualities are that you can use in this time or this project*'. However, to a certain degree, a person's level of flexibility also seems to be subject to personal preference or a character trait. It is important to mention that flexibility should not be seen as a dichotomous concept, where an individual is flexible or not, but rather on a continuum. The same student also said: '*But [uncertainty] also set us free. So little bit like, you can also be like, go crazy and creative*'. Hence, certain preferences for structure can also go hand in hand with, ergo is not mutually exclusive of, appreciation of flexibility. The creativity aspect of flexibility got mirrored by other participants who explicitly mentioned it as an aspect they enjoyed: '*I really enjoy the fact that you just have to figure everything out. So it's like a constant adventure and roller coaster (...) Because of the defining, like, puzzle and to find out something new to create something new, and be creative with whatever people put on the table*'. Almost all participants reported on their flexibility relating to their study choices. Many of them decided to join the MSc MADE program on a gut feeling or following a happenstance: '*So then I started looking for information and actually decided to switch on the final day before the deadline. And I think that was a great decision*'.

4.3 Process Appreciation of Learning

The reply of one student to the question of whether there are aspects that they wished they had known when they started the program displays the appreciation of learning as a process: '*There's not really a thing that I thought I should have known already. (...) And it also kinda beats the purpose of education (...) There might be things that I've learned where I was like, well, if I knew this few years ago, I would have done my courses better. But then what's the point?*'. Certain aspects are not something you learn by reading a book or by hearing about them in a lecture, certain aspects need to be experienced. The important feature then does not consist of the fact or the knowledge itself but rather the process of dealing with a challenge. It involves struggling with a problem and then overcoming it. This type of learning then becomes more valuable and ingrained than just a simple transfer of knowledge. Another participant described her experience as a young child in the school's garden: '*But I do remember how hard it was when it was pouring rain and we had to still like pick out the weeds. That was not fun to do. But I think that helps in learning how it works. Interact with it, I think*'. These accounts stress the importance of ecological learning forms such as the living labs implemented in the MADE program. In addition to this appreciation of the process itself, the participants displayed high motivation for self-improvement and self-development through seeking out learning opportunities. As mentioned, interdisciplinary contexts provide a rich environment for these opportunities by exposing the individual to a wide variety of possibilities and perspectives: '*That's something that I choose then to focus on that every time in a new project, I choose something that I really want to learn, and then I'm going to make that my new expertise. But I think that that is every time something new, I'm learning also for myself, but from within, from my background, I'm usually the connector of everything.*' This constantly evolving set of new requirements is rich in opportunities while simultaneously setting high expectations for the student. This experience can be frustrating but also extremely rewarding: '*That's my motivation to also already start learning how other people from different backgrounds in this program work together. And that's not always very easy, but very interesting*'. It seems that a growth mindset is the right fit for complex learning

situations: '*I really believe in the sort of constant stimulation of seeing different things and I definitely learn from difference'*.

4.4 Desire to Create Positive Impact

One participant expressed the following observation: '*Because (...) the thing that you always run into within my bachelors or within the technology part, we always designed something and that would never be applied and would never be adopted by any policy or anything because no one was able to translate it in such a way that the policymakers would understand'*. Connecting theory and practice, therefore, was a logical conclusion for many of the students. Building the bridge means taking research and implementing it into the real world where it can make a difference in peoples' lives. Furthermore, they emphasized that in complex systems it was important to make choices between a variety of different options and that the most important factor was to maximize impact: '*Because we eventually chose to focus on the option that had the best potential and the solution that would have the greatest impact'*. They brought up a problem that links to the hyperlocal nature that is inherent to living labs, especially related to the city of Amsterdam, which can be seen as a model city in many regards but also a utopia when compared to other places: '*If we would be able to communicate the concept of Dutch cycling infrastructure more (...), if we only were able to wrap up this concept, export into a different country, we would affect the lives of 15 million people (...) Well, isn't that worth something?*'. These lines of thinking display the participants' high aspirations and motivation to create an impact not only on the lives of people in their vicinity but around the world. The fascination with the urban context can also be explained by their desire. As one participant put it in the context of his interest in urban areas and impact maximization: *'Because they're very little area, but they contribute most to a lot of global challenges. So, solutions in the city usually mean, it impacts a lot of lives*. Their motivation is not only limited to society but also more specifically to the biophysical surroundings: '*I would really love it if I can help to create a greener world. This sounds really idealistic, but sometimes I picture myself just working in a shop or being, like a very practical job (...) but then eventually, I just really want to help this change*'.

5 Discussion

5.1 Openness to New Experiences and Psychological Flexibility

Openness to new experiences and flexibility are closely connected to resilience thinking through the dynamic nature of social-ecological systems (Cumming, Olsson, Chapin, & Holling, 2013). These complex and adaptive systems are characterized by constantly emerging gradual and abrupt changes and the consequent necessity to adapt and transform accordingly (Folke, 2016). A shift towards an ecological consciousness (Pisters et al., 2019) can only be made possible by the ability to adapt and transform current pathways onto more sustainable ones. Openness to new experiences and flexibility seem to be necessary to enable students and professionals to make these shifts.

Additionally, both factors are crucial to every individual working in interdisciplinary teams, since actors find themselves in varying roles depending on the composition and the skill set of each team. Overall, the interplay between these two factors and interdisciplinarity was a reoccurring theme in participants' accounts of their experiences. VUCA learning environments and the related wicked, real-world challenges, almost by definition, transgress the traditional boundaries of disciplines. As a result, those who strive to navigate these

environments and challenges successfully need to be flexible and open-minded when applying their skills and knowledge. This is especially true for those cases, where students were educated in rather traditional, monodisciplinary environments.

5.2 Desire to Create a Positive Impact

The desire to create a positive impact on one's direct biophysical environment and society directly relates to the educational shifts described by Tilbury (2011). More specifically, it is connected to the shift from teaching attitudes and values to encouraging values clarification. Wicked problems and their inherent complexity and uncertainty can cause considerable amounts of frustration. Dealing with setbacks, course changes, and other hindrances seems to require high levels of intrinsic motivation. All students in this research displayed remarkable levels of desire to have a positive impact, which seems to serve as a powerful driving force. It might play a central role in thriving in complexity by bolstering students' energy, resilience, and perseverance. It is also possible that this is a potential pitfall for students engaging in such forms of education, as it is possible, they are so motivated that they push too hard and burn themselves out. This is something that educators have to pay attention to. Encouraging and supporting students to explore and consolidate their values concerning sustainability transition challenges should therefore be placed more centrally in higher education curricula.

5.3 Process Appreciation of Learning

The dynamism and transformative nature of VUCA problems related to sustainability transitions require individuals who deal with them to constantly evolve and adapt to the emerging structures and factors. The process appreciation of learning relates to the skills needed to function or even excel in transdisciplinary teams dealing with complex problems. The students are required to constantly seek out opportunities for learning and self-growth as new challenges, or new elements to the challenge, emerge. It was highlighted how powerful ecological constellations to learning are for exposing students to learning beyond superficial knowledge to the root of the problem (Tilbury, 2011) by interacting and struggling with it. Consequently, this type of learning then becomes more valuable and ingrained. These might be the characteristics of learning that enable transformations that eventually lead to a change in qualitative consciousness (Pisters et al., 2019). Understanding and appreciating these qualities of learning is therefore crucial for students and educators alike.

5.4 Are These Elements Educable?

An important sociobiological educational question that follows from these findings is to which degree these four above-described qualities are malleable and hence, teachable and to which degree they are predispositions and hence, subject to selection or recruitment procedures. Like with most dichotomies, the truth lies somewhere in the middle. A similar question that philosophers and scientists historically have debated over is the one of whether characteristics are innate or acquired. Today, we know that all traits require both genetic and environmental factors for their development (Griffiths & Linquist, 2021). Thus, it is not unreasonable to assume there will be students who are more educable in ecological constellations. Research by Ben-Avie and Darrow (2018, p. 46) into malleable and immutable student characteristics found that "malleable characteristics among students were more important predictors than immutable ones". Further, they emphasized the importance of focusing on students' development since "in fact, promoting the highest levels of development among students seems to be what helps them reach high academic goals" (p.48).

Hence, enhancing all students' development of openness to new experiences, flexibility, a process appreciation of learning, and a desire to create a positive impact on one's direct biophysical environment and society seems to be a promising avenue to pursue. More research is necessary to instigate how exactly this can be accomplished. At the same time, well-designed selection and recruitment procedures might enable universities to identify those students that are not only able to learn through the complexity of VUCA problems but also able to thrive under these circumstances.

5.5 Limitations

When evaluating our findings, a number of limitations need to be taken into consideration, such as certain general limitations concerning the method of IPA. Noon (2018) investigated the appropriateness of IPA as a method for educational research. He concluded that "it has the potential to be a powerful tool in helping researchers to understand the lived experiences of those within the education system" and that "findings of IPA studies can contribute in assisting educationalists in shaping future policy and practice around the needs and expectations of both students and educators" (Noon, 2018, p. 82). However, he also mentioned a number of limitations and challenges which apply to our research. "Language barrier" refers to the fact that IPA assumes that "language provides participants with the necessary tools to capture their experiences" (Noon, 2008, p. 81). The richness of responses determines to which degree it is possible to access the participants' experiential worlds. While the interviews for our research were held in English, all of the participants and researchers were non-native English speakers. It therefore might be possible, that the language barrier limited our insight into participants' experiences. However, all participants are participating in a master's degree taught in English, which indicates high-level language proficiency and permits the assumption that results are sufficiently detailed. A second limitation is "uncomfortable dualism" which refers to "dualistic tension between idiographic commitment and the search for connections across cases". It can become difficult to represent individual experiences sufficiently, while still generating common themes. This is especially true if the published articles are restricted by word limits, which then leads to the necessity to reduce other sections to ensure that "findings are not diluted". This is also true for this research, which originally included a more in-depth review of literature on underlying theory. Consequently, the focus is on the students' lived experiences rather than a detailed account of the theoretical background. This focus also connects to the third aspect of generalizability. IPA is based on relatively small sample sizes, in our case the experiences of seven individuals, which "inevitably raise questions concerning representativeness and transferability of findings". The goal of IPA, however, is not to make general claims about all settings, but rather represent the individual experiences in a specific setting. Our research aims at contributing a small piece to the whole, then "through the gradual accumulation of similar studies, more general claims can be made". It is for these reasons that we consider these results as indicative only.

6 Conclusions

Our research on the lived experience of students from the MADE program provides an entry point to further investigation of learning ecologies and the qualities that enable students to thrive under complexity and uncertainty. While the labels attached to these forms of education differ – Living Lab, Challenge Lab, Fieldlab – the underlying educational purpose is the same: exposing students to wicked problems in VUCA environments with the ultimate goal of transformative learning (Holmberg, Andersson, & Larsson, 2015) and changing a

place (Pisters et al., 2019). With growing interest in learning ecologies in educational practice also grow the number of opportunities to examine what makes them successful. Which educational elements provide students with the best opportunities to foster important skills and to consolidate existing personal qualities? This research was designed and conducted with an exploratory focus using IPA. Individual experience is at the heart of this method and hence, also at the heart of our findings. These findings provide a detailed, in-depth insight into seven students' encounters with the complexity of VUCA problems. Their experiences point towards the importance of openness to new experiences (1), flexibility (2), a process appreciation of learning (3), a desire to create a positive impact on one's direct biophysical environment and society (4) as key elements of thriving in VUCA learning environments such as ecological forms of higher education. Whether these factors apply to a more general population and whether there are additional crucial factors needs to be determined by further research. Learning ecologies seem to be a promising route to introducing real-world complexity into learning environments and consequently equipping students with the necessary tools to thrive under VUCA circumstances. More ecological forms of higher education will likely emerge and the authors applaud these efforts. At the same time, the authors hope to have shown that careful consideration of the human elements of such education is essential, and much about engaging with such forms of education for students remains unknown. We hope that the provided insights can help other practitioners in (re)designing their own ecological education that connects to VUCA challenges in place, and warmly invite more research into the design of such higher education and how they are experienced.

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Empowering Graduate Success with Career-Driven Modular Curriculum

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Graduates entering an ever-more-competitive job market are often unaware of the skills and values they offer employers. The challenge is more significant with emerging job roles requiring certifications, multidisciplinary skills, specialist knowledge, even entry-level positions. We seek to empower our graduates and maximise their career prospects. New research has enabled us to harness the power of artificial intelligence for a custom-designed course planning and recommendation system for students based on the skills their desired jobs require. We named these curriculum delivery models JobFit and ModuLearn.

Keywords: Employability, Graduate Success, Skills, Skill Development, Learning Management

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Introduction

Current graduates enter highly competitive national and international job markets, requiring job-ready knowledge with a demanding set of skills (Morrell & Morrell, 2014). Scientists examined various approaches that human resources use to find candidates (Harris, 2017), involving a high level of algorithmic processing and automation using text mining. The most common filtering method is finding and extracting desired features/keywords from CVs. Thus, when applying for positions with many candidates, it is essential to understand and describe applicant skills matching the employer's needs.

Employers distinguish between two skill types: "hard skills" and "soft skills." Hard skills represent the job-related specialised knowledge and abilities to perform the job effectively. Soft skills represent personal qualities and traits. While research shows that soft skills often have a more significant impact on career success (Heckman & Kautz, 2012), candidate filtering and selection mainly focus on hard skills. With this approach, graduates face an issue where they often do not understand and cannot express their skill set to potential employers.

However, the current curriculum approach informs students on subjects and their content rather than which skills they develop upon completion of a given subject (Kumpas-Lenk, Eisenschmidt, & Veispak, 2018). Then, a key issue is mapping acquired academic knowledge to industry-required skills (Shankararaman & Gottipati, 2016). Likewise, this process is opaque to the industry, relying on references and connections between academics and industry professionals to 'translate' what students can achieve.

Not only does understanding skills and abilities pose a challenge, but it is also often challenging to acquire the desired skills in the relatively short period that students spend in higher education. In undergraduate university degrees, the structure of the first few semesters is often pre-defined with core subjects. Students have a more significant opportunity to explore different knowledge pathways in the second year, leaving only one or two semesters to focus their knowledge on the desired skill set. This problem is even more significant in shorter courses, such as two-semesters long diplomas.

As a result, curriculum designers face issues trying to address the job-ready student needs with the traditional approach (Misni, Mahmood, & Jamil, 2020). Analysing the curriculum of higher education institutions, we can often spot overlaps in capabilities and skills delivered. While partially the reason is pathway (prerequisite) issues, we spot a different trend. Trying to maintain an advantage over competitors, institutions introduce new subjects at a fast pace, leading to an incoherent curriculum, particularly concerning current/future industry and employment needs. Consequently, the lack of understanding of what is needed and ad-hoc additions have led to programs that do not provide a clear pathway and relevance to work roles.

However, higher education institutions can work with industry to co-develop technologies that can support this mapping and simultaneously help graduates market their knowledge. If we can achieve this, the whole system benefits: students will find academic and extra-curricular pathways that deliver the critical job skills that their dream jobs require (Knight & Yorke, 2002). Further, curriculum designers will intuitively interact with the "job-ready" approach by assessing how well the curriculum covers specific skill requirements.

This is now possible. With rapid changes in computing and engineering technology, the curriculum development process can be more agile and future-focused rather than reactive. In

this paper, we scope and describe a prototype of a technological solution, “JobFit” and “ModuLearn”. The “JobFit” harvests data from employer adverts, define the requisite skills, map to academic subjects, and – considering user preferences and career aspirations - construct educational study pathways. The ”ModuLearn” framework proposes a modular decomposition of academic content delivery, increasing the variety of studied content and facilitating the curation of targeted pathways of study.

JobFit Model

The JobFit model proposes explicit annotation of learning components (e.g. subject, units, modules) with the information on hard and soft skills they deliver. For hard skills in Science, Technology, Engineering and Mathematics (STEM) areas, we propose to use the definition of skills from the popular Skills for Information Age (SFIA) framework (https://sfia-online.org/en). The SFIA framework version 8 defines 121 skills, mainly focusing on technology and business. For example, “Acceptance Testing” or “Business Modelling” are skills from SFIA. Furthermore, each skill can reach seven different levels of responsibility. Level 1 - “Follow” restricts the knowledge to following instructions under supervision in the given knowledge area. Level 3 - “Apply” defines the capability to apply the knowledge to new problems and challenges. Level 7 - “Set strategy, inspire, mobilise” concerns managers, visionaries and thought leaders capable of defining organisational as well international procedures, policies and standards.

While SFIA works well for STEM skills, for all other sectors (e.g. health, social sciences), we use the aggregated skillsets extracted from job advertisements by the commercial data provider Burning Glass (https://www.burning-glass.com). While the Burning Glass skill definition is not as comprehensive as the SFIA, it provides the possibility to discover available job offers in world markets. On the other hand, SFIA defines comprehensive, multi-level skills but only maps to often outdated job definition datasets, such as Australian Public Service, listing 149 career pathway roles (https://sfia-online.org/en/tools-and-resources/standard-industry-skills-profiles/australian-public-service). Table 1 compares the two skills providers.

	SFIA (version 8)	**Burning Glass**
Number of Skills	121	Hundreds
Industry Sectors	STEM, Business (partially)	Any
Skill Description	Comprehensive (7 levels)	Limited to None
Job Mapping	Job roles in a few datasets	Thousands of live jobs
Implementation	Easy	Very Difficult
Requires Post-Processing	No	Yes (aggregations)
Price	Free (Corporate User License)	$100.000 +

Table 1: Comparison of SFIA and Burning Glass

But, the idea of using skills to assess the quality of the curriculum is not novel. University of Auckland (Putt, 2020), or the University of Tasmania (Herbert, Lewis, & Salas, 2013), used

SFIA to analyse their degrees and assess their strengths and weaknesses in relation to job-market opportunities. Using the analysis results, they proposed degree changes and discontinued or introduced new units.

Consequently, the JobFit model proposes to embed the skills information into learning outcomes of learning components, assuring their continuous updates. The skill-based approach supports both curriculum designers and students. For curriculum designers, it delivers quantifiable measures to assess the curriculum structure and support for jobs or roles. For students, it facilitates the what-if analysis of their study pathways with relation to employability requirements of their desired job roles. Moreover, embedding skills into the curriculum facilitate accreditation of study programs, where accrediting bodies use skill analysis (e.g. Australian Computer Society). Also, if this approach becomes widely adopted, it will facilitate student transfers among institutions and study programs.

JobFit Framework

The primary functionality of the JobFit Framework is to automatically assess and aggregate the embedded skill information of a defined study pathway and compare it with the requirements of a selected job role or a job category. This provides a quantifiable approach to assess the "compatibility" of the pathway with the selected job. Figure 1 shows the compatibility assessment screen of the JobFit framework.

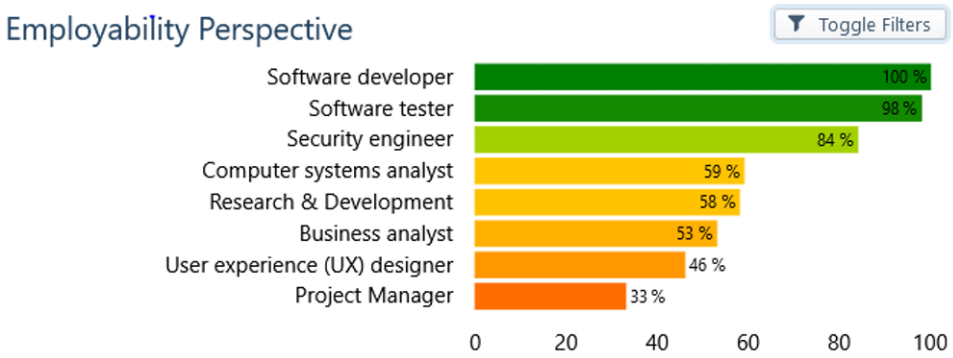

Figure 1: Compatibility Assessment of the JobFit Framework

The JobFit framework supports students and curriculum designers in making the best-informed study or curriculum decisions. For this purpose, we designed state-of-the-art artificial intelligence planning, monitoring, recommendation methods and support systems. The framework curates information differently with respect to who interacts with it:

Prospective Students

1. Explore careers supported by institution study programs.
2. Based on career selection and/or knowledge area preferences, explore diverse study pathways and choose the best matching course and program.

Existing Students

1. When choosing a new elective, perform the what-if analysis to choose the most interesting one with respect to chosen career and/or knowledge areas of interest.
2. Monitor the study progress, proactively detect problems or opportunities, plan alternative pathways.

Curriculum Developer and Curriculum Quality Officer

1. Check the compatibility of the study program with the target job roles and categories.
2. When adding or discontinuing new knowledge units, analyse the impact on compatibility.
3. Automatically generate new multi-disciplinary courses or micro-credentialing degrees from the catalogue of available knowledge units.

Figure 2 depicts the interface of the JobFit application, with tools for curriculum developers. On the left is a selected study pathway (core + major). In the middle is the career compatibility analysis. The details of the chosen pathway concerning the selected career are on the right. Under "SFIA Skills" section, on the left, green are the desired target level of the skill. On the right, are the skills obtained after completing the chosen pathway. We see that many of them did not reach the desired target level (depicted red). Underneath the SFIA Skills section, we see the analysis of skill progression and the analysis of units contributing to further skill progression.

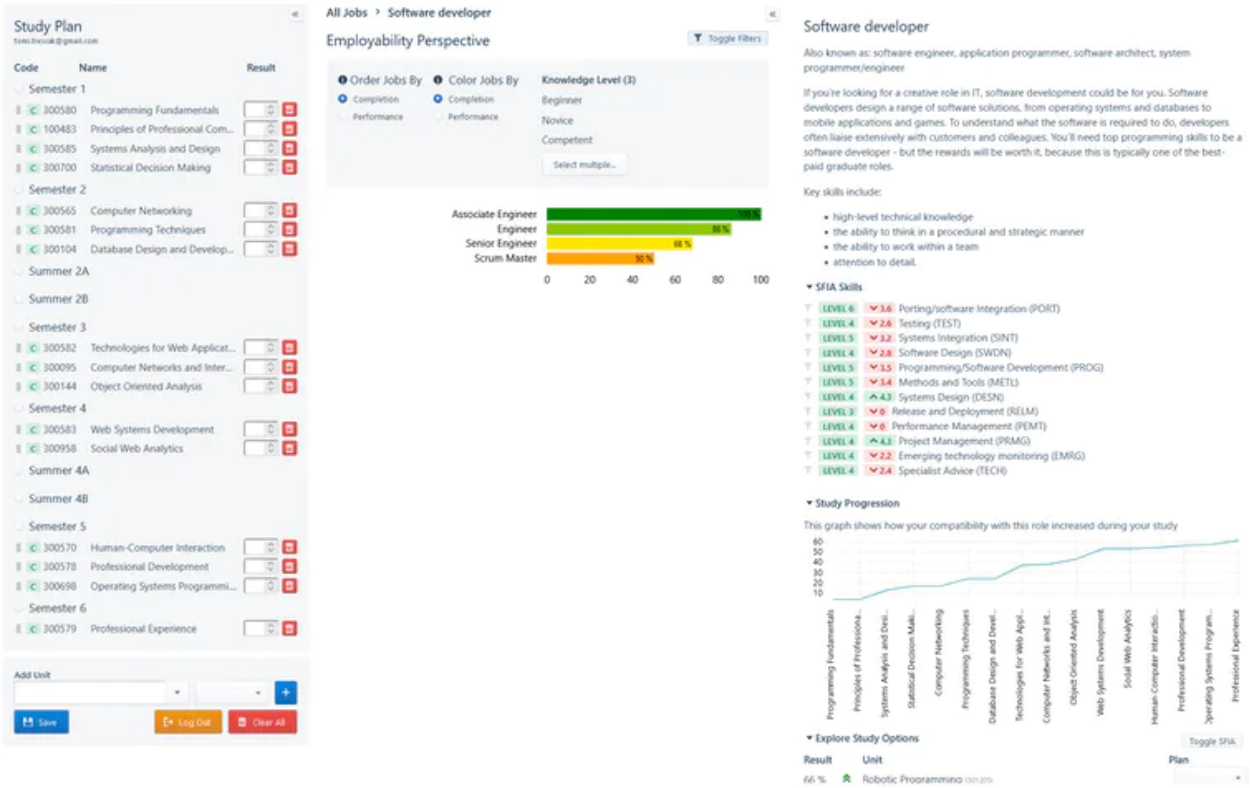

Figure 2: JobFit Framework: Curriculum Designer Tools

While JobFit Framework should deliver positive benefits, with short programs, such as diplomas or certificates with a limited number of knowledge units, the impact of the JobFit framework is limited. Even many undergraduate courses are composed of a large pool of core units, permitting only a very few electives. To increase the variety and number of options from which we can construct a pathway study, we propose the ModuLearn model. We describe the model in the next section.

ModuLearn Model

The ModuLearn introduces modules as the novel building block of the modern curriculum. Modules represent short, skill-informed learning units lasting two to four weeks. An intertwined network of modules delivers fundamental knowledge with lower commitment needs than semester-long subjects, allowing for experimentation and dynamic skill acquisition with a wider variety of skill options across multiple knowledge domains.

We base the ModuLearn model on the Charles Sturt University (CSU) Topic Tree (https://www.csu.edu.au/engineering/curriculum), delivering 1000 topics within their engineering degree. Unfortunately, the CSU topic tree solution has no technological back-end, and the tree exists only as a visualisation. There is no notion of skills, allowing to explore the knowledge acquisition in diverse pathways. As a result, students cannot perform what-if analysis and estimate the impact of their chosen plan on their career prospects.

The ModuLearn modules use the JobFit approach to define the skills module delivers. Moreover, ModuLearn uses skills to define prerequisites and completion criteria. For example, traditionally, we specify that the prerequisite to study a knowledge unit “A” you need to complete knowledge units “B” and “C”. With ModuLearn, we can specify that the prerequisite to study a knowledge unit “A” you need to have skills “a”, “b” and “c” (at a specific level). This ensures the understanding and progression of acquired skills and a more natural and dynamic approach to defining study pathways, such as obtaining similar skills through multi-disciplinary studies. Overall, modules provide various opportunities to develop a more engaging curriculum.

First, modules can provide prerequisite knowledge for first-year students, allowing all students from diverse backgrounds to have the same starting position. For example, we propose entry-level mathematical and science modules for first-year ICT students or students from other faculties to acquire fundamental knowledge required in applied modules.

Second, we discovered that knowledge units are missing the desired prerequisites due to study pathway issues, affecting students with insufficient starting knowledge, leading to their failure. Modules define a vast intertwined knowledge network of shorter, targetted knowledge units, connecting fundamental knowledge to applications, providing better motivation and insight. For example, we propose to deliver Linear Algebra classes (fundamental knowledge), with modules focused on Video Games Programming (applied linear algebra). Consequently, curriculum designers can explore this network to specify more targetted prerequisites (based on skills or modules), lowering failure rates.

Third, short module length and limited content facilitate keeping the content up to date and adjustments for dependants and applications. Last, with our approach, it is easy to estimate the impact of curriculum adjustments with its quantifiable skill-based assessment. For example, it informs us which careers the new applied module supports or benefits from a new fundamental knowledge module on other modules.

Conclusion

We deliver an innovative product, represented by the framework for the curriculum design, supported by innovative technological solutions. We designed a state-of-the-art planning and recommendation tool processing a large variety of modules and combining them into a

meaningful study pathway based on user preferences. The system proactively monitors student progress and provides alternatives to maximise the best possible career opportunities. Students can use the system to do the "what-if" analysis and explore career options. Combined with live-job market data, we can analyse different study pathways and compare study outcomes with real job prospects, quality and quantity of offered jobs.

Curriculum designers use the system to find and bridge skill gaps and support global job markets by addressing increasing and ever-changing demand for graduate skills. Moreover, the system can automatically analyse and design micro-credential degrees according to current job market needs.

The impact of this system will be greatly enhanced if it spreads across many organisations. But, the implementation may become a hindrance for often large institutions with established structures and policies. Thus, the JobFit Framework, which is easy to integrate into the existing structures and information systems, can exist independently of ModuLearn, often requiring complex policy adjustments. Implementing ModuLearn is only encouraged as it significantly increases the impact of our solution.

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The Role of Gamification and the New Technologies in the Construction of Mathematical Thinking

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The game has always represented a role of fundamental importance in the activation of learning processes. The development of videogames have given a distinctive mark to the introduction of innovative technologies in education. With the advent of Generation Z, the theme of the game has become very important for human life. The effect of these factors has led to the birth of the phenomenon of gamification both in school environments (Biró, 2014) and in work contexts, becoming a management practice (Mollik and Rothbard, 2015; Kapp, 2012). In summary, attention will be focused on three different points of view: the contribution of gamification in motivational processes, the type of skills developed and the effectiveness of the learning process activated. Surely, the development of human skills is successful where investments are correctly managed and oriented. The effectiveness of an educational process is subject to three conditions: the involvement of the student, the accurate analysis of his training needs and the adoption of effective tools for the desired purpose. In this regard, the Theory of Intentional Change formulated by Richard Boyatzis suggests that without the drive for personal improvement, any activity would be useless.

Keywords: Gamification, New Tecnologies, Mathematical Thinking

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Introduction

The primary objective of this work is to consider the aspects of gamification from an educational point of view and to highlight its ability to stimulate learning processes and the structuring of human skills, especially when considered in the context of mathematical thinking. Gamification is based on the consideration that playful elements play a fundamental role in the approach to knowledge, especially when referring to school-age children.

Gamification bases its assumptions on the application of the mechanics of games in various contexts: learning, productive work, and marketing. The main purpose of gamification is to make an action more enjoyable and engaging which, alternatively, would be boring, banal and repetitive. Surely, implementing game mechanics is one of the most efficient ways to involve people in activities (study, work) and to facilitate the behavior of a gamified system.

The objective of this reflection is to analyze gamification on the basis of the psychological aspects and experience of each individual and to evaluate, then, its effectiveness in the learning processes of mathematics, even when it refers to complex processes and is considered to internship of higher-order school situations (high school mathematics).

Gamification seeks to structure learning through the motivation to learn through game, a psychological construct of great interest and educational relevance. In fact, the use of gamification stimulates the user's interest and both intrinsic and extrinsic motivation. Intrinsic motivation arises from the inner awareness of the subject, who decides whether to perform a specific action guided by principles such as: altruism, competition, cooperation and a sense of belonging. On the contrary, extrinsic motivation occurs on the basis of external stimulations (classification, levels, points, badges, trophies, missions).

Therefore, motivation leverages people's desires and needs, pushing them to achieve goals (learning, work, etc.) in a stimulating and productive way. In fact, the human being tends by nature to have an intrinsic motivation that pushes him to seek novelty and challenges to extend his abilities, to explore and to learn.

The spontaneous interest that grows in every person from the first years of life helps develop their cognitive and social skills. Such conditions occur only if certain psychological and social needs are met. They are: autonomy, understood as the player's willingness to perform a task; competence, understood as the player's need to participate in challenges feeling competent and efficient (positive feedback stimulates competition and the perception of competence); relatedness, which consists in the experience lived by the player who feels in relationship with others; the purpose, that is, the need to make sense of one's actions. For Marczewski the purpose represents the need to perform an action only in the presence of a reason and a deeper meaning (Marczewski, 2015).

It is understood, then, how much in Education, each course of study calibrated on the principles of motivation and active stimulation of all perceptual and sensory channels is significant, effective and efficient for the structuring of cognitive processes and for the optimization of learning. It is, also, good to consider that gamification allows players to achieve their goals by choosing the methods that best suit their needs, but considering their performance and the related feedback almost always collectively (Birò, 2014, pp. 148-151).

Taking a cue from the numerous research areas that investigate the educational potential of the game and the emotional involvement of the subject who uses gamification, we intend, in these notes, to investigate its educational potential and, in this specific case, its contribution to learning mathematics.

Gamification in Action

Due to the material and structural characteristics that characterize them, Gamification systems are capable of generating profound implications in teaching and school processes. Both the extraordinary diffusion of numerous game consoles and the great success of mobile tools such as tablets and smartphones contributed massively to achieving this goal. Their spread has fueled the use of video games, making them increasingly usable in school settings.

One of the features most considered in the use of educational software dedicated to gamification is the ability to affect the habits and behavioral performance of the recipients. The implementation of playful mechanics is one of the most effective methods for involving pupils in activities capable of facilitating and developing significant behaviors and attitudes within the context considered.

Through gamification, a type of active participation is implemented through which dynamic behaviors are encouraged in which the message to be communicated can be connected to the action itself and be contained in the context of the experience. From this point of view, another fundamental advantage that can be obtained through Gamification should not be underestimated, i.e. user behavior is measurable, by collecting data based on the actions performed within the game and this stimulates users to intentionally improve the their attitudes towards the task addressed.

The "Theory of Intentional Change", formulated by Richard Boyatzsis, suggests that without a deep-seated drive for self-improvement, any training activity would be in vain. For the development of soft skills, a phase of awareness of the importance of these skills for individual performance is necessary, which prepares the subjects to implement a change (self-assessment, self-awareness, self-confidence, self-control, adaptability, etc.). In this sense, the supports that information and communication technologies make available can prove to be effective and efficient tools, which however require careful analysis. Many think that Gamification is a part of the world of gaming and the game industry (Petruzzi, 2015).

This is a big misunderstanding, because in reality the purpose of Gamification is not to create a game tout court but to apply some typical dynamics of game design to other contexts to achieve specific objectives. We have often talked about good design, but: "What do we mean by this term?" Analyzing the psychology of Gamification, we realize that all the guidelines for defining a project that works converge towards a common idea: the good design of a gamified experience always places the user, his needs and requirements (also educational) personal at the center.

Through "user-centered design", a term referring both to a broader design philosophy and to certain application methodologies, the goal becomes to ensure that the needs and wishes of the people involved in Gamification are fully considered and satisfied, throughout the game experience life cycle (Abras, C. Maloney-Krichmar, D. Preece J., 2014). If "user-centered design" is used appropriately, it allows to achieve relevant results in: better understanding psychological, organizational, social and ergonomic factors; manage the expectations and

motivations of users; increase acceptance of the gamified experience; increase the effectiveness and efficiency of the project (Abras, C. Maloney-Krichmar, D. Preece J., 2014).

Without "human-focused design" it is impossible to create effective Gamification systems. On the contrary, a design centered on the needs of the players allows to design Meaningful Gamification consisting in the integration of elements of "user-centered design" within non-playful contexts (Nicholson S., 2012). Even if the risks are always present and lead to Meaningless Gamification phenomena, often the positivity of the experience lived by the people involved stimulates them to involve and take action towards the activities required by the gamification project and this allows a perfect realignment in the long term. between personal and organizational goals.

According to Jane McGonigal, all games, when stripped of all gender differences and technological complexities, have four defining traits in common: a goal, a set of rules, a feedback system and the voluntariness of participation (McGonigal J., Reality Is Broken, 2011). What makes gamification so effective is the strong motivational component that stimulates people to carry out certain activities (Maestri A., Polsinelli P., Sassoon J., 2015). It becomes important to understand the psychology of motivation by trying to understand what it consists of, what the different types are and how to be able to repeat it over time, enriching the experience lived by the user.

Motivational research done by university researcher Michael Sailer, together with other colleagues (Sailer M., Hense J., Mandl H., Klevers M., 2013) have identified six main study perspectives on motivation which are: *traits, behavioral, cognitive, self-motivation, interest, emotions.* These six perspectives are not to be seen as contradicting or potentially competing with each other. They simply focus on different sides of the same coin and can be used to better investigate the persuasive and motivational potential of playful elements that can be used within an educational Gamification project. Finally, the motivational dimension offers a strong importance to emotions, which can also be influenced by specific strategies. In fact, Gamification increases one's attraction towards players if it facilitates a decrease in negative feelings such as fear, anxiety and anger, while increasing the positive dimensions such as joy and personal happiness (Maestri A., Polsinelli P ., Sassoon J., 2015).

Regardless of the study dimension with which the theme of Gamification is approached, the main classification of motivation provides for its differentiation into two types: intrinsic and extrinsic (Werbach K. and Hunter D., 2012).

Intrinsic motivation originates within the individual, rather than being generated in the surrounding world. This derives from a situation of curiosity, genuine involvement and the desire to increase one's skills. People engage in a specific activity as they find it stimulating, rewarding and fully satisfying. Users are motivated by different and subjective intrinsic motivations (Havercamp S.M. and Reiss S., 2003). On the contrary, extrinsic motivation is generated most of the time by factors external to the user such as the desire to receive recognition or the desire to avoid unpleasant situations.

The basic concept is not so much wanting to do something as the perception of having to do it (Pink D., 2009). In conclusion, it is emphasized that there is no better type of motivation than the other, while experiences in the educational field show that Gamification works best

when it is designed to align and integrate intrinsic motivations and extrinsic variables (Zichermann G. and Cunningham C., 2011).

Gamification in Education

To design an educational learning experience through the use of Gamification, it is necessary, first of all, to balance the challenges offered by the environment with the skills and competences of the person. Any imbalance of intrinsic or extrinsic motivational factors would generate conditions of boredom or anxiety. Thanks to the state of flow, the subject instead experiences a strong sense of self-awareness and effectiveness.

Thus, a virtuous cycle is generated capable of increasing personal satisfaction and performance towards the final goal, the effects of which are expanded by Gamification itself (Hamari J and Koivisto J., 2014). The flow experience is characterized by intense involvement, the loss of the sense of time and high concentration. It represents a situation of perfect balance between the perceived level of a challenge and our perceived ability to overcome it, for this reason it does not generate anxiety (understood as the fear of not succeeding), nor boredom (understood as the certainty of succeeding easily) (Petruzzi V., 2019).

This sensation of flow, which we rarely experience in everyday reality, is instead generated by those activities that are able to seriously and totally involve and that have their own motivation and reward within themselves. An effective and functioning Gamification is able to amplify the overall scope of this state of flow, enriching its perceived value in relation to daily experience (Hamari J and Koivisto J., 2014).

Study and fun are often seen as contradictory. Even if at times the study can be competitive, it is not easy to create situations where it can become a pleasure. But this perspective perhaps remains a little dated and does not take into account the fact that a lot depends on how you study and play. Teenage play has become a field of interest in developmental psychology, which has associated it with building their intelligence. The genesis and development of the game of young people have been thoroughly analyzed and it is now an established fact, children learn while they play, and it is on this basis that we find the union between play and learning, whatever form the game may have. Often, in fact, we accept the idea that children learn by playing, not paying enough attention to the learning methods contained in the different situations.

The transition from the gaming experience to a learning content is in some cases very mysterious (Maestri A., Polsinelli P., Sassoon J., 2015). That play can have a much more fruitful relationship with study than one might think is a concept at the basis of the new school, where the meaning of knowledge today has shifted from being able to remember and repeat information to being able. to find, evaluate and use them convincingly in the right context. Education in the early part of the twentieth century tended to focus on the acquisition of basic skills and knowledge of content such as reading, writing and arithmetic.

Many experts, on the other hand, believe that success in the twenty-first century depends on an education that develops higher-level skills such as the ability to think, solve complex problems and interact critically through language and media. To cope well with the challenges of the contemporary world, the skills acquired with the game seem to be fundamental.

This statement links many of the normal teaching and learning practices and all this has al-

ready become part of that area of Gamification that deals with e-learning. In general, it is very important that a gamified project is able to identify the user's level of competence and give him immediate feedback.

The tests must be of slightly higher difficulty than the user's starting level to give him satisfaction when he succeeds in passing them, and without mortifying him when he fails. As the level of competence increases, even the stages of learning can and must increase the degree of difficulty (Kapp K.M., p.336). Currently, it is observed that a generation of digital natives is increasingly expanding within contemporary society. Some call it "Generation Y", also called Millenials, a term coined in relation to the previous "Generation X" which represents those born in the sixties and seventies (Prensky M., pp.1-6). Millennials are people born between 1980 and 2000 who have lived with digital technologies since birth and who therefore recognize the language and codes of the web, gaming and social networks as their mother tongue. Papert talks about the “Generation gap”, understood as the distance and diversity between those who grew up in a digital environment and those who instead learned the language of new media as a second “digital immigrants” language (Papert S, 1996). Digital natives have learned from an early age to manipulate technologies to satisfy their needs, while digital immigrants find themselves in a situation of cognitive disadvantage, which often gives rise to prejudices such as those that have always characterized the relationship between adults and video games.

Digital natives are used to receiving information quickly, they love to manage processes in a parallel and multi-task manner, they prefer graphics to text, and random access, as happens in hypertext. They are more productive when they log on to the net, make progress through instant gratification and frequent rewards, and enjoy reflective work games more. After dealing with Generation Y also called Millenials (digital natives), it is also important to reflect on the new next cluster provisionally called Generation Z.

We are talking about about 1/4 of the world population characterized by being currently of school age, not yet included in the working world and, therefore, without one's spending power. In fact, it is essential to start looking at their distinctive features, their ways of behaving, relating and consequently acting in the world of learning (Viola F. 2011).

Designing a learning experience, even gamified, follows a very specific procedural flow. Among the points to be taken into consideration, the target audience is fundamental. As indicated in the previous chapter, each of us is motivated to interact with a product or service on the basis of different dynamics. Without careful analysis, every motivational design and every attempt to create involvement through the use of Gamification mechanics becomes random (Viola F. 2011). Generation Z is the first to be always connected with technology, especially touch, to represent a real body extension.

It is enough to observe two or three year old children and the naturalness with which they move between the screens of a smartphone rather than a tablet, their ability to "swipe" and click and their expectation of similar interactions with any object in the environment. domestic. This, as far as learning is concerned, opens the door to a more conscious use of new technologies.

About 90% of this generation habitually use video games, making this medium the most important in terms of time and money spent, overwhelming entertainment products such as books, films and But, what are we talking about, when we pronounce the term Gamification

in reference to school education? According to Deterding (Deterding S., 2012) the term is currently used in reference to multiple related concepts, such as the increasing prevalence and omnipresence of games and video games in daily life, and the use of game-specific elements to capture the attention of students in contexts traditionally far from entertainment such as, for example, training and learning.

In general, the purpose is to involve users, encouraging them to achieve certain objectives by following pre-established rules and possibly having fun. Gamification has applications in many areas of daily life, such as those characterized by repetitive, boring or aversive actions, such as, sometimes, learning. The game has always been used as a tool for didactic purposes, since the youngest age groups, and there are many examples of "educational" games, capable of developing skills and abilities such as concentration, memory and manual skills from time to time.

Educational Math Games

The discourse becomes more complex and articulated if it refers to the study of mathematics and the use of gamification. Some research on affectivity related to mathematics has shown that the range of emotions that often accompanies the traditional study of mathematics ranges from negative feelings (anger, fear, inadequacy, frustration, anxiety, boredom) in percentage more frequent to positive feelings (happiness, excitement , fun, trust, relief) in less frequent percentages.

Surely the psychological tension that creates the study of mathematics is related to its conceptual structure and to the type of language through which the teaching is proposed. It would be desirable that even in mathematical high schools an interdisciplinary interaction could be considered capable of synergistically intersecting the scientific language of mathematics with the humanistic one. This approach together with the use of gamification could allow students to tackle topics related to the study of mathematics with less tension.

Dealing with something that you find interesting and fun can facilitate learning processes and make studying more enjoyable. If you manage to transform what you "must" do into something you "want" to do, the results obtained can only be better. In this regard, the use of the Moodle platform (Moodle for Education - M4Edu) by some Italian high schools was very interesting.

All Moodle Activities and Resources provide for the establishment of certain conditions that allow access only to students who meet them. The requirements to be met may be based on various elements, such as the assessment obtained in other activities or membership in certain Groups. This made it possible to reconsider learning mathematics on the basis of a different approach. The possible Moodle activities, in this sense, were: the task, the quiz, the crossword puzzle, the glossary and GeoGebra. To make the path more interactive, it is possible to install various plug-ins and, in particular, to stimulate competition more, the "Level up" plug-in can be installed, through which students can monitor their progress in the assigned path and their position in the class ranking.

The plug-in allows you to establish rules according to which scores are assigned. To encourage the pupils, unsuccessful attempts were also rewarded, albeit in a reduced way. The experience has presented numerous positive results: active participation of pupils, assimilation of content with greater ease, engagement and loyalty and immediate feedback on objectives.

To evaluate the users' perception of the path, an evaluation questionnaire was administered which provided substantially positive and encouraging results. The use of gamification techniques has made it possible to attract the attention of students by transforming passive participation in the learning process into active participation capable of making learning more personalized and therefore more effective.

Conclusion

The integration of cognitive theories into mathematical teaching research marked a turning point in the study of affectivity, because they highlighted that emotion is not intrinsically linked to a specific experience, but depends on how it is perceived and interpreted. This means that the feelings expressed by students depend on both their view of mathematics and their relationship to it.

The above may explain the results of some studies according to which mathematics is, in general, the favorite subject of elementary school children, but becomes the most detested by adolescents. The emotions aroused by matter change over the years and this is due to the fact that, continuing their studies, the students change their way of interpreting it.

Gamification is a complex issue, which will still require time and a lot of research, both theoretical and applied, to be explored in all its forms. What is certain is that the growing application of gamified logic and gaming elements to non-playful contexts is also deeply and substantially changing the world of school education.

Gamification can help overcome obsolete and ineffective training models, generating interactive, engaging learning environments in which the student is not just a passive receiver of notions. By exploiting the close relationship that exists between play and learning, Gamification can become a powerful ally in stimulating continuous improvement of pupils, in school learning, especially in those areas of more difficult cognitive access such as mathematics and physics.

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Disparities in Access to Basic Education in Brazil During the COVID-19 Pandemic

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The purpose of this article is to identify the implications of inequities in access to basic education (SDG 4) during the Coronavirus pandemic in Brazil, and their reflections on structural inequalities. The H-D method is used, focusing on early childhood education, since its deficits reflect on human development and the social exclusion of historically marginalised groups. Many structural inequalities are the consequence of inefficient allocations that limit the universalisation of basic schooling. Primary education, mainly childhood education, was made unfeasible in the educational portfolios of Brazilian governments throughout its conservative, authoritarian and participative history. The results of this study demonstrate that the sanitary crisis has exacerbated the inequalities linked to institutional racism and poverty (sub-citizenship) in the basic educational cycle, as the government during the crisis management did not provide mechanisms for an equal remote teaching and incentives for students. About 2/3 of OECD countries took investments in elementary education by reason of the impacts generated by the COVID-19, while the Brazilian government did not announce changes to investment in education. Children aged 6-10 years were the most affected by educational exclusion and the majority were from unequal geographical areas. Therefore, considering the setback of the pandemic on the educational development of social minorities, and Brazilian status-quo, investment policies are recommended that correct the psychosocial and economic deficits generated by the crisis—filling in gaps related to learning poverty that will arise in the recovery period (post-pandemic phases).

Keywords: Brazil, COVID-19, Early Childhood Education, Educational Development, Public Policies

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Introduction

Economic history, together with the economics of education, demonstrates that the impact of unequal access to education transcends multiple dimensions related to the eradication of structural inequalities in Brazil. It is observed in the literature that basic education, especially during early childhood, plays an important role in the formation of human capital (Heckman et al., 2011; Heckman, 2008), which is extremely significant for economic growth (Mankiw et al., 2011; Heckman, 2008). Furthermore, the importance of primary education goes beyond the economic sphere, as cracks in cognitive and non-cognitive skills can be attributed to early childhood experiences (Heckman, 2008). Consequently, the collaborations to the gaps in the economics of education reflect on the emancipatory potential and the exercise of citizenship (Sen, 1999), challenging the inequalities of latent opportunities in the Brazilian State since its beginnings.

In this context, when analysing socioeconomic disparities, it becomes essential to understand how the interests of political elites and their bargaining power in institutions shaped many educational policies, making them restricted throughout Brazilian history, contributing to the phenomenon of social exclusion—sub-citizenship (Kang, 2017; Kang, 2010; Souza, 2003). The lack of investment in education and disparities in access to basic education, especially Early Childhood Education (ECE), have led to an increase in inequality in numerous aspects, as the lack of education leads to lower wages and racial minorities are especially affected by the political game of the described situation. This is also seen as a form of violence within a structuralist and security perspective, as seen by (Galtung, 1969), because it impacts on structures that guarantee the social and economic development of human beings in the face of the social contract.

At the international level, since 2015 global agencies have been committed to achieving the Sustainable Development Goals (SDGs), which are considered an evolution of the Millennium Development Goals (2000)—they prioritise the universalization of primary education. Nevertheless, in 2020, with the advances of the COVID-19 epidemic, the United Nations Economic and Social Council announced that the pandemic had consequences in terms of the goals of progress on the SDGs, with a focus on the issue of universal education—especially in developing countries. Due to mandatory social distancing measures, aimed at preventing the spread of contagion, as well as inequities in access to technologies, thousands of children had limited access to school and to learning, bringing serious problems—stipulates that there may be an educational setback of up to two decades—regarding educational development in the context of basic schooling in Brazil (UNICEF, 2021).

In view of this exhibition, this interdisciplinary inquiry seeks to identify the implications of disparities in access to basic education, in Brazilian reality, among the most vulnerable socio-economic classes and their effects on structural inequalities during the COVID-19. This work is shown as a contribution to the development of forecasts of educational investment policies in the face of the recovery from the crisis generated by the coronavirus. Our focus is directed mainly on early childhood education, since its interference is significant for human development, as already exemplified.

Wherefore, the results and discussions section are divided into four topics. In a first moment, the structural inequities in the Brazilian State apparatus are debated, under the prism of sub-citizenship, focusing, above all, regarding institutional racism. Sequentially, the right to

education is examined throughout the Brazilian constitutional charters, expanding to the international commitments. In the third axis, the deficits, and gaps in basic education in Brazil are released from a historical economic perspective. Finally, the State's actions during COVID-19 are verified, as well as the consequences of the inequalities in the pandemic on the right of social minorities' education.

Methodology

This study adopts a qualitative-quantitative approach in the form of bibliographic, digital, documentary, and experimental investigation. The comparative method adjunct to the historical method is applied to achieve the research objectives. Comparative-historical analysis is defined specifically by epistemology, as part of interdisciplinary tradition. In this way, academic productions that opt for comparative-historical methods seek a social scientific vision, using methodological pluralism within a balance between the particular and the general analysis (Lange, 2013).

Considering the validity of the sources, this academic production focuses on the use of peer-reviewed articles, as well as publications in high-impact journals and books—in conducting the bibliographic research. The documentary analysis, as well as the selection of legal documents, social indicators in the measurement and operationalization stage employing the compared method, went through sources present in the legal systems, which are available in a digital analogous way in the databases of national, supranational and international institutions—such as the United Nations (UN), World Bank (WBG), United Nations Children's Fund (UNICEF), Organisation for Economic Co-operation and Development (OECD), *Brazilian Institute of Geography and Statistics* (IBGE) etc.

Results and Discussion

1. Structural Inequalities and Institutional Racism

Social Stratification in Brazil, as a fragment of what constitutes sub-citizenship[1] within the historical processes of social inclusion and exclusion, is intertwined with the colonial heritage, which combines abandonment with the inaptitude of the marginalised ethnic-racial population. In the perception of Souza (2003), headed by Bourdieusian and Taylorian sociology, the "*precarious habitus*"—with incorporated cultural capital being habitus—materialises in the Global South through the tools that constitute structural oppression, which disqualify social agents and precarious groups as sub-citizens. Within this segment, the author calls "*secondary habitus*" the appropriation of goods in scarcity, which establishes static forms of inequality in developing countries.

In the historical-materialist conception traced by Florestan Fernandes (2006), the recent socioeconomic divisions, present in the context of late capitalism in Brazil, hide the hierarchies of a federation founded by a reactionary and slave-owning political elite. This elite sustains the social order—the status quo and societal inequalities of race linked to income percentiles. Although the State is considered "liberal", in terms of sovereignty and institutions, there has not in fact been a break with its conservative essence—involving patrimonialism and feudalism—in terms of social-political relations (Silva, 2013). The right to education of newly freed indigenous and enslaved peoples co-participates in this historical

[1] Jessé de Souza's (2003) interpretation of social exclusion in peripheral States.

perspective, because of essentialism associated certain humans above others, building a stigmatised legal inequality in the autocratic State apparatus, reiterated in (Carneiro, 2015; Soares et al., 2021). Scientific racism, coined equally from social Darwinism, co-opted "science" to map humanity through raciality. This being, in post-modernity, the great legacy of biassed colonialism in the Brazilian political scenario (Claeys, 2000; Souza, 2003).

The semantic understanding of institutional racism appears for the first time in the literature through activists Charles Hamilton and Stokely Carmichael, who describe it as a mechanism of societal exclusion of ethnic and black minorities in the political sphere, which results in the perpetuation of racial discrimination (Bhavnani et al., 2005: 28). Later, when establishing his structural analysis permeating human security at a systemic level, Johan Galtung (1969) considers structural violence as one of the manifestations of social injustice propagated by state dimensions, which mainly impedes the social and economic development of individuals, affecting the exercise of citizenship and the promotion of peace. In this horizon, Amartya Sen (1999: 15–27) proposes human development—including the educational axis—as an advance of instrumental freedoms associated with the rule of law. In this way, social opportunities are a gear for compensating historical social exclusion (material imparities) by political elites.

Sueli Carneiro (2015) shows in her work '*Racismo, Sexismo e Desigualdade no Brasil'*, through advances in economics and sociological sciences, that Brazil remains a racially separate country—*apartheid.* She uses social indicators, present in the Human Development Index (HDI), income, life expectancy, and education as an example of the higher standards of living of the self-declared white population in Brazil. While the white population has standards of living compared to developed countries; the racialized sample shows lower rates than those of nation-states that have overcome racial segregation in a revolutionary way. The insertion of race as a unit of analysis, given the security prospect in the dimension of redistributive justice, appears as an essential tool for the implementation of public policies aimed at solving the problems conditioned by structural inequalities.

"With regard to colour or race, 55.8% of white people had at least completed the basic education cycle, whereas among black or mixed-race people this percentage was 40.3%, a difference of 15.5 pp. From 2017 to 2018, this difference reduced – it was 18.9 pp in 2017 – but remained at a high level, indicating that educational opportunities were different between these groups" (IBGE, 2019: 11), translation by authors.[2]

[2] IBGE. (2019). *Pesquisa Nacional por Amostra de Domicílios Contínua 2016-2018* (p. 11). https://biblioteca.ibge.gov.br/visualizacao/livros/liv101657_informativo.pdf

2. The Right to Education in the Constitutional Charters

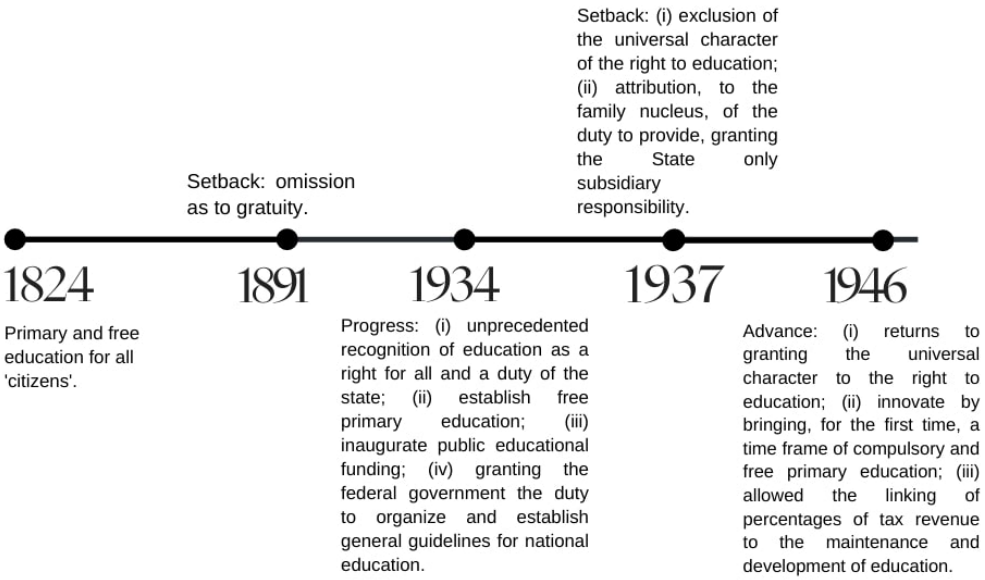

Figure 1: Education in the schedule of constitutions 1824-1946.
Authors' elaboration based on literature review

Education has the character of a fundamental right in the Brazilian legal system, and this status was attributed by the Brazilian society, through its Constituent Original Power, and positively stated in Article 6 of the Constitution of the Republic of 1988. However, although education enjoys this status in the current wording provided in this Magna Carta, it is undeniable how long was the process of universalization and formal effectiveness of this right to Brazilian society, especially about the constitutional history of Brazil, since education is provided for in the homeland constitutional order since the first Constitution, namely the Imperial Letter of 1824 (Sarlet et al., 2018)

In Brazilian constitutional history, seven constitutional charters have been in force, namely those of 1824, 1881, 1934, 1937, 1946, 1967 and 1988. To demonstrate the process of universalization and formal realisation of the right to education, a brief historical incursion will be made, demonstrating the normative evolution of the matter concerning this right provided for in the constitutional texts.

Regarding the Imperial Constitution, it is emphasised that there was only the provision of free primary education for all citizens. However, the constitutional letter did not bring the definition of citizenship and/or who had it, as well as did not establish the age range by which individuals would have the right to enter school for the beginning of primary education. In this way, in practice, there was only a generic declaration of a formal recognition of a subjective right of citizens, instead of an effective obligation of the State. The wording of the Republic Charter of 1981, on the other hand, is characterised by not bringing advances, but retrocede in relation to the previous constitution, since it is omitted even on the points addressed in the previous constitutional wording, being these free and compulsory education (Savelli, 2010).

At the turn of the 20th century, two very different constitutions came into force during the period known as the "Vargas Era", namely the Letters of 1934 and 1937. The Magna Law of 1934 innovated by (i) bringing in its wording the unprecedented recognition of education as a

right of all and duty of the state; (ii) fixing free primary education; (iii) inaugurating public educational financing; (iv) granting to the federal government the duty of organising and fixing general guidelines for national education. The constitutional text of 1937 presented a huge setback to the process of universalization and realisation of the right to education, since it excluded the universal character of this, as well as attributed to the family nucleus the duty to provide, granting to the State only the subsidiary responsibility for the realisation of the enjoyment of this right (Savelli, 2010).

In relation to the Constitution of 1946, a progressive text was observed, after all, this returned to grant the universal character to the right to education, besides innovating by bringing, for the first time, a time frame of compulsory and free primary education, as well as allowing the binding of percentages of tax revenue for the maintenance and development of education (10% of the Union and 20% of the States, Federal District and Municipalities). Regarding the 1967 Constitution, no setbacks were observed, only the important legislative innovation regarding the unprecedented determination of an age range for compulsory education, this range corresponding to students aged between 7 (seven) and 14 (fourteen) years (Savelli, 2010).

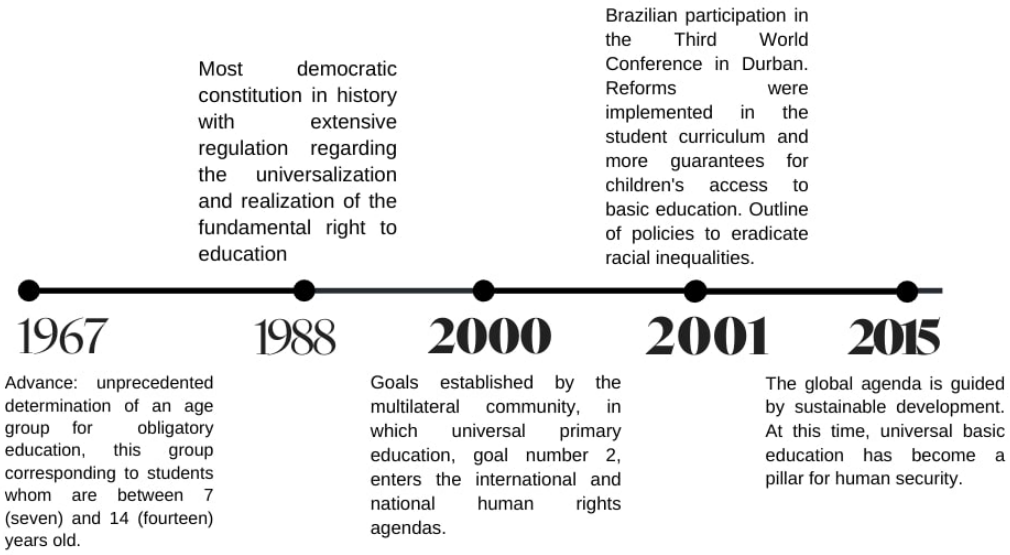

Figure 2: Constitution of 1967 and 1988 (current) and participation of Brazil in global agendas.
Authors' elaboration based on literature review

The 1988 Constitution of the Federative Republic of Brazil is considered to have the most democratic constitutional text in the history of the country's legal system, thus demonstrating a commitment by Brazilian society to a true socioeconomic and political transformation. In this sense, it is possible to observe that the adoption of the Democratic State of Law, as the state paradigm adopted by the Constitution of 1988, has brought about significant changes with respect to the functioning of social institutions, since, for the first time ever, a constitutional charter has brought a wording with a strong plural and compromising character. Thus, it is important to emphasise that these substantial changes have occurred because the adoption of this state paradigm has led to the observance of the exercise of social institutions with the basic principles and values of a democratic state.

Likewise, the impacts of the adoption of this paradigm in the current educational model can be clearly seen. The Constitution of the Republic of 1988, among all the constitutional

charters that have been in force in the Brazilian State, is the one with the most extensive regulation on the right to education, providing exhaustively, between articles 205 and 214, on the organisation, functioning, and planning of the education system in the country.

In the current Brazilian legal system, the right to education is also recognized as a right for all, as well as the State's duty to ensure its enjoyment by all citizens. To guarantee the effective enjoyment of this right, mechanisms are then created in the constitutional text, which are listed in the following provision: (i) FUNDEB; (ii) LDB; (iii) PNE.

The Fund for Maintenance and Development of Basic Education and Valorisation of Education Professionals (FUNDEB), established by Constitutional Amendment No. 108/2020 and regulated by Law No. 14.113/2020, has the pooling of resources from transfers from the States, Federal District, and Municipalities, by way of tax collection, which have the main purpose of providing financial support for the educational system in the country. Law 9.394/96 (LDB) was instituted to establish the bases and guidelines for national education, while the National Education Plan (PNE), a ten-year plan, is a governmental instrument for educational development, through which the State creates goals, objectives, and strategies.

Regarding Early Childhood Education, the object of this article, the Constitution assigns, in §2, Art. 211, the priority competence to the municipalities regarding the promotion of early childhood education, as well as defined, in item IV, Art. 208, the age group that makes up this educational system, being composed of children up to 5 (five) years of age.

Basic Education in Multilateral Agencies

Multilateral organisations, the United Nations (UN) and the Organisation for Economic Cooperation and Development (OECD), are the promoters of agendas aimed at implementing universal education. The framework of redistributive policies associated with forms of remediation of inequities is the participation, at first, through the process of Brazil in the World Conference against Racism, Racial Discrimination, Xenophobia and Related Forms of Intolerance, also known as Durban Conference, held in South Africa in 2001.[3]

The importance of the Durban Conference resides in the formulation of an action plan, which aims to eradicate racism, racial discrimination, and xenophobia, with the participation of historical colonialism victims. The forms of action would be through the implementation of public policies—compensatory investment policies in Brazil. In terms of the right to education, in addition to curricular reforms and education based on human rights, the program covers the issues surrounding the disparity in access to education. Therefore, the States would guarantee principally:

- Equal access to education for all, in law and in practice, and to refrain from any other legal or other measure leading to the imposition of racial segregation in any form in access to the education system.

[3] Declaration and Program of Action of the World Conference against Racism, Racial Discrimination, Xenophobia and Related Forms of Intolerance, held in Durban from 31 August to 8 September 2001, available at: https://www.ohchr.org/Documents/Publications/Durban_text_en.pdf [accessed 10 November 2021]

- And take all appropriate measures to remove obstacles limiting children's access to education and ensure that all children have access to good quality education without discrimination.

Since 2015, international agencies are committed to the realisation of the Sustainable Development Goals (SDGs), which are considered an evolution of the Millennium Development Goals (MDGs) implemented in the 2000s—these have already prioritised the universalization of basic education.[4] The SDGs (2015) are present in paragraph 54 of Resolution A/RES/70/1, with the participation of 193 countries and civil society, debating a global agenda that involves social justice and climate action.[5] The objectives are made up of goals that must be achieved by 2030, among which 'Education for All', Goal 4 of 17, focuses on ensuring universal education for children and adolescents. In addition to the above, early childhood education gains special attention, covering vulnerable children and minority social groups in the Global South. At this stage of development policies, universal basic education appears as a priority until then unresolved by previous agendas, although it is seen as the central pillar for the full achievement of human development (King, 2016).

3. Basic Education in Brazilian Economic History

Not much was done regarding educational policies before 1822 in Brazil. With the rise of imperial Brazil and the 1824 constitution, there were legal instruments to conduct public educational policy, however, very little was done in this period in terms of primary education, and what was done focused in the urban core. Regarding higher levels of education, pre-existing initiatives were expanded, both by the private sector and by state support. Even with the influx of immigrants, the illiteracy rate was still around 70% of the population (Heimer, 1975).

After the fall of the monarchy and the rise of the republic, there was a small increase in the number of elementary schools during this period, however, there were no advances in higher levels of education. The unequal character of the educational expansion, prioritising urban centres, continued. And, even with this small increase in elementary school, the illiteracy rate went from 67.2% in 1899 to 60.1% in 1830 of the total population (Heimer, 1975).

The rise of Getúlio Vargas and his developmentalist ideology led to some changes in educational policy. The prioritisation of secondary and higher levels of education happened again, however, with a new focus: industrial education and nationalism. It is worth mentioning that during the '*Estado Novo'* there was even a drop in the proportion of children in elementary school (Kang, 2017; Kang, 2010; Heimer, 1975).

After the fall of Vargas, Brazil had a democracy for a few years, called the "Populist Republic"'. The presidents of this era were substantially different from each other, therefore, they conducted different educational policies and projects, however, in the aggregate, there

[4] UN General Assembly, United Nations Millennium Declaration, Resolution Adopted by the General Assembly, 18 September 2000, A/RES/55/2, available at: https://www.refworld.org/docid/3b00f4ea3.html [accessed 10 November 2021]

[5] UN General Assembly, *Transforming our world: the 2030 Agenda for Sustainable Development*, 21 October 2015, A/RES/70/1, available at: https://www.refworld.org/docid/57b6e3e44.html [accessed 10 November 2021]

were several relevant advances, such as a substantial increase in the primary education enrolment rate, however, the focus remained on the secondary and higher education levels. The João Goulart government represented an exception in this period, since his policies focused on basic education (Kang, 2010; Kang, 2017; Heimer, 1975).

With the 1964 coup, the military in power wanted to develop industry in Brazil, thus, the focus on industrial development meant that primary education was going to be neglected again, that is, the Brazilian state carried out policies to encourage industrialization and higher education leading to the stagnation of the proportion of children enrolled in elementary school (Kang, 2019).

Evidently, a structural inequality of access to education and of investment in different levels of schooling emerged throughout Brazilian history. Before we can proceed to the analysis of the current state of Brazilian basic education, it is important to understand why education is an important public policy. As said earlier, education plays a major role in economic growth, formation of human capital and, beyond the economic sphere, gaps in cognitive and non-cognitive abilities may be traced back to experiences in first childhood. Therefore, the investment in primary education has many positive effects, not only economic ones, but also social and cognitive.

Recently, Brazil experienced a substantial improvement regarding infant education, however, many schools still don't have proper resources to provide a quality education for children. For instance, only 53.5% of primary schools have access to computers for pedagogical purposes. One of the biggest gaps in Brazil's performance in educational development is its socioeconomic, social, and cultural status, which has the greatest influence on learning outcomes. The Programme for International Student Assessment (PISA index) demonstrates that children from lower social classes reach literacy results 55% lower than children with higher economic status, 29% lower compared to the OECD educational development averages made available in 2018 (OECD, 2021). Equitable learning, within the dimension of class, is conditioned by the investment variable in basic education and early childhood care, which are neglected within the totality of basic education in Brazil when compared to investments per student (OECD, 2021).

4. Repercussions of the COVID-19 on Educational Inequalities in the Basic Cycle

In 2020, with the advances of the COVID-19 epidemic, the United Nations Economic and Social Council announced that the pandemic had consequences in terms of the goals for progress in the SDGs, focusing on the issue of universal education, especially in developing countries. Due to mandatory measures of social distancing, aimed at preventing the spread of contagion, which limited the access of millions of children to schooling.[6] [7]

[6] United Nations Economic and Social Council (2020) Progress towards the Sustainable Development Goals Report of the Secretary-General Archived 30 December 2020 at the Wayback Machine, High-level political forum on sustainable development, convened under the auspices of the Economic and Social Council (E/2020/57), 28 April 2020. available at: https://undocs.org/E/2020/57 [accessed 10 November 2021]

[7] Gustafsson, M. (2021). *Pandemic-related disruptions to schooling and impacts on learning proficiency indicators: A focus on the early grades*. UNESCO Institute for Education. https://unesdoc.unesco.org/ark:/48223/pf0000377781?1=null&queryId=e395e0d7-39fa-47e5-bd24-ec9feb2642ee

In Brazil, the Pandemic was poorly managed, specially by the federal government, without tests, data, or access to the most economically vulnerable communities in different regions of the country are neglected. The official record made invisible how these peripheral communities faced the pandemic and the inefficiency of policies aimed at managing the health crisis, which, in turn, use these same official records as the basis for their preparation. Consecutively, the public policies adopted thus far did not consider the specificities of rural and urban peripheries in Brazil and their marginalised populations.[8] Currently, the expressively high numbers of victims of COVID-19 among lower-income populations, particularly those who identify themselves as black and brown, demonstrate the degree of vulnerability of these groups, which constitute most of the population in peripheral regions (UNICEF, 2021).

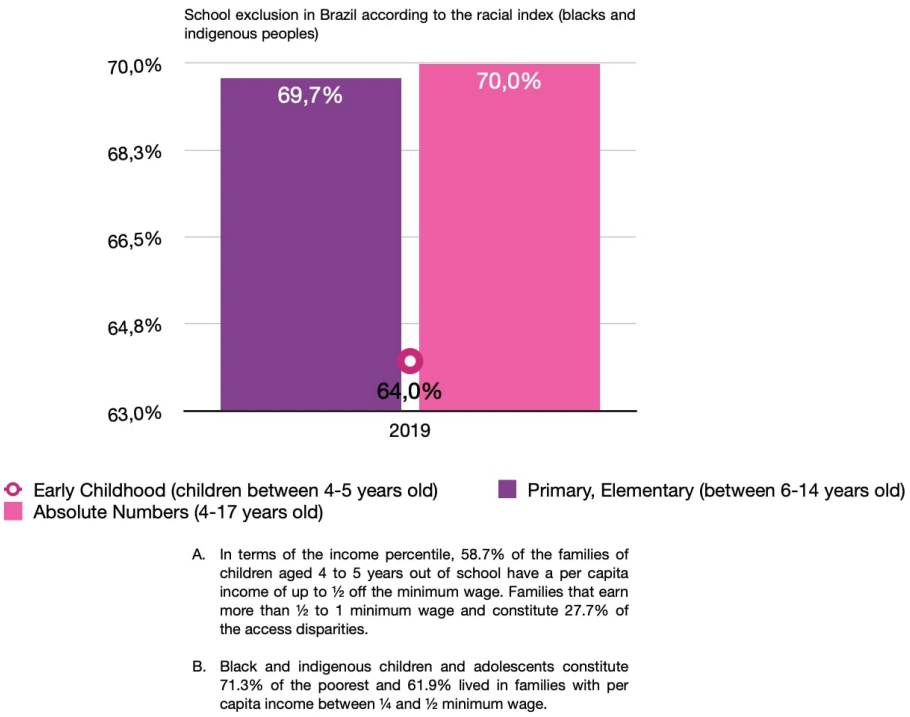

Figure 3: Using the racial index from IBGE and PNAD, shows the pre-pandemic percentage of school exclusion and socio-economic situation of children's families. Furthermore, school trajectories of blacks and indigenous peoples are marked by higher exclusion, failures, age and grade distortions than those of the declared white population. Thus, this portion of the population is, due to structural and economic factors, more vulnerable to educational exclusion and low development than the white population.
Data by Report Study "*Cenário de Exclusão Escolar no Brasil*" (UNICEF, 2021).
Authors' elaboration

Regarding education, the failed governance of the pandemic affected especially those in vulnerable situations. Due to the structural racial inequality, minorities had poorer access to important resources for remote learning, such as computers and a good connection to the internet, they experienced more difficulties and effectively experienced a bigger educational

[8] Braga, C., Tomesani, A. M., Ricarte, J., Maschietto, R. H., & Rupani, N. (2020). *As margens do estado na pandemia: experiências periféricas de (in) segurança humana no Brasil*. Sertanias: Revista De Ciências Humanas E Sociais, 1(1), 03-28. https://doi.org/10.22481/sertanias.v1i1.8272

deficit. Moreover, the budget allocated to education did not increase during the pandemic, therefore, many educational institutions, especially primary and secondary, suffered from a lack of resources to provide a good remote learning experience and to provide a safe return to school in 2021. This lack of investment goes against what was recommended by most experts, for instance, the Education at Glance report (2021) prepared by the OECD exposed that Brazil needed additional measures to address the disparities in access to education during the Pandemic.

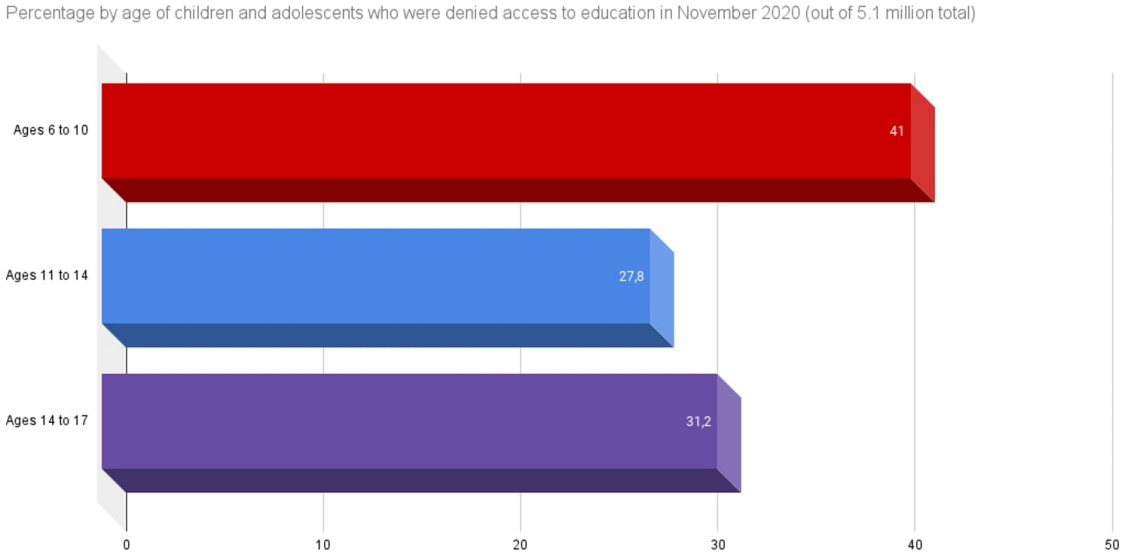

Figure 4: The data above shows how the COVID-19 led to greater exclusion from access to education. Almost 1.5 million children and teenagers did not attend school. Approximately 3.7 million were enrolled, but did not have access to activities, as they were unable to maintain remote learning. A total of 5.1 million (children and adolescents) were denied access in November 2020.
Data by UNICEF (2021) Authors' elaboration

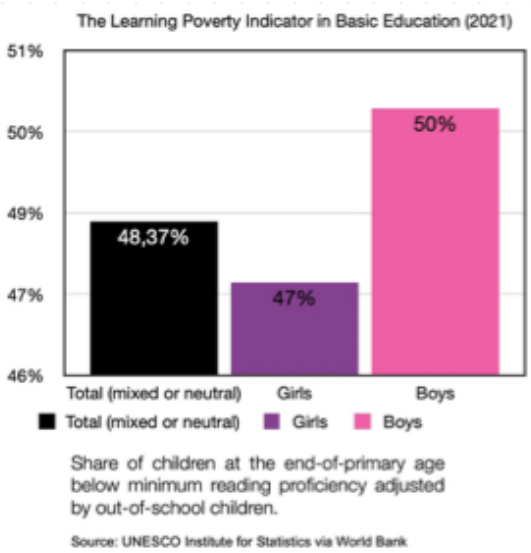

Figure 5: The data demonstrate impasses in educational development, during COVID-19, that lead to the *learning poverty indicator*.[9]
Data by Johns Hopkins University, World Bank & UNICEF (2021)
Authors' elaboration

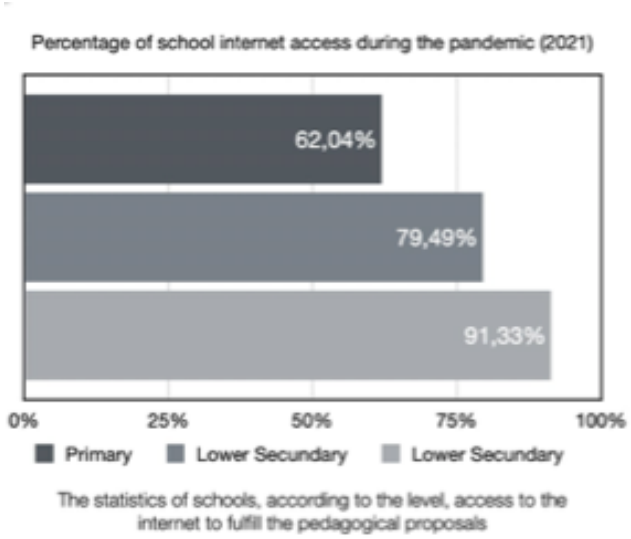

Figure 6: Sequentially, it is observed that primary schools during COVID-19 have reduced structures of internet access compared to secondary schools.
Data by Johns Hopkins University, World Bank & UNICEF (2021)
Authors' elaboration

Regarding investments, spending on basic education added to secondary and technical education in Brazil reached 4% of Gross Domestic Product (GDP) in 2018, above the average when compared to the OECD average of 3.2%. However, while 2/3 of the OECD countries and other partners have increased public investment in primary education institutions because of the pandemic crisis, the Bolsonaro government has reported no educational budget change in fiscal year 2020 and 2021 (OECD, 2021).

[9] According to the World Bank, school precariousness during early childhood education raises the indexes related to the reading deficit. This indicator is related to poverty eradication and sustainable development.

Therefore, the remote learning propagated inequality throughout the whole educational system, not only during the lockdown, but also when vaccination began and reopening started to be discussed, since schools reopened at very different rates, due to many forms of inequality, especially regional. Concerning ECE, the consequences are deeper, since there are cognitive and emotional reflexes (Silva et al., 2021).

Recommendations

We understand that a possible path for the construction of public policies that seek to deal with the context of early childhood education after COVID-19, should consider not only the universalization of access, but also the correction of the deficits generated (psychosocial, economic, and educational) by the crisis, thus, correcting the gaps that emerged in this period.

In view of the above, the lack of attention to this sector and investment in teachers and pedagogues reverberates in all stages of the basic education cycle linked to the learning poverty. It was observed that investments in early childhood bring generational returns and serve as a basis for improving structural inequalities, as it acts directly in areas of reproduction of life (socio-political system).

Conclusion

This research investigated the effects of disparities in access to education in the basic education cycle, among lower socioeconomic classes, within the scope of the COVID-19 pandemic. Moreover, the correlation of this social phenomenon with the rise of structural inequalities, social exclusion, within the Brazilian administrative and institutional apparatus.
It was found that the Brazilian State faces difficulties in complying with egalitarian basic education, objective number 4 (SDG), due to the allocation inefficiency. Basic education, with a focus on early childhood education, was made unfeasible in the educational portfolios of Brazilian governments throughout authoritarian and participative history. The findings showed that the great challenge for educational development, regarding the structural dimension, that is, socioeconomic and cultural, is the lack of prioritisation of investment in early childhood education. The neglect of this educational sector reflects on other levels of learning, equity, and training in basic education. The COVID-19 pandemic exposed the weaknesses of unequal globalisation linked to the centuries-old lack of income redistribution and wealth concentration. Consequently, the racialized population mostly represents the high percentages of school dropouts, learning difficulties and were the most neglected throughout the health crisis due to the lack of access to electronic resources. Regardless of all the educational fractures exposed in the wake of the pandemic, the sectors of social reproduction, specifically basic education, did not receive a budget increase and specific attention from the Brazilian government.

Sociological literature showed that sub-citizenship, as a historical process of marginalisation and abandonment of ethnic-racial minority groups in Brazil, manifests itself as a colonial and an oligarchic heritage, which is perpetuated through the inequality in the distribution of resources and rights. As a result, in circumstances of the status quo, the racialized, Afro-descendant, and indigenous population continues to face difficulties linked to human security, as these social groups have precarious standards of quality of life when compared to those of individuals declared white. The Brazilian State underwent significant institutional changes but did not break with the reactionary and patrimonial social order, given that the right to

quality basic education is discriminatory, socio-political—having racial and economic aspects. In this way, the manifestation of institutional racism affects, above all, the implementation of public policies and the enforcement of human and constitutional rights.
The legal analysis showed that, although the right to education finds provision in all Brazilian constitutions, it was only recognized in the Constitutional Charter of 1988 as a right of all and a duty of the State. About basic education, the current Constitution—and the current infra-constitutional legislation applicable to the matter—innovated by determining that the State's duty to ensure education for its citizens extends to the early childhood age group.
Succinctly, the crisis caused by COVID-19 amplified inequalities in several instances, since it was found that the remote teaching and return-to-class process did not observe the specificity and needs of each socioeconomic group. The pandemic esterized fractures in the dimensions of social justice encompassing access to universal basic education, highlighting the structural disparities linked to racism and poverty throughout Brazilian administration history.

Bibliographic, documentary, and digital findings were extremely relevant for the construction of the qualitative and legal analysis on the right to education and Brazilian social classes. Besides, the historical and comparative method proved to be adequate in this scope. One hypothesis was not fully resolved in the investment investigation stage, because data on indicator (B2), which represents the quality of early childhood education in OECD countries, was not available to Brazil. It is indicated for future academic work analyses involving the quality of basic education in Brazil, compared to other developed and developing countries that invest in early childhood education, and educational progress based on investments in this sector.

Acknowledgements

This investigation is the result of months of poring over data around the pandemic and the increase in social disparities. Our first results about the object were presented at the IX Oxbridge Conference on Brazilian Studies in October 2021. Since then, we have seen paradigmatic changes.

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Complexity and the Art of Education: A Study of How to Approach Teaching More Challenging Engineering Systems Development Concepts

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
As the demand for ever more capable products increases, so too does the inherent complexity of the product itself in order to facilitate increased functionality. This is broadly true of products of all sizes, from mobile phones to automobiles to large infrastructure projects. This increased complexity makes specification, design, development and implementation more difficult to understand and achieve, potentially making the process and nature of product development more difficult to teach. There are a number of pedagogical factors to this, including the complexity of the subject, the ability of available teaching methods and technology to communicate and provide coverage of the topic, and the educational preferences of the students involved. This paper considers this issue through the prism of the design of a new masters-level course on complex engineering systems. Literature is analysed to study the nature of complexity in engineering systems development and the challenges it causes, and what mix of taught and experiential-learning might be most appropriate. Experience in delivering courses to masters students is also taken into account to gauge from an andragogical perspective what teaching methods have previously been successful in communicating subject matter that is for some difficult to understand. Feedback from students past and present is analysed to understand how different preferences affect the ability to understand more complex topics, in an attempt to assess how different students respond to different teaching methods. This analysis is used to propose an approach to enhance the education of complex systems design and development for masters students.

Keywords: Complexity, Pedagogy, Engineering

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Introduction

As the demand for ever-more capable products and services increases, and knowledge develops incrementally, so the systems that we understand become continually more complex in nature. This is true of most things from consumer goods (Sauer and Ruttinger, 2007; Pak et al, 2017) through medical understanding (Levine and Oren, 2009) to the procurement of defence (NAO 2017; 2020b) and infrastructure systems (NAO 2020a; 2021). Moreover, the emergent properties associated with the use of more complex concepts and ideas must also be considered (Sarkozi et al, 2003; Aghion et al 2020). This presents a number of challenges which might be seen to fall into two categories: that of creating – or specifying and designing more complex systems – and that of understanding the outcome – i.e. comprehending the effect of increased complexity to enable the use of a system, and understand its consequences. The former requires a broad understanding of all factors associated with the acquisition of the (new or revised) system (Warfield, 1994; Batty, 2007). As an example, designing and procuring an individual system might be seen as complicated in that it will involve many different interconnected parts or sub-systems, but it can be bounded in terms of system understanding, use and maintenance across a lifecycle. Procurement of a capability, however, is much more nuanced, and opaque, as the required capability may not be easy to understand, and the means of achieving it could be challenging to envisage or define. Thus, there are more factors needing to be considered, as described below:

- Understanding the capability – the nature of the requirement is likely to be orthogonal and multi-faceted in nature
- Multiple interacting independent systems – the solution could well involve multiple systems which may not be continually present, and interactions that are numerous, diverse, and potentially unpredictable in nature
- Different lifecycles – systems might exist within different lifecycles and timescales
- Greater potential for emergence and entropy – there is a increased likelihood of unpredictable systems behaviour and unforeseen events affecting development and use of the capability systems

Stakeholders must therefore ensure complete understanding and share consensus on an appropriate course of action in order for the complexity to be managed, and the capability to be successfully delivered.

The second category – understanding the outcomes and affects of increased complexity – in order to ensure public understanding. Abraham et al (2017) pointing to the importance of branding new and innovative technology properly so as to manage consumer expectations, whilst Aghion et al (2020) considered the effects of increased automation on employment. Such effects may be negative, and therefore communication is important, and ramifications need to be carefully considered and mitigated where possible. Moreover, as Stephens et al (2016) point out, there may be costs to the consumer of more complex products, and so benefits must clearly be understood and weighed against potential negatives.

The understanding of complexity and its effects can therefore be seen as important, and that raises the question: how do we educate people in the nature of complexity in a manner that promotes understanding and enables those people to deal with its challenges and effects? This paper will evaluate the nature of complexity, why it is difficult to understand and educate, and will analyse pedagogical factors and techniques which might impede or assist in that education. Past experience in teaching complex subjects at masters level is considered, as is

the student view on how best to learn such material. Conclusions will be drawn as to the most suitable teaching approach.

The Nature of Complexity

Complexity can be defined as a state "consisting of many different and connected parts" which are "not easy to analyse or understand" (OED, 2010), and as "The degree to which a system's design or code is difficult to understand because of numerous components or relationships among components" (ISO/IEC, 2009). The common factor is that it is difficult to comprehend and understand. This is confirmed by Sheard and Mostashari (2009) who state that complexity is "a measure of how difficult it is to understand how a system will behave or to predict the consequences of changing it". Given this challenging precept, it is useful to try to breakdown, codify, and understand the concept of complexity as best as is possible. Sheard and Mostashari (2011) identified types of complexity, these being structural, dynamic, and socio-political, as defined below:

1. **Structural Complexity** looks at the system elements and relationships. In particular, structural complexity looks at how many different ways system elements can be combined. Thus, it is related to the potential for the system to adapt to external needs.
2. **Dynamic Complexity** considers the complexity which can be observed when systems are used to perform particular tasks in an environment. There is a time element to dynamic complexity. The ways in which systems interact in the short term is directly related to system behaviour; the longer-term effects of using systems in an environment is related to system evolution.
3. **Socio-Political Complexity** considers the effect of individuals or groups of people on complexity. People-related complexity has two aspects. One is related to the perception of a situation as complex or not complex, due to multiple stakeholder **viewpoints** within a system context and social or cultural biases which add to the wider influences on a system context. The other involves either the "irrational" behaviour of an individual or the swarm behaviour of many people behaving individually in ways that make sense; however, the **emergent** behaviour is unpredicted and perhaps counterproductive. This latter type is based on the interactions of the people according to their various interrelationships and is often graphed using systems dynamics formalism

From this, we can deduce that structural, or physical, complexity increases with the number of system elements and their interactions, whilst dynamic complexity concerns modes of use over time, bringing in notions of configurations and reconfigurations of elements and their interactions. Socio-political complexity then considers the actions, perspectives, and viewpoints of humans within the system. This can be used to develop a categorization of factors which might help identify or recognize complexity, as described at table 1 overpage (Barker, 2021). These characteristics in the left-hand column are primarily structural in nature, and one of the characteristics of a complex system or situation is that it will embody a greater level of detail in terms of the number of nodes or elements than a simple system. It can be seen that should the number of elements or nodes, and/or their interconnections change over time, especially should this happen at a high tempo, then the result will be dynamic complexity. How individuals perceive the complexity both structurally and behaviourally, and form conclusions and courses of action as a result, will add the dimension of socio-political complexity. Complex situations can involve all three types, which only increases the difficulty in understanding the system and its environment.

Characteristics	Exacerbating Factors
No. of nodes	What we understand
No. of connections	What we think we understand
Size	What we don't understand
Distribution	Human involvement
Location	Organisation
Level of Detail	Context and Environment

Table 1: Characteristics of Complexity (Barker, 2021)

The right-hand column of table 1 contains factors which might influence and increase complexity. With the exception of the organizational structure, these relate largely to human activity in terms of what is known or not known, how individuals act and react, and how the context and systems environment is perceived. A crucial aspect of this is the rationale: why do people behave in the way they do and perceive things as they do. Suh (2005) and Zenouzi and Dehghan (2012) both point to perception as being crucial to the understanding of complexity, and the wrong perception, perhaps based on incorrect assumption or incomplete information, can lead misunderstanding the nature and extent of complexity, leading in turn to poor decision-making and its consequences.

The structure – and behaviour – of an organization can also contribute to complexity. Anderson (1999) notes that organisations can display nonlinear behaviour which may well be unpredictable in its nature, which makes the situation harder to understand and comprehend. Rouse (2007) reinforces this by pointing to the fact that there ae several issues with Complex engineered, organizational systems which need to be understood further.

Other factors making the concept of complexity harder to understand can be the academic theory behind it; Complexity Theory (Jackson, 2019) and the idea of propagation and systemic feedback (Boulton et al, 2015) are not necessarily readily understandable by those unfamiliar with the concept, and so a means needs to be found to articulate and explain such concepts meaningfully in a clear and understandable manner. A further complicating factor is that different terms and language are used to describe complex situations in different settings and circumstances (Sussman, 2002). This would seem to be backed up by the work of several authors including Salura (2013), Bury et al (2019) and Levinson (2019), who have commented on how the use of language can be confusing and affect understanding. Beyond such factors is then the unpredictable, such as the advent of the coronavirus pandemic of 2019, which made even relatively simple tasks and perceptions imminently more complex (Lee, 2020) and could serve to bring about significant change in the way individuals carry out tasks (Coombs, 2020).

As result of this we can summarise that there are a number of causal factors associated with the difficulty in understanding complexity, as described below:

- Complexity is often defined as something that is difficult to understand, comprehend, or describe
- It involves an increased level of detail or sophistication, meaning that it is less easy to quantify
- Complexity can be difficult to conceptualise: It is "More than a (single) headful"
- Complexity can be confusing, and therefore hard to recognise or characterise?
- Dynamic in nature: complexity inherent within a system can present a moving target and exhibit a tendency to self-perpetuate

To aid and facilitate understanding of the topic, we might identify a number of questions that can guide us in terms of determining a suitable means of articulating the nature of complexity, and the characteristics associated with it, in order that we can move toward devising a suitable method of teaching and educating people about the concept. These are listed below:

- What is 'Complexity'? - and what is not 'complexity'?
- Why are things 'complex'?
- How does 'complexity' manifest itself?
- When are things 'complex'? – does the thing being considered alter state?
- Where are things 'complex'? – does location or context affect complexity?

The next section of this paper will analyse the challenges that this presents to teaching complex systems concepts and suggest an approach which might facilitate it.

Challenges in Teaching Complexity Systems Concepts

The above concludes that there are a number of challenges inherent to the understanding of complexity and its attendant systems concepts. This is at least in part because complexity is in itself complex to understand, but also because different individuals exhibit different preferences (Briggs Myers, 2000) and have different learning styles (Barker, 2014). Moreover, evidence from literature suggest that different teaching mechanisms achieve differing outcomes where effectiveness of learning is considered (Ramsden, 2003), whilst students have an expectation that teaching methods will be varied to meet different learning styles and individual experience (Biggs and Tang, 2007). In this light, consideration needs to be given to:

- What teaching methods are best suited to informing understanding of multi-faceted, orthogonal subjects involving multiple systems and stakeholders?
- How can these be structured into a coherent pedagogical/andragogical approach?
- How can such an approach be moulded to student expectations and their different learning styles?

Building upon the understanding of the nature of complexity, it might be seen that the teaching methods must be able to facilitate study of the complexity-related aspects within the relevant engineering domain, as described in table 2 over page.

<table>
<tr><td>Detail: number of nodes or components, depth of organisational or system development 'layers'</td><td rowspan="4">Stakeholders: number – and variety – of stakeholders, and their
• views,
• intentions,
• Needs, and
• Motivations</td></tr>
<tr><td>Interconnections: Number and variety of links between components</td></tr>
<tr><td>Multi-faceted nature: Multiplicity of competing/conflicting factors needing consideration</td></tr>
<tr><td>Variation and behaviour, especially across time</td></tr>
</table>

Table 2: Challenges to Teaching Complex Engineering Concepts

The task of educating individuals in the nature of complexity is exacerbated by the fact that to some, the concept is daunting, and the enormity of the subject is off-putting, and that complexity evolves not necessarily at the same rate of knowledge concerning it (Foster et al,

2001). It is therefore essential that the topic be broken down into digestible chunks and related to student knowledge and experience for ease of understanding as advised by Ramsden (2003). Use of multiple, complimentary teaching techniques can further facilitate this endeavour (Fry et al, 2009). In the light of this, and questions raised in the previous section, the following topic areas can be used to structure a taught offering:

- The "essence" of complexity
- How to recognise complexity
- How to understand the 'severity' of the situation
    - What is the extent of the issue?
- How to describe complexity
    - The degree to which it can be modelled and formalised
- How to communicate the situation
    - How to 'keep tracks' on the spread of complexity

Research done by Lohse et al (1994) demonstrates that visual means such as images and graphs improve the likelihood of comprehension, and so pictorial models are likely to convey more powerfully the 'essence' of complexity in terms of engineering system or problem structure, detail and interaction, and elements that might facilitate the emergence and spread of complexity. And by extension, multiple interconnected models might then illustrate the multi-faceted nature of complex problem situation better than a textual representation, described the holistic nature of the situation in a clearer and more digestible manner. In this way, 'simple ideas' can be utilised to convey difficult messages, using pictorial images supported by short descriptions, worked examples, and exploratory case studies to increase understand and relate ideas of complexity directly to students' knowledge and understanding. These methods can be linked together to provide a step-by-step approach to learning and bring structure to the unstructured. Different models can highlight understanding of different aspects of the situation, some, for example, focusing on structure, and behaviour, of the engineering design whilst others describe human activity and perception of the problem. Other techniques can then be used to show how complexity might propagate and spread throughout an engineered system over time and illustrate what the effects of his might be. The way in which this is packaged will be key to student understanding, and could differ depending on subject, circumstance, and cohort size and type.

Constructing a Teaching Andragogy

In order to combine these ideas into a coherent teaching strategy, we need to revisit student expectations and learning styles. Barker (2014) suggested, based upon experience of teaching multiple cohorts across different levels of attainment, and feedback from students, that student expectations of education are centred around an interactive mixture of teaching techniques to provoke debate, challenge assumptions, and encourage reflection – an essential ingredient to the learning experience (Ramsden, 2003). Students also differ in their preferences (Briggs Myers, 2000) and learning styles (Honey and Mumford, 1982). Some students may exhibit a natural preference for formal lectures with worked examples, whereas others may be more comfortable with a more exploratory open-ended modelling approach and independent student-driven learning. Authors such as Bligh (1998) have debated the merits and otherwise of various teaching techniques to facilitate learning for different styles and circumstances.

If this is taken in the context of a potentially limited attention span (Bradbury, 2016) available to impart high-quality learning, then short instructional segments to convey the

"essence" of complexity, such as essential principles, definitions and characteristics of complexity and related concepts would seem appropriate. Given the difficulty in comprehending the subject, establishing a firm foundation of basic knowledge is essential to further understanding. This can then be underpinned through the use of pictures and images, or metaphors, to create an 'image' of complexity to provide visual understanding of the nature of complexity, whilst worked examples and mini-case studies taking in complex systems across different engineering domains and industries can be used to make the concept 'relatable' by locating it within the experience and understanding of the student's 'own world'. If such devices are poorly used, however, the risk of misunderstanding can increase.

Once initial understanding of key concepts and ideas of complexity is achieved, then more advanced factors can be addressed by a variety of means as follows:

- Cross-cutting examples
  - Provides continuity of understanding across different ideas and concepts
  - Links teaching segments together
  - Maximises the opportunity for student understanding
- Modelling and exploration of multiple, orthogonal viewpoints
  - Provides a holistic view of the problem situation
  - Demonstrate how contrasting views or use of terminology can increase misunderstanding
  - Illustrate need to clarity and consensus
- Range of interactive case studies
  - Illustrate complexity in different context
  - Increases chance of relevance to individual experience, therefore increasing likelihood of understanding
  - Allows students to bring their own knowledge and understanding to bear on realistic complex issues and problem situations and scenarios

In allowing students to interact with modelling exercises and case studies, attention span may be enhanced (Geri et al, 2017) whilst a natural variety is added to the teaching andragogy which can only help the learning experience. In this way, basic principles can be inculcated, whilst more detailed and intricate real-world examples can be used to reinforce understanding and put the subject matter in context. This pedagogical/andragogical approach can then be enhanced still further by assessment – both formative and summative – which invites students to challenge their assumptions and reasoning and test their understanding in representative situations.

Whilst these provides a means to support education of ideas of complexity, it must be highlighted that the educational offering should be varied according to the students education level (so, for example, a degree-level student is likely to require more formal instruction, whilst a masters-level student can be expected to grasp more advanced concepts more quickly), and so factors such as prior knowledge and experience, and previous qualifications gained, will affect the students ability to understand, as will learning preferences, and the educational offering should be carefully and appropriately tailored. The next section will consider how this approach can be put into practice.

A Delivery Mechanism for the Teaching of Complex Systems Concepts

The analysis of the pedagogy/andragogy shows that short, impactful instructional sessions interspersed with worked examples to demonstrate key principles, and interactive case

studies to allow the exploration of the effects of complexity is likely to be the most successful method of educating students in the nature and concepts of complexity. It is essential that students engage with this way of teaching and delivery, so discussion with students as to how the subject will be delivered is key to success, and this should take place before, throughout, and after the course is run. Experience of previous delivery allowed student expectations to be understood, and subsequent discussions via student feedback forums indicated that those initial indications were indeed valid. Feedback suggested the need for an incremental, step-by-step approach to building up knowledge gradually, with short, concise instructional lectures backed up by examples, and mini-exercises with sample solutions, so that students can ground their understanding before citing it within the domain of the real-world. It was also thought appropriate that the instructional lectures should be held as 'conversations' to allow the students a more immersive participation which might further their understanding, and that regular question and answer tutorial sessions should be scheduled to ensure student understanding and to repeat material if necessary. Realistic case studies, as described in the previous section, were thought to lend an opportunity to explore complexity, especially is these were used to link up ideas and build knowledge and expertise across the course. As a result of this consultation, the following mechanism was implemented:

- Live sessions held as 'conversations' rather than formal lectures
- Short follow-on individual exercises to embed understanding
- Provision of worked solutions/model answers
- Q&A/Tutorial sessions to answer queries and repeat material if needed
- Self-paced research exercises to explore particular aspects of relevance
- Longer, group interactive workshops to simulate reality and foster peer-to-peer understanding and learning
- Seek regular feedback from students: session-by-session to ensure understanding and test different ideas
- Consistent 'storyline' through course

Initial feedback during the course indicated that the variety of pedagogical techniques used helped understanding and succeeded in engaging the students with the subject matter. It was found that some combination of the above would work for students at different levels of educational learning; for masters students, the expectation would be that the students would move from basic principles more quickly, and focus more extensively on the more detailed interactive case studies, bringing their knowledge and experience to bear, and reflecting on lessons which could be applied to their individual working environments.

Conclusions and Further Work

In conclusion, it has been demonstrated that the topic of complexity, its effect upon systems of whatever type, and its tendency to propagate in a self-perpetuating manner, is one that is difficult to comprehend and understand. This can be for a variety of reasons ranging from the inherent complexity of the subject itself through the learning preferences of the student to the degree of advancement of members of the learning cohort, and the level at which it is being taught. Consideration of a suitable pedagogy (or andragogy) led to the identification of the need for interactive exploratory sessions, because it is of the essence that students are able to explore the effect of such detailed and extensive concepts, and this notion received positive feedback. It should also be noted that choice of teaching mechanism, be it imagery, phraseology, or use of metaphor, can induce confusion and reduce understanding. The delivery mechanism should make use of a suitable variety of teaching techniques to deliver the intended outcome at the intended level of qualification. For degree-level students, this

mechanism will tend to focus more on the theoretical, but for masters-qualification students, a greater emphasis can be placed upon independent study, exploration, and reflection. Key conclusions of this work are therefore as follows:

- Need to choose imagery and metaphors with great care, as can easily reduce understanding of such a complex topic
- Simple techniques and methods engendered greater understanding – but need to ensure that ILOs of qualification are still met
- 'Conversations' and workshops proved effective at relating topic and concepts to student experience – more so than lectures?
- Pace – and pitch – of learning has to be right
- Constant themes through course improve understanding

In terms of further work, it should be said that the work reported is an initial study, and ideas need to be developed in the light of continued student feedback, with the delivery mechanism being further attuned and making use of more developed case studies. It is therefore desirable that the teaching concept should be repeated on other cohorts to increase feedback and refine teaching andragogy. A further enhancement to the teaching concept would be te consideration of work-based projects to allow students to apply the lessons for managing complexity directly into their working practice, and there is also the possibility of including 'reinforcement' sessions at a period of time after the course to gauge how students have applied lessons and confirmed their understanding.

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A Multidimensional Approach to Assessing China's Adherence to Article 26(1) of the Universal Declaration of Human Rights (UDHR)

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
While China has frequently been accused of challenging international human rights, its involvement with the right to education has rarely been the centre of scholarly attention. Education as a fundamental right is deemed essential to securing social justice, enhancing individuals' dignity, and enabling their enjoyment of other rights. This paper investigates the degree to which China adheres to UDHR Article 26(1) through Tomaševski's three dimensions of education. Methodologically, this paper adopts elements of both document analysis and critique of practice by drawing on China's official law documents and practical applications, as well as academic literature on international human rights. This paper found that while the Chinese government shares some common ground with the UDHR on the right to education, it detracts from what is endorsed and implied in UDHR Article 26(1) to a large extent. Notably, due to different ideological beliefs between China and the dominant international community, nuances abound in the interpretations of the right to education and priorities placed on each aspect of this right. Furthermore, this paper noticed that under the present social and cultural conditions, it is difficult for China to translate its stated ambitions, which sometimes align with UDHR Article 26(1), into reality. Broadly, this paper contributes to the limited research on education as a fundamental human right in the Chinese context. It calls for a more in-depth investigation of the Chinese discourse and the UDHR, and a broadened scope of different types and levels of education.

Keywords: International Human Rights, Social Justice, Right to Education

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Introduction

In 2018, China's President Xi Jinping delivered a congratulatory speech at the Beijing Human Rights Forum to commemorate the 70th anniversary of the Universal Declaration of Human Rights (UDHR). He recognised the significance of this declaration in the history of human civilisation and its profound influence on the human rights cause globally. Despite being a signatory and co-drafter of the UDHR, China has been described as a "powerful enem[y]" of this declaration by the international community (Kinzelbach, 2018, para 1). While most human rights discussions have been concerned with China's violations of its citizens' freedom of expression (e.g., Chen, 2018; Chomhaill et al., 2015; Wellens, 2009), relatively little attention has been paid to China's engagement with the right to education. Education as a fundamental human right is deemed indispensable to the moral rationality of securing social justice, the enhancement of individuals' intrinsic dignity, and the effective enjoyment of other human rights (Akattu, 2013; Kumar, 2004; Nowak, 2016). This paper endeavours to examine the extent to which China has adhered to Article 26[This paper primarily focuses on the first part of Article 26 of the UDHR (hereafter referred to as UDHR Article 26(1)).] of the UDHR (1948), the first internationally accepted articulation of the right to education (Bergström, 2010):

> Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

UDHR Article 26(1) identifies education with formal schooling as it categorises different kinds of education into elementary, technical, and higher. Accordingly, the present paper deals with formal education, which is "institutionalised, intentional, planned through public organisations and recognised private bodies" (Olcott, 2013, p.331). Among the various elements comprised in UDHR Article 26(1), this paper critically discusses everyone's right to education, free compulsory elementary education, and equal access to higher education (HE) by merit. I structure this paper based on three dimensions of education as a human right proposed by Tomaševski (2004, 2005): 1) education as a civil and political right that calls for the respect of freedom; 2) education as a social and economic right that requires the state's provision; and 3) education as a cultural right that regards it as a group right. Throughout the paper, I draw on academic literature on international human rights and China's official law documents to substantiate the analysis.

Civil and Political Dimensions

Education as a civil and political right relates to the freedom aspect, which "requires governments to permit the establishment of schools respecting freedom of and in education" (Tomaševski, 2004, p. 7). Coinciding with UDHR Article 26(1) that recognises everyone's entitlement to education, the Constitution of the People's Republic of China (PRC) (1982) proclaims that education is a fundamental right endowed to all Chinese citizens (Article 46). Specifically, the Compulsory Education Law of the PRC (2014) requires that "[a]ll school-age children and adolescents ... enjoy the equal right, and fulfil the obligation, to receive compulsory education" (Article 4). The duties of education receivers are further detailed in the Education Law of the PRC (1995), which includes "developing good ideology" and "studying strenuously" (Article 43). This right-duty duality mirrors the underlying expression of the Constitution of the PRC (1982) that "[e]very citizen is entitled to the rights and at the

same time must perform the duties prescribed by the Constitution and the law" (Article 33). While the UDHR is known for promoting individuals' rights and disregarding their duties (Constantinides, 2008), its Article 26(1) contains the element of duty by making elementary education compulsory. This is justified on the belief that "the free choice is a right only for matured minds ... and that parents cannot be trusted to do what is in the best interest of their children" (Marshall, 1992, p. 16). Unlike the rationale provided for UDHR Article 26(1), the legal responsibility of receiving education in China stems from the state's desire for economic development and societal regulation (Zheng, 2005).

Although the right to education is endorsed by both China and the international community, China seems to diverge from the UDHR in its proclaimed nature and scope of education. The Education Law of the PRC (1995) announces that "[e]ducation shall serve the construction of socialist modernization" (Article 5) and "[t]he state shall conduct education ... in patriotism, collectivism and socialism ... national defence and ethnic unity" (Article 6). The incorporation of socialist doctrines is also mandated for HE (Article 53 of the Higher Education Law of the PRC, 1998) and vocational education (Article 4 of the Vocational Education Law of the PRC, 1999). Evidently, while the educational purpose advocated in the Chinese law is closely related to the imposition of socialist ideology, UDHR orients the aim of education to "the full development of the human personality and to the strengthening of respect for human rights and fundamental freedoms" (Article 26(2)). Indeed, as asserted by Spring (1998), education as a human right should place the citizens in the position of demanding an education that serves their interests rather than the state's. Hence, China's promotion of a politically-driven education system departs from the human-oriented dimensions of education enshrined in the UDHR.

Coomans (2004), who studies international human rights instruments including the UDHR, argues that the right to education implies individuals' liberty to choose educational institutions outside the state school system. This necessitates the government to authorise the establishment of educational institutions by private bodies (Tomaševski, 2005). In China, although private schools have been granted equal legal status as state schools (Hua, 2009), the state plays a prominent role in the development, inspection, and assessment of the former (Article 24 and 25 of the Education Law of the PRC, 1995). Another aspect of state interference in education is the marginalisation of certain content. For example, religious knowledge and activities are minimised from the compulsory education system (Mahmut, 2019) and "[a]ny organization or individual may not employ religion to obstruct activities of the state education system" (Article 8 of the Education Law of the PRC, 1995). As a result, although individuals are accorded the right to choose their desired type of education, the state has controlled the kinds and substance of education available, which renders education as a civil and political right opaque in the Chinese discourse.

Social and Economic Dimensions

The social and economic facets place the obligations of making education available and accessible on the state (Coomans, 2004; Tomaševski, 2001). With reference to Article 22 of the UDHR, Beiter (2005) affirms that the availability of education is associated with the state's responsibility to provide educational institutions, teachers, and teaching resources. Reflecting the social and economic aspects, China has made it mandatory and free for its citizens to complete both primary and secondary (Grade 1 – Grade 9) education since 1986 (Article 2 of the Compulsory Education Law of the PRC, 2014). As UDHR Article 26(1) only mandates free compulsory elementary education, China has surpassed this minimum

requirement. Despite being a developing country, China has allocated plentiful resources to raise the educational level of its new generation, particularly those from underprivileged areas (Zhang et al., 2019). Statistically, China's total national education expenditure exceeded 5.3 trillion yuan (0.59 trillion pounds) in 2020, with 2.43 trillion yuan (0.266 trillion pounds) spent on compulsory education (MOE, 2020). The outcomes of China's efforts are reflected in the National Bureau of Statistics (2019), where in 2018, the primary school enrolment ratio of school-age children reached approximately 100%, and the primary-to-secondary school promotion rate reached 99.1%.

However, behind the facade of fee-free state provision are growing numbers of fee-paying private schools (Zhang et al., 2019). Contrary to UDHR Article 26(1) that upholds education as a human right, privatisation of education echoes "[education] as a service" defined by the international trade law (Tomaševski, 2005, p. 1). Besides those established by entrepreneurs for middle-class children, many privately-run schools have been built for underprivileged rural children (Schulte, 2018). While the former type of schools gives economically-capable families more options, the latter is used as a solution to compensate for the state's inability or unwillingness to provide free-of-charge education in underdeveloped regions (ibid.). In light of this, China has not been entirely successful in executing its mandate to provide free compulsory education for all despite remarkable resource mobilisation.

Compared to elementary education, UDHR Article 26(1) provides less guarantee for other types of education. For example, HE is required to be accessible rather than free, compulsory, or available. Similarly, while China has developed a fairly complete legal system of HE (Xue, 2010), which has driven college enrollment rates from 9.1% in 1997 to 42.7% in 2016 (Li, 2019), China's current material circumstances cannot allow everyone to pursue their right to obtain HE (Jin & Zhou, 2020). Consequently, China has also implemented a nationwide HE tuition charging system (Dong & Wan, 2012). Although the tuition fees are low compared to many western countries, they constitute an economic obstacle for the financially difficult (Xue, 2010). Given this, the government has provided abundant educational loans and student aids to impoverished candidates. Thus, as affirmed by Tian and Liu (2019), HE in China can be described as a quasi-public good as it is selective, fee-charging, yet considerably funded by the state. Therefore, regarding HE, China parallels with UDHR Article 26(1) as both offer lower and vaguer promises in terms of the availability and affordability of HE than elementary education.

Cultural Dimensions

As indicated by the word "everyone" in UDHR Article 26(1), the right to education accrues to all. In conjunction with Article 2 of the UDHR, social categories "such as race, colour, sex, language ... [or] birth" should not deny individuals' entitlements of the right to education. An example of a breach of this right would be restricting entry to state education of citizens belonging to a particular social community (Coomans, 2007). In China, children of migrant workers (usually those who have migrated from rural to urban regions for brighter economic prospects) have limited access to free state schooling outside their original place as a result of China's unique household registration system (Chen & Feng, 2019). While the government has recently allowed these children to receive state education in cities where their parents work through legalisation and resource allocation, their educational right has not been effectively realised at the city government or school level (Goodburn, 2016; Pils, 2017). Consequently, many of these children end up attending substandard migrant-run private schools (Goodburn, 2015, 2016). Therefore, despite the central government's well-

intentioned endeavours, the right to free primary education has not been fulfilled for everyone on a non-discriminatory basis as delineated in UDHR Article 26(1).

Concerning HE, UDHR Article 26(1) declares that it "shall be equally accessible to all on the basis of merit". This suggests that no one should be barred from entering HE by factors other than individual excellence (Beiter, 2005). Consistently, China also adopts a merit-based model of HE admission by assigning HE opportunities as per candidates' scores through the National College Entrance Examination (NCEE) (Li, 2019). This is deemed a highly fair system as it disallows the use of social connections, a commonly employed method in modern Chinese society (Muthanna & Sang, 2015). Furthermore, this merit-dependent selection is believed to enable the hardworking yet socially disadvantaged to actualise upward mobility (Li, 2019). However, as argued by Huijser et al. (2008), displaying merit is contingent upon one's previous access to educational opportunities, which can be significantly affected by various social conditions. One type of social inequality salient in China is the severe rural-urban divide, where urban families are far more capable of investing in their children's learning by utilising various forms (i.e., social, cultural, and economic) of capital (Wu, 2008). Aside from these structural inequalities, which have been increasingly addressed by the government (Li, 2019), rural students also encounter what Roberts and Green (2013) term rurality-based spatial injustice, where they are socially constructed as deficient and have their cultures devalued in the urban-centric testing regime (Li, 2019).

Another social group with lower chances to attend HE through the NCEE is the ethnic minorities in China, who are believed to have low educational levels and less exposure to the ethnic majority mainstream culture (Lang, 2010; Teng & Ma, 2009). In order to safeguard their right to education, the state has enacted laws to compensate for their disadvantage in the current HE admission system, such as allowing them to be educated and examined in their ethnic language (Article 37 of the Regional Ethnic Autonomy Law of the PRC, 2001; Liu & Liu, 2015). One controversial policy is granting them substantially more marks or setting substantially lower cutoff marks in the NCEE (Lang, 2010). This is legally supported in the Regional Ethnic Autonomy Law of the PRC (2001) that "[i]nstitutions of higher education ... shall appropriately set lower standards and requirements for the admission of students from ethnic minorities" (Article 71). Guided by the principle of "different but equal", this policy aims to provide equal access to HE through differential treatments in HE admission on the basis of ethnic identities (Lang, 2010, p. 45). However, opponents of this policy regard it as reverse discrimination against the ethnic majority's educational right, especially those from equally disadvantaged backgrounds (Teng & Ma, 2009). Therefore, as this preferential policy prioritises collective right over individual equality (Lang, 2010), it violates the individual merit-based equal access to HE enshrined by UDHR Article 26(1).

Discussions and Conclusions

Through the three lenses of education as a civil and political right, a social and economic right, and a cultural right, this paper has examined, theoretically and practically, the degree of China's adherence to UDHR Article 26(1). By considering the civil and political dimensions, it has found that the Chinese legislation concurs with UDHR Article 26(1) as both recognise the right-duty duality, with China being more explicit about the duty aspect, justified by its socialist development aspiration. However, as education in China is fraught with political indoctrination (at least based on the legislation), it differs from the UDHR, which cherishes the fulfilment of personal autonomy. Moreover, while the free choice of the education type seem to be granted for individuals in China, the kind of education available has already been

regulated or restricted by the government. From social and economic perspectives, China has exceeded the minimum criteria outlined in UDHR Article 26(1) by implementing free compulsory primary and secondary education. In reality, however, the presence of private schools as supplementary educational providers means that China has not yet attained its proclaimed goal. For HE, which the Chinese government has heavily financed, China aligns with UDHR Article 26(1) by implying less guarantee of availability and affordability. Regarding education as a cultural right, China has not ensured everyone's right to free primary education as endorsed by UDHR Article 26(1), with the case of migrant children exemplifying place of origin-based discrimination. Separately, although China embraces the merit-oriented HE entry policy stated in UDHR Article 26(1), other social categories such as rurality have influenced the accumulation of merit in the first place. Additionally, the case of implementing preferential policies to secure ethnic minorities' collective right runs counter to the individual right espoused in UDHR Article 26(1).

In the final analysis, this paper argues that although the Chinese government shares some common ground with the UDHR on the right to education, China departs from what is embodied and implied in UDHR Article 26(1) to a large degree. Notably, while the principles expressed in China's rhetoric often coincide with UDHR Article 26(1), there are nuances in interpretations and priorities owing to different ideological consciousness between China and the dominant international community. Further, it appears challenging for China to translate its ambitions into reality under the present practical and cultural environments. Reflexively speaking, as a Chinese citizen who has been through the Chinese education system, crafting this paper has allowed me to question what was previously beyond my contemplation. Yet, I acknowledge that the choices made during researching, writing, and argumentation were subject to my own socially constructed worldview. That said, this paper contributes to the limited research base on education as a human right in the Chinese context. Further research could strengthen the analytical rigour through a more in-depth investigation of the interpretations behind the Chinese discourse and the UDHR. Moreover, technical and professional education, non-citizens' and adults' right to education, and a similar topic in other contexts, which are beyond the scope of this paper, could be areas for future exploration.

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PACIE Methodology Applied to English Teaching in Virtual Classrooms with Moodle

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The Barcelona Conference on Arts, Media & Culture 2021
Official Conference Proceedings

Abstract
The misapplication of a digital presence, academic scope, inadequate training, low interaction, and a methodology with little pedagogy suitable within a virtual learning environment such as virtual classrooms on any platform, whether Moodle, Claroline, Kornukopia, or Chamilo, Etc., lead to decrease and demerit significant learning at the time of training or study an online course or in turn to achieve a certificate with distance education and quality. This particular related to virtual learning environments causes collaterally severe damage when applying a correct methodology, while also generating a high dropout rate in this type of distance education or E-learning that is currently booming and which becomes an excellent alternative for any student who wants to break the barriers of time and space. Furthermore,This research has 1200 participants from Salesiana University, 13 language teachers, and two e-learning expert instructors, which showed the improvement in language acquisition throughout PACIE methodology.

Keywords: PACIE Methodology, Virtual Learning Environments, Information Technology and Communication, Platforms, E-learning

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Introduction

The inclusion of technology in face-to-face classrooms as a support to improve meaningful learning where human learning develops in a naturally active mental and social process by engaging their learning process interacting and manipulating the objects in that environment. (Jonassen & Strobel, 2006). Therefore, technology use has grown exponentially, resulting in many changes, including new forms of teaching, focused on distance learning or e-learning, to reduce university dropouts and bulky classrooms with a high number of students.

Nevertheless, unfortunately, with the emergence of many educational platforms and virtual classrooms as support for face-to-face classrooms and distance education, students' interest is reduced, demotivation to study increases due to the lack of a suitable pedagogy and methodology applied to environments 0, virtual classrooms. In fact, this is because of ¨the nature of the tasks that so many students most commonly experience in schools is completing standardized tests or memorizing information for teacher-constructed tests. ¨ (Howland, Jonassen, & Marra, 2012,p2)

However, the adequate application of ICTs in the teaching and educational management processes allowed access to educational content, real-time interactions, wikis, or collaborative work, and other devices and tools that support and go hand in hand with the dissemination of knowledge. Unfortunately, some of digital educative resources were underutilized due to the little or no knowledge of implementing a satisfactory methodology and pedagogy within virtual learning environments.

As a result, the classrooms lacked a correct order or organization and had low interactivity, poor virtual presence, and little academic reach. However, teachers must consider adequate pedagogical use of ICTs in class which has led to innovative methods, sometimes replacing traditional face-to-face and distance teaching methods with radical online learning designs, or more incremental changes that blend online with traditional face-to face or print-based distance teaching approaches. (Caird & Lane, 2015)

For this reason, this research is intended to improve the use of virtual classrooms in any VLE and generate in the student the interest of working within virtual environments with an appropriate pedagogical and methodological quality and develop improvements in English language learning.

Background

According to the premise underlying the (UNESCO, 2010) "Towards inclusive knowledge societies", the contribution of ICTs has been transcendental for humanity, due to the considerable impact on academic and continuing education processes through real-time educational content and devices that allow communication, interaction, and dissemination of knowledge.

The implementation of virtual learning spaces favors many aspects that are not contemplated in the face-to-face; so it is necessary to find optimal e-learning platforms coupled with the PACIE methodology, which facilitates the introduction of this online learning within the educational processes. Many countries such as Europe, the United States, and Latin America have failed due to the exaggerated dependence on technological devices such as computers

and the Internet, neglecting the methodology and pedagogy, i.e. the educational area itself. (Oñate, 2009)

With the application of virtual classrooms in educational processes on different platforms both open source and private, it becomes necessary to have a specific order and an adequate structure within the EVA or AVA that allows independent learning with correct routes to work collaboratively within the virtual environment.

The PACIE Methodology is focused on the learning and self-learning processes, giving a pedagogical enhancement to distance or blended learning. (Camacho P., 2008). The P.A.C.I.E. methodology whose acronym means (P) Presence (A) Scope (Training) and (I) interaction proposes the following aspects to consider when working virtually (Jácome, L., 2010). It consists of specific phases:

Graph 1: Phases of PACIE Methodology

Source: by the author

The first phase or Presence in an (EVA) focuses on the visual part that the teacher transmits to the student, through the correct use of the optimal resources provided by Web 2.0. (Camacho, 2011). Virtual classrooms, in addition to being efficient, should cause a visual impact, interesting and attractive not only for students but teachers, authorities, and users in general; that is to give life to the virtual campus with color, images, videos, photographs, etc., that is why significant educational content resources should be used, in addition to using additional tools to the platform for a consolidated presence on the internet that serves as cognitive support. (Zerpa, 2012).

The second stage, (Zerpa, 2012), mentions that the PACIE methodology is based on establishing precise objectives about what is done with students on the network such as: communicate, interact, and report; thus making the academic, experimental, and tutorial scope effective, and meeting the main objective, that the student learns.

(Pérez, 2010), exposes the third phase that makes up the Training, preceded by the scope and followed by the interaction, a sequence is achieved with which a more extensive vision of virtual education is strategically generated, starting from the micro that is the design of virtual classrooms to the macro that involves the training of human talent.

The fourth phase called Interaction uses educational resources to collectivize and share, where the teacher motivates, guides, and accompanies the student, seeks to eliminate the

overload of many activities and generates interactive classrooms which cause real interaction in an EVA; at the same time seeks to stimulate student collaboration on Online encouraging socialization on the Internet. At this stage (Zerpa, 2012), he argues that communication should focus on EVA with updated information maintaining the institutional (corporate) image.

The structure generated by applying the methodology makes it possible to divide the virtual environment into 3 main blocks.

Zero Block – PACIE

1) Information Section. About the course, tutor, and evaluation.
2) Communication Section. On the process of classroom operations.
3) Interaction Section. Collaborative learning.

Academic Block.

1) Exhibition Section. Academic course information, resources.
2) Rebound Section. Self-criticism activities
3) Construction Section. Knowledge Building, Analysis and Discussion
4) Checking Section. Synthesis, Comparison, and Verification.

Closing Block

1) Negotiating Section.
2) Feedback section.

The fifth phase of the PACIE methodology is called e-learning, which is based on and executed through the Internet, between teacher and student, maintaining synchronous and asynchronous communication, the student in this stage of the methodology becomes the center of the training, at the time of self-managing their own learning. The word "e-learning" means Electronic Learning. The same is conjugated with the different technologies and to the pedagogical and methodological aspects of the teaching and learning process.

E-learning is based on the following aspects:
Pedagogical, which refers to Educational Technology as the standard of educational sciences, proper to technological means, educational psychology, and didactics.

Technological, concerning Information and Communication Technologies, through the choice of web 2.0 tools, design, individualization, implementation, hosting and where the open-source or free software technologies are integrated.

The pedagogical principles are the core of e-learning and work with the contents, perhaps at the beginning they are the least perceptible, but finally, they are the most important components for effective techniques of the teaching and learning process objectives and effectiveness techniques.

Characteristics of the PACIE Methodology

This modality of training or distance education through the Internet or blended learning helps training to reach a larger conglomerate of people. Among the most visible features of e-learning are the following:
The space-time barrier disappears: Students can take and participate in a course from their home or workplace, having access to all the contents of a course at any time of the day and hour. This way, the time a person dedicates to self-training can be maximized.

Accessibility and flexibility: It allows the development of a fairly accessible and flexible training to the new way of education today, due to a large number and variety of existing methods and resources on the web, properly employed within a virtual environment; given their contribution to the knowledge they can adapt to the characteristics and needs of any student with any type of need and with different learning styles.

Student-centered: The student ceases to be a passive entity within the learning process and becomes the center of the teaching-learning process and participates actively and participative through constructivist learning, i.e. the student knows his needs and becomes the builder of his own knowledge, self-training according to his own needs and interests; while the teacher becomes a virtual tutor or facilitator of knowledge, who guides and orients the student throughout his training process using ICT tools that virtual platforms offer for a better acquisition of knowledge.

Avoid impact shocks: PACIE facilitates techno-educational processes that are developed consecutively and gradually to avoid impact shocks that may generate resistance in various groups of the learning community such as teachers and students, due to a curricular overload of work and student time, respectively.

Techno-education: PACIE includes ICTs within the educational processes, but no longer revolving around the student, it is mostly focused on the teacher who is the axis of the educational processes on the Internet, with the administrative and curricular burden that the teacher has; PACIE seeks to provide the teacher with all the necessary resources to take advantage of technology in favor of education and not in an inverse process, therefore, PACIE allows the inclusion of e-learning based on the teacher.

Competencies

In this sense, among the competencies necessary for the teacher to perform successfully in virtual environments, according to (Yot, 2016) "the mastery of didactics, technology and tutoring is fundamental, as well as the empowerment of technological competence that is connected to the mastery of basic digital skills such as, (hardware, file management, navigation, multimedia application, web pages, author software, Internet applications)", interest in permanent renewal and updating and ability to simplify the technological and procedural aspects so that the student can focus on the exclusively formative.

"Digital Competence involves the critical and safe use of Information Society Technologies for work, leisure, and communication. Building on basic ICT skills: using computers to retrieve, evaluate, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet" (European Parliament and the Council, 2006).

The didactic competence is linked to the knowledge of learning theories and principles of adult learning, scientific mastery of the specific area of knowledge, ability to adapt to new training formats, creative and innovative attitude to the multiple opportunities that arise at each stage of a virtual course. (Revista Electrónica Diálogos Educativos, 2012).

Finally, tutorial competence refers to communication skills, ability to adapt to different users respecting their religion, race, social condition, open-mindedness, and perseverance to follow up the student's progress and predisposition to assume roles according to the learning situations. (Revista Electrónica Diálogos Educativos, 2012).

In addition, the value of good tutoring or timely assistance to the student within a VPA is of no less importance, as mentioned by (Chickering, A., & Gamson, Z. 1987), in their article "Seven principles for good practice in undergraduate education. AAHE bulletin, 3,7." refer that the 'good practices' observed in VPAs lead to: (a) encouraging student-faculty contact; (b) encouraging cooperation among students; (c) encouraging active learning; (d) providing prompt feedback to students; (e) emphasizing time on task: (f) conveying high expectations; and (g) respecting different abilities and learning styles.

Roles

Regarding the e-mediator's role, (Ferrer, 2012) it is located in four main areas: the pedagogical, related to the development of an effective virtual learning process; the social, linked to the development of a learning environment with a comfortable emotional and affective climate in which students or participants feel that learning is possible; the organizational and managerial, related to the establishment of an adequate and trained instructional design that includes encouraging or motivating those involved in this process to be clear in their contributions; and finally the technical, which includes actions aimed at helping students feel competent and comfortable with the different resources and tools.

Methodology

This research is of a mixed qualitative and quantitative type since its objective is to measure the improvement of the teaching-learning process through the Moodle platform for students and the application of the PACIE methodology in virtual classrooms for teachers.

It is quantitative research because it determines its processes systematically, methodological, and means that it is in permanent transformation. The modality on which this research is based on the objectives since it is beneficial for students, teachers, authorities, and society, and it is intended to reduce the desertion rate of students in e-learning and b-learning courses by applying the PACIE methodology" optimizing and perfecting the design of learning processes through the mentioned methodology and the improved management scheme of virtual classrooms.

The type of study applied is descriptive since it is field research, and it will take place in the Faculty of Languages of the Salesian Polytechnic University. It is also Web-bibliographic because it is essential to develop the research based on a series of articles related to applying the PACIE methodology in virtual classrooms.

Due to its nature, the present research is considered to be experimental, descriptive, and applied research since the knowledge will be used to carry out a study of the incidence of the

use of the PACIE methodology in classrooms of the Moodle virtual platform as a methodological strategy of learning, applied to the first level students of Languages of the School of Environmental Engineering.

Participants

The population is made up of students enrolled in the subject of English in the first year of Environmental Engineering in the first cycle of the 2018 - 2019 semester with 50 students of Environmental Engineering and 50 students of the second cycle of the 2019 - 2019 semester and teachers who taught English in the periods mentioned above, which total 13.

The Moodle virtual platform was used with classrooms designed with the PACIE Methodology with the Environmental Engineering students of the 2019 - 2019 semester, while the Environmental Engineering students of the 2019 - 2019 period did not use the methodology above. A total population of 1200 students and 13 teachers participated in this research.

In addition, the Survey technique was used, one applied to students and another to teachers with reference indicators (Moodle virtual platform, synchronous and asynchronous activities, Internet, and WEB 2.0 Tools), and the instrument used consists of 1 questionnaire with ten questions. Once the student survey had been developed, a survey was conducted with teachers unaware of and did not apply the PACIE methodology in their virtual classrooms.

Analysis and Results Interpretation

In this research, the survey and observation have been used as a data collection technique, the same that was applied to the two groups (experimental group and control group), the experimental group includes the environmental engineering students of the 2016-2017 semester and the environmental engineering students of the 2015 - 2016 semester to the control group, which allowed them to capture, appreciate and perceive reality for decision-making.

For the analysis and interpretation of the results of the survey applied to first-year students of Environmental Engineering School in the English subject were considered the following criteria: accessibility, frequency of use, instructional virtual classroom design, technological learning tools, assessment system, interaction, and learning materials. It is detailed below:

Question 1

How easily can you access and solve the exercises in the virtual classroom?

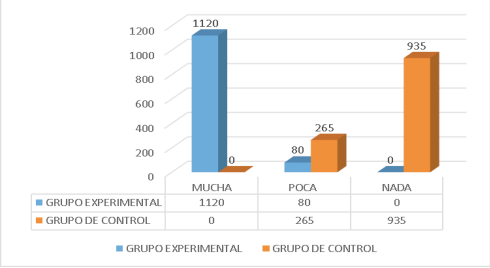

Figure 1. Result of Experimental Group Vs Control Group

A high percentage of students where teachers apply PACIE methodology can access and solve exercises in their virtual learning environment. The results show how learning is strengthened, awakens interest in learning mediation between teachers and students. In addition, it stimulates the sense of autonomous responsibility and supports and strengthens curricular and extracurricular teaching-learning practices from various innovative scenarios; while a high number of students where the methodology is not applied have problems accessing and resolving their activities in the EVA (Virtual Learning Environment).

Question 2

How often do you use your virtual environment for academic activities?

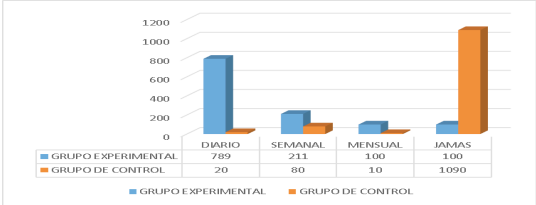

Figure 2. Result of Experimental group Vs Control group.

The repetition and continuity in the use of the virtual classrooms where they were designed with PACIE methodology encouraged the students the pleasure and interest to enter their EVA and work in it, while in the other group we can observe the opposite.

Question 3

Is your virtual classroom designed in a more interactive, intuitive, and easy way to navigate?

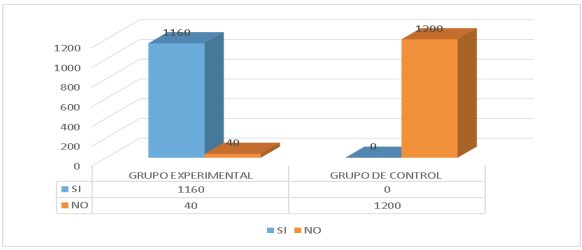

Figure 3. Result of Experimental group Vs Control group.

1160 students state that their EVA is designed in a more interactive and intuitive way when working on it, while in the control group without PACIE there is a high rate of students who find their EVA difficult to navigate, unattractive, and interactive.

Question 4

Do you think it is necessary for the teacher to use NICT as didactic material in the second language learning such as English?

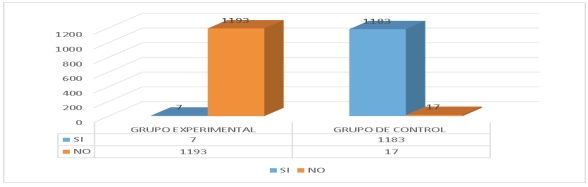

Figure 4. Result of Experimental group Vs Control group.

In the classrooms where PACIE was applied, students do not feel the need for their teacher to use more didactic material than that existing in the EVA, while in the classrooms that do not work with the methodology, they demand that the teacher work with much more didactic and attractive material appropriate to the subject he/she teaches.

Question 5

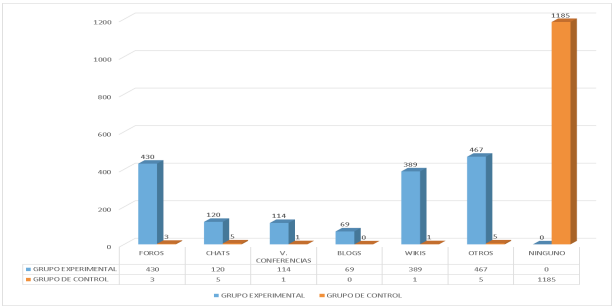

Figure 5. Result of Experimental group Vs Control

Does your teacher make use of Discussion Forums, Chats, Videoconference, Blogs, Wikis, Other, None for the learning process?

By using an EVA correctly with an appropriate, inclusive, and varied methodology in their classroom activities, students have the possibility to work individually or collectively allowing them to have better reception and enjoyment of the subject, while in the other group where PACIE was not applied there is no work from either the teacher or the students in their EVA.

The analysis and interpretation of the survey results applied to first-year teachers at Environmental Engineering School in the English curriculum once the PACIE methodology was applied in their virtual classrooms are detailed below:

Question 1

Do you use resources such as (forums, chats, quizzes, etc.) file sharing spaces in your virtual classroom in the academic block?

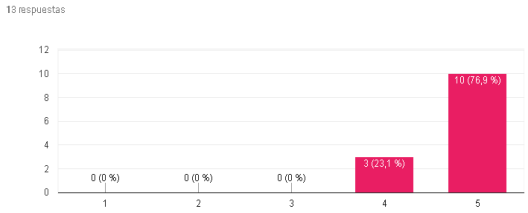

Figure 1. Result of Question Applied PACIE Methodology

When P.A.C.I.E. is applied in the classroom, 76.9% of teachers work with their students in an orderly and correct manner, providing a better quality of education.

Question 2

Are your students able to locate and understand the instructions on the topics or exercises you place in your AVAC applying the P.A.C.I.E. methodology?

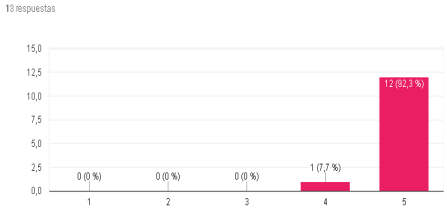

Figure 2. Result of Question Applied P.A.C.I.E.

92.3% of teachers' state that the instructions of the exercises or activities they post in their EVA applying P.A.C.I.E. are now more understandable.

Question 3

Has the number of retired students in your class been reduced when you apply P.A.C.I.E. in your virtual classroom?

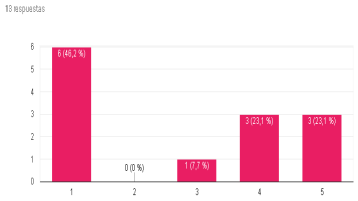

Figure 3. Result of Question Applied PACIE

Absenteeism and dropout rates in courses taught through a virtual classroom have been reduced, not completely, but by 42.2% when applying P.A.C.I.E.

Question 4

Are your students motivated to do evaluations, activities, and permanent work in the virtual classroom using PACIE?

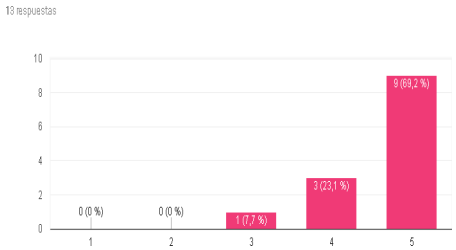

Figure 4. Result of Question Applying PACIE

69.2% of students feel motivated and willing to continue with the course using PACIE, motivation is the main driver when working on e-learning or b-learning courses.

Conclusions

The use and work on a virtual platform as a methodological strategy do NOT improve the English teaching-learning process in the first-year students of Environmental Engineering in the English subject. What improves the learning-teaching process of Environmental Engineering students is the methodology implemented in the virtual classroom.

The appropriate use of the New Information and Communication Technologies and a good methodology facilitate the educational process in the English subject since it allows the creation of learning objects that support and validate the contents in a virtual environment of learning or VLE.

With the implementation and use of virtual learning environments applying the P.A.C.I.E methodology as a methodological strategy, meaningful learning is achieved in the students of the experimental group, having meaningful resources like improving in their academic scores between 92-99 %.

The experimental group students achieved better academic performance by being evaluated through a virtual classroom with the P.AC.I.E. methodology and dropout and absenteeism were reduced by a high percentage of 80%.

Having a correct methodology in a V.L.E (Virtual Learning Environment) helps students the possibility to have a good language acquisition in many different skills such as: Listening, Reading, Speaking, and writing, because it provides a logical, sequential process and for students help to follow appropriately any kind of instruction for different tasks in the VLE.

Future work

This research makes a meaningful contribution to online education, a modality that will continue, so it is necessary to support with New Information and Communication Technologies and an adequate methodology that facilitate the educational process in any subject, through the creation of learning objects that allow learning the contents.

Acknowledgements

This research was possibly applied thanks to English teachers who make important difference in language acquisition, MSc. Edwin Loján, MSc. Rocío Patiño, and Estefania Quezada Tobar, Salesiana students from Environmental Engineering from distance learning modality, who were the main participants. A special gratitude to Indoamerica Authorities Ing. Saul Lara Paredes, Dr. Franklin Tapia, Ph.D. Janio Jadán, who guided the Research University Fundings.

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Resources

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"Importancia de la metodología PACIE en los EVAs" by Ligia Jácome: https://pdfslide.tips/education/importancia-de-la-metodologia-pacie-en-los-evas.html

"La metodología PACIE. Fundación para la Actualización tecnológica de Latinoamérica" by Luis Oñate: https://docplayer.es/55319-La-metodologia-pacie-autor-ing-luis-onate.html

"Modelo de Educación Virtual – PACIE" by Pedro Camacho: https://www.scielo.cl/scielo.php?script=sci_arttext&pid=S071850062018000200035&lang=pt

PACIE. Introducción, Presencia y Alcance by Alexander Zerpa: http://metodologiapacieacuariogeminis.blogspot.com/2012/11/pacie-introduccion-presencia-y-alcance.html

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Machine Learning Analysis of Problems Encountered by STEM Students from Underrepresented Groups During the Covid-19 Pandemic

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
During the current Covid-19 pandemic, STEM students from underrepresented groups have been disproportionately affected. These include women in STEM degree programs, "first generation" students from non-academic families, students with a migration background, students with physical or psychological disabilities and students with children. A control group of university students who do not belong to any of the categories above was defined. This work presents concrete problems reported by students from underrepresented groups as ascertained during interviews. The interviews were first recorded as audio files and then transcribed using speech-recognition software. Transcripts from interviews were analyzed with machine learning methods in an to attempt to identify whether specific patterns of problems were experienced by members of one of the underrepresented groups, or whether the difficulties encountered were uniform across all types of student groups, including the control group. The problems identified in these interviews were compared and contrasted to those previously presented in published literature before the pandemic. These results will be used to define requirements for the design of future digitalization measures to specifically support university students from underrepresented groups.

Keywords: STEM, Underrepresented, Pandemic, Machine Learning

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Introduction

During the Covid-19 pandemic, lockdowns and contact minimization regulations were implemented in most countries to slow the spread of the virus. For universities and other educational institutions, this meant a rapid, unplanned introduction of distance learning. Both educators and students had to do the best they could in a difficult situation. Financial and technical resources as well as emotional support and advice available to cope with the increased challenges of distance learning are not equally distributed among all university students.

This work investigates two research questions:
1. Subject-oriented: Did university students in Germany from underrepresented groups in STEM subjects experience changes in their psychological or social situations during the pandemic?
2. Technically-oriented: Can machine learning methods discover text patterns with a limited data set?

First, background information about underrepresented groups is presented. Next, the methods used in this investigation are explained. Experimental results are described and discussed. Finally, conclusions are drawn and plans for future work are presented.

Underrepresented Groups

University students from underrepresented groups already reported feeling disadvantaged before the pandemic (Whitcom, et al., 2021). Underrepresented groups in STEM subjects are defined as

- Women
- First generation
- Migration background
- Parents
- Financially disadvantaged.

Although women represent approximately 50% of the total population, they are still a minority of students in STEM subjects. At the Nuremberg Institute of Technology, only 21% of IT students are female (THN, 2018). First generation students are defined as the first ones in their family to attend a university. Especially in Germany, a person's chances of going to university is highly correlated with the academic level achieved by their parents. 80% of students with academic parents attend university, while only 48% of first generation students do so (Heine 2010). People with a migration background were either born in a different country or one of their parents was. People with a migration. In Germany, although 24% of the population identifies as coming from a migration background, only 11% of university students does so (Berthold, 2018). 6% of university students have one or more children. 41% of them report that they are single parents (Berthold, 2018). Students with disabilities could not be included in this study, because too few respondents self-identified as belonging this group. This would have violated EU data privacy regulations, because individuals could be personally identified. Instead, financially disadvantages students were included as an additional group.

Methods

A number of process steps were conducted to gather and analyze empirical data.

1. Structured interviews were conducted with students from different underrepresented groups and recorded as audio files.
2. These audio files were converted to text using speech recognition software.
3. The text data was pre-processed to normalize capitalization and remove stop words.
4. N-gram terms were analyzed to calculate their significance within the interviews.
5. Machine learning algorithms classified the sentiments associated with n-grams.

23 structured interviews were conducted with students from underrepresented groups. Students self-identified as to whether they belonged to one or more of the groups, as shown in Table 1. Approximately half of the participants identified as female, about half as male. None self-identified as non-binary or diverse. Slightly more than half reported that German was their native language, the other half identified as non-native speakers. Eight of the participants claimed a migration background and eight said they were the first in their family to attend university. Two of the students identified as parents. Five students said they were financially disadvantaged.

Self-Identification	M	F	German Native Speaker	German as 2nd Language	Migration Back-ground	1st Gener-ation	Has Child (-ren)	Financial Difficulties
of Interview Subjects	12	11	12	11	8	8	2	5

Table 1: Interview Subjects

All of the students answered the same questions in the same order. The interviews were record as audio files and uploaded to a secure university server.

Next, these audio files were converted to text characters using the online speech recognition tool Amber script. Each interview had an average of 667 words. In total, approximately 15,000 words were available in total. One inherent weakness encountered here arose during the speech to text conversion. Due to differing accents, the interviews with non-native speakers resulted in a higher number of conversion errors than those conducted with native speakers.

Before the text could be analyzed by the machine learning algorithms, a number of pre-processing steps were required. First, the text was divided up into individual words, a called tokenization. Next, all of the text was converted to lower case, so that a capitalized instance of a word would be recognized as the same word non-capitalized. Stop words, such as “the”, “is” or “a”, are so commonly used that they do not contribute much additional information. These stop words are removed to speed up the analysis. Here, it is important not to remove all three letter words, such as “not”, since this would completely change the meaning of the sentence (Manning, et al., 2008).

Next, so-called “n-grams” were generated. An N-gram is a sequence of “n” words. One example of a 2-gram, or bi-gram, could be “child care”. An example of a 3-gram, or tri-gam, could be “lack child care”. These n-grams are used in Natural Language Processing (NLP) in order to predict the next word in a sequence, based on probabilities calculated from past

examples. The importance or significance of a particular n-gram was calculated using Term Frequency – Inverse Document Frequency (TF-IDF) value. The Term Frequency (TF) is calculated as the number of times a specific n-gram is used in one interview, divided by the total number of words in that interview. The Inverse Document Frequence (IDF) measures how often a certain n-gram appears in all of the interviews. For example, a term such as "pandemic" would probably appear several times in all of the interviews conducted for this study, since the study was conducted during a pandemic, about issues related to the pandemic. As a result, the term "pandemic" would probably not supply much significant additional information. On the other hand, the 3-gram "lack child care" would probably only appear in interviews with student parents and thus be judged by the TF-IDF value to be highly significant (Qaiser, Ali 2018).

After identifying the most significant n-grams, or semantic word groups, the next step was to try to identify which sentiments were associated with each of these terms. Sentiment Analysis is a machine learning method, which attempts to identify the context in which a term is used. Subjective information is extracted to infer the sentiment of a user when using a certain term. The goal is to classify the context in which a term is used in order to predict whether the term is associated with a positive, neutral or negative sentiment. For example, the term "good financial situation" would probably be associated with a positive sentiment, while "financial difficulties" would probably be associated with a negative sentiment. (Pang, Lee 2008).

The sentiment analysis was conducted using a neural network with supervised training. Similar to the way humans learn, supervised learning neural network is trained on a large number of past examples, in order to make predictions for new data. The machine learning tool RapidMiner was utilized to perform this analysis. A neural network needs a large number of past examples (many thousands to millions) in order to be trained correctly. For this project, only a relatively small data set of approximately 15,000 words was available from the interviews. If the training data set is too small, the neural network often fails to produce good predictions, due to a problem called overfitting (Goodfellow 2016). The second research question addressed by this work addresses this aspect: Can machine learning methods discover text patterns with a limited data set?

To improve the performance of the neural network in spite of the small amount of training data, a method called k-fold cross-validation was used, as shown in Fig. 1. Instead of just entering the entire training data set several times in the same order, the training data is partitioned into a number of groups, called folds. The letter k is used to designate the number of partitions, or folds. First, the training data is fed into the neural network in the order: Fold 1, Fold 2, Fold 3, Fold 4. Next, the training data is fed into the neural network in a different order of folds: Fold 2, Fold 3, Fold 4, Fold 1, and so on. This method has been shown to help avoid the problem of overfitting when using small training data sets in supervised learning of neural networks (Berrar 2018).

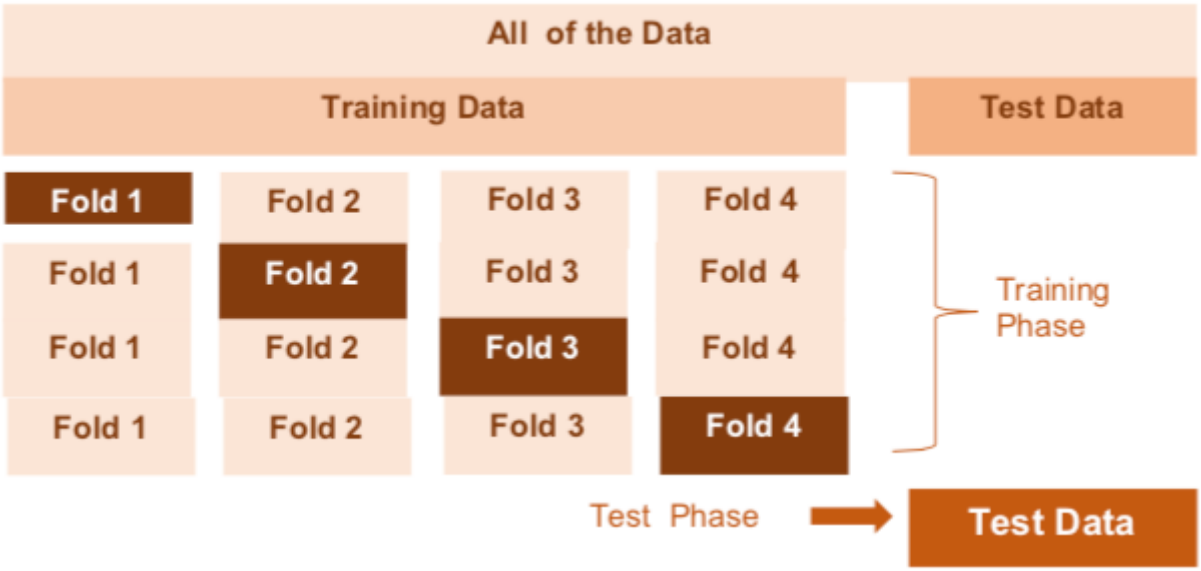

Figure 1: K-Fold Cross Validation

Results

As described in the Section "Methods", after the pre-processing was completed, the first task was to generate n-grams of the text data. The largest words in the word cloud have the highest TD-IDF values and thus judged to have the highest level of significance.

Figure 2 shows a word cloud generated by 1-grams in the text data. "books", "university" and "financial" appear highly significant. Interpretation of this 1-gram word cloud is made more difficult by the high significance of both "good" and "not". Depending on context, each of these 1-grams could completely change the meaning of a sentence.

Figure 2: 1-Gram Word Cloud

Figure 3 shows the bi-grams with the highest TD-IDF score for significance. Here, we see that the bi-grams “financial situation”, “technical difficulties”, “psychological situation” and “changeover presence” are judged to be highly significant. Some terms, such as “cared for family members” were bi-grams in the original German text. The translation of German compound words into English resulted in four words instead of two.

Figure 3: Bi-Gram Word Cloud

Figure 4 shows the tri-grams with the highest TD-IDF scores for significance. Here, we can ascertain quite a number of tri-grams which deliver significant information, such as “thoughts terminate studies”, “distance held younger” and “children home schooling”.

Figure 4: Tri-Gram Word Cloud

After the n-grams with the highest TF-IDF scores were identified, a neural network was used to classify these n-grams according to three different sentiments:

1. Positive
2. Neutral
3. Negative.

Figure 5 shows the results of this classification by the neural network using sentiment analysis. Values to the left of zero signify negative sentiments, values to the right of zero signify positive sentiments. Especially the negative n-grams were classified correctly: "family caused", "psychological situation" "need time adjust". A number of neutral sentiments were also classified correctly, such as "situation interim aid", "relatively managed". Most of the positive sentiments were classified correctly, such as "luck financially", "rather well setup" and "sources obtained". One glaring classification error occurred for the term "abandon studies". This should definitely be classified as a negative sentiment, rather than a positive sentiment. This error is probably due to overfitting of the neural network, due to the insufficient size of the training data set.

The machine learning algorithm used in this experiment was able to recognize some of the common problems reported by students from underrepresented groups. Worsening psychological and financial situations, a lack of motivation and difficulty concentrating when studying at home due to the presence of family members or children, feelings of isolation due to lack of contact with peers and difficulties in communication with professors were mentioned most frequently.

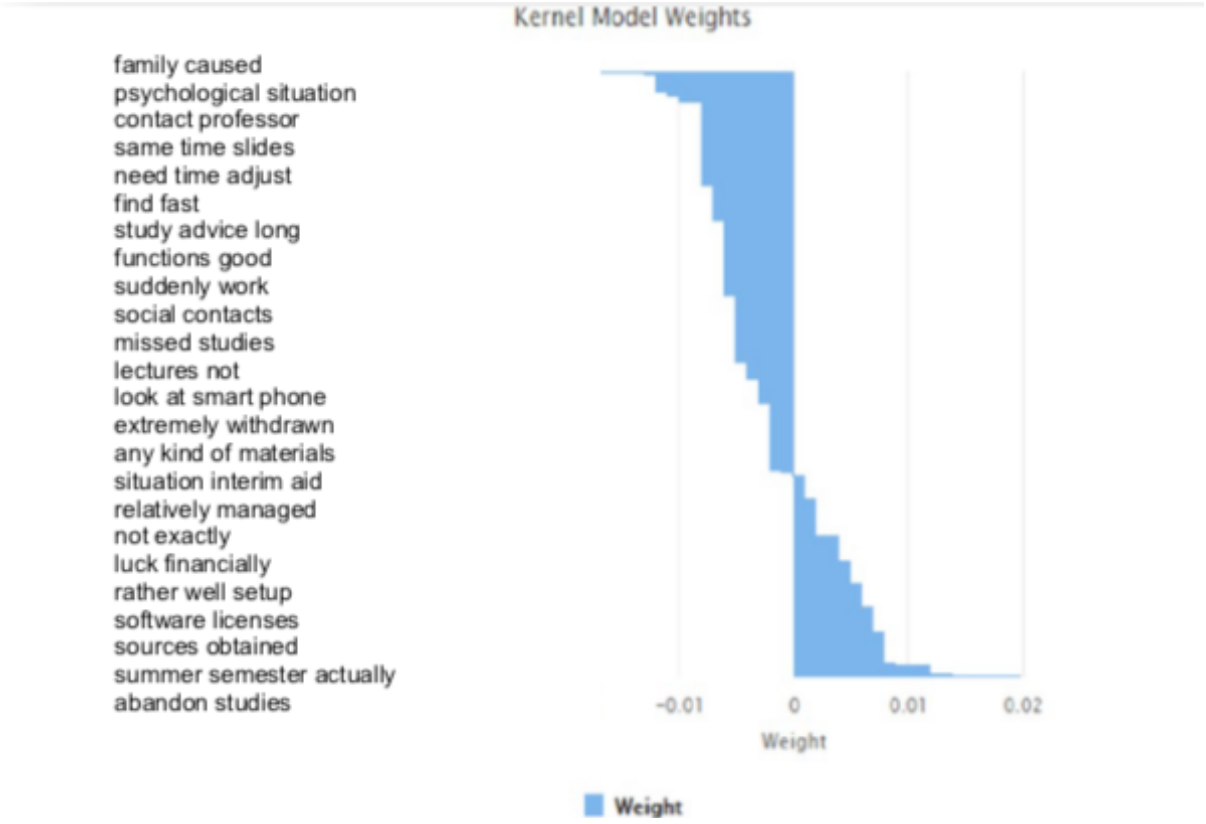

Figure 5: Results of Sentiment Analysis

Positive changes were also noted, such as the rapid digitalization of learning and library materials and excellent support from the computing center. Especially students caring for children and family members appreciated the increased flexibility of distance learning.

Conclusions and Future Work

In conclusion, students from underrepresented groups reported experiencing negative sociological and psychological changes during the pandemic. Machine learning methods, such as neural networks and sentiment analysis can discover unknown patterns in data. Limitations of this study due to the relatively small data set of 23 interviews hindered mapping of correlations between individual underrepresented groups and specific problems. Future work will conduct analysis with larger data sets to increase confidence levels.

Acknowledgements

This work was conducted with support from a research grant from the Nuremberg Institute of Technology in Germany: “Teaching Research – Exploration-Based Learning”.

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Virtual Classroom Management from the Teachers' Position in the New Education Normality

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Given the current pandemic emergency (COVID-19), it is necessary to have updated information on the educational reality of Ecuador. Education, in any situation, should be a priority and should never stop, which leads to adapting the curriculum to the emergency through virtual classrooms; although they already existed before, not all schools and students used it to the same extent. The aim of this research is to translate into a theoretical framework the management of virtual classrooms from the teachers' point of view within the framework of the new educational normality. A methodological design with a mixed approach was used. The qualitative paradigm was applied, of the phenomenological-hermeneutic type, and an interview with 5 teachers was used as an instrument. The quantitative technique was also applied, using a questionnaire as an instrument. The sample consisted of 50 teachers from a high school in the city of Quito, Ecuador. Most teachers have assumed with real commitment their management of teaching and learning in virtual classrooms and recognize the importance of the use of technological tools and their contribution to education. The support of the authorities on duty is required so that teachers are continuously trained and can face any crisis in the educational field; thus, achieving an adequate structure that allows teachers and students to be at the forefront of the technological demands that society currently requires.

Keywords: Virtual Classrooms, Teachers, Management, Technological Tools

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Introduction

The coronavirus pandemic (COVID-19) has caused an unprecedented crisis in all areas. In the education field, this emergency led to the massive suspension of face-to-face activities of educational institutions in more than 190 countries, to prevent the spread of the virus and mitigate its impact. According to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO 2020).

Likewise, Castro (2020), reveals that, during the first half of March, when the first cases of COVID-19 began to be detected in Latin America, Ecuador urged confinement and suspended face-to-face classes in private and public entities. Therefore, teachers and students with the support of parents of the investigated high school in the city of Quito took on the challenge of teaching through social networks.

Facing this health crisis meant a great opportunity for teachers to reinvent themselves and look for different ways to innovate their pedagogical practices in virtuality. For this reason, it is also relevant, according to Valenzuela (2020), education should focus on the essential, the important, and the possible in order to achieve the objectives prioritized by our official curriculum with flexibility and empathy. The teacher becomes a guide who stimulates and collaborates with the student in his learning process to show the results obtained through the evaluation of each subject or specific knowledge.

Faced with this new reality, it is necessary to ask the question:
What was the virtual classroom management from the teachers' point of view in the new educational normality?

According to the foregoing, the aim of this research paper is to reflect in a theoretical scheme the management of virtual classrooms from the teachers' position in the framework of current educational normality, which will be part of the research line of Management and Organizational Development in the Family - School - Community Program, in order to promote the development of individual and collective capacities and potentialities of students, enabling the learning, generation and use of knowledge, techniques, arts, and culture through virtual classrooms in the High school under investigation.

Background

The global context of the pandemic has transformed the different dimensions of our lives and the education world. In this regard, Poblete (2020) mentions that we can continue to do the same, live it as pure loss or learn from the great transformations that our society has experienced due to this health crisis. The development of information technologies has favored the development of virtual classrooms, making it possible to overcome geographical, social, and other barriers of a personal nature.

The implementation of virtual classrooms in education allowed the training of teachers in these spaces. According to Valenzuela (2020), this health crisis forced schools to suspend face-to-face teaching, which does not imply transferring the role of the educator to the parents (recognizing that they are the first and main educators of their children), burdening them with new tasks and responsibilities for which they have not been trained and which, probably, due to the multiple difficulties associated with these times, it is not possible to assume either.

To speak of management is to administer and establish concrete actions to make the programmed tasks a reality. In this regard, Rebolledo Saavedra (cited by Sánchez, 2019) defines Management as a process undertaken by one or more people to coordinate the work activities of other individuals. Indicating also that the management comes to be like a new way of seeing the institution, it mobilizes it towards the achievement of its purposes and develops its capacity to articulate the internal processes. In addition, management is to develop the art of discovering and closing gaps, and to achieve this effectively requires knowledge, competencies, disciplines, and reference models.

In the field of educational management, Pérez Sayago (n/d), relates this term to the possibilities of an institution to solve situations or achieve a purpose. He also argues that it is the process through which an educational institution is directed, conducted, oriented, and administered. It is also seen as the set of processes, decision-making, and execution of actions that allow to carry out pedagogical practices, their implementation, and evaluation.

Borja and Carcausto (2020), point out that digital tools in education are the set of applications and platforms that help both teachers and students in their academic work. Currently, information and communication technologies (ICT) are being used, of which digital tools or resources are part.

Virtuality and Education in Times of COVID-19

In this regard, it is pertinent to highlight, according to Expósito and Marsollier (ob. cit.), the importance that online education has acquired in 2020, an unprecedented fact that will mark a before and after in pedagogical practices and in current educational systems globally. In addition, the social, cultural, and economic inequalities of more than 180 countries that have been victims of the pandemic by COVID-19 have been highlighted.

The need and urgency brought about by the current health crisis led governments to change the mode of study of educational institutions as a measure to mitigate the effects of the pandemic, affecting 94% of students worldwide according to UNESCO data (2020). However, researchers argue that the flame of education cannot be extinguished and even in this context of extreme emergency, it must be guaranteed as a fundamental human right.

It is worth mentioning that in the study conducted by Expósito and Marsollier (ob. cit.), they state, regarding the use of technologies, that the WhatsApp application has been the most used by teachers to communicate with their students and carry out their pedagogical tasks. The results allowed identifying two types of technologies (Popular and Specific) and the use of popular technologies by students of low socioeconomic resources, state-run schools, compulsory education levels, and in adult education predominates.

Other authors coincide in highlighting the importance of the use of popular technologies (especially WhatsApp) insofar as it has allowed most teachers and students, especially from disadvantaged contexts, to continue with the educational process, at least in the first moment of the crisis, as pointed out by Kem-Mekah-Kadzue, Bonilla-Guachamín 2020 (cited by Expósito and Marsollier, ob. cit.) [8]. With reference to specific technologies, the results indicate that their use prevails among students of middle and high socioeconomic level, in privately managed institutions, and at higher levels (non-university and undergraduate) of the educational system.

Methodology

The methodological design with mixed approach will be used in this research. The qualitative paradigm will be applied, of a phenomenological-hermeneutic type, which considers the importance of understanding the phenomena from the perspective of the participants in each situation. The interview with 8 teachers will be used as an instrument. In addition, the quantitative technique will be applied, the instrument will be a questionnaire. The sample will be constituted by 50 teachers of high school in Quito's city, that is why this knowledge is based on logical principles used to achieve a range of objectives that govern a scientific investigation.

The survey consists of 10 questions that are divided into two sections, the first section tries to know about the management of technological tools, the second section aims to know about the management of virtual classrooms. The results obtained are as follows:

Chart 1: Teachers' Questionnaire

Questionnaire
1. Do you know what the acronyms TIC and TAC mean?
2. Do you think that the use of Virtual Learning Environments makes us dependent on technology and not very reflective when using it as support in the classroom?
3. Is there a contingency plan established by the authorities of the educational institution regarding the COVID 19 pandemic?

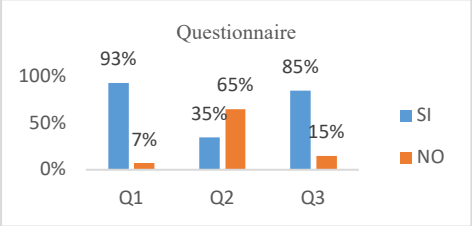
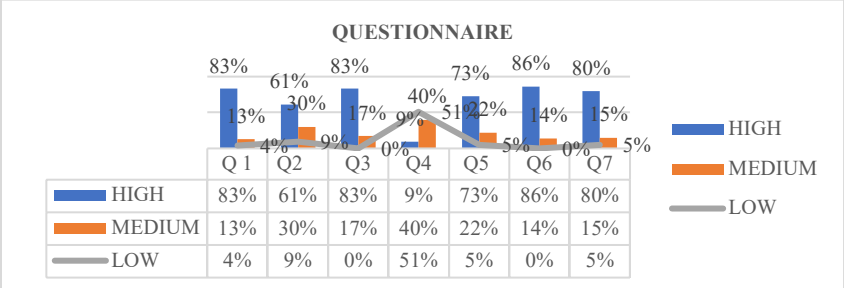


Figure 1: Statistic Analysis

Chart 2: Teachers' Questionnaire

Questions
1. How often do you use these means to support your teaching work?
2. What percentage do you consider you use ICT and ACT in your virtual classes?
3. In what percentage would qualify the support in training by the Ministry of Education for the management of ICT and virtual classrooms?
4. Do you consider that the use of ICT in class is a determining factor in student learning as support tool alternative in the teaching of various

contents?
5. Do you use new technologies such as email, platforms or mobile devices to communicate with your students?
6. Have you presented symptoms such as Stress, anguish or any illness in the new educational normality?
7. Do you consider that technological resources allow greater interaction with knowledge, motivating the learning process?



	Q 1	Q2	Q3	Q4	Q5	Q6	Q7
HIGH	83%	61%	83%	9%	73%	86%	80%
MEDIUM	13%	30%	17%	40%	22%	14%	15%
LOW	4%	9%	0%	51%	5%	0%	5%

Figure 2: *Statistic Analysis*

Result Analysis

According to the results, it shows that the pandemic forced authorities and teachers to accelerate digital adoption in the education sector, trying to find urgent correctives to face this emergency, who had to investigate, self-train, and take advantage of the human resources that the institution had to support and train classmates who knew something and others who were totally unaware of the management of ICT in the classroom. It is important how to carry out teaching and how to reach students virtually, which becomes a great challenge for all members of the educational community, teachers, students and parents.

The educational task involves the use of technological skills of its members through the commitment that determines the virtual educational environment and the communication needs that are established between them.

Chart 3: Teachers' Interview

Interview
1. How was the virtual classroom management in Ecuador before COVID 19?
2. What is your perspective on the return to normal education in Ecuador?
3. What do you think of the virtual classroom management that is carried out according to academic standards and what is the teachers' perspective, at the COVID-19 pandemic time?
4. What would be your support to translate into a theoretical scheme the

virtual classroom management that guarantees quality learning from virtual classrooms in Ecuador?

Result Analysis

According to the results of the interviews, the teacher must promote permanent communication with the student and seek interaction with available resources. One of the roles that must be assumed is mediator, and this action must be systematic and reinforcing the student's behavior to achieve the fulfillment of the objectives, for this reason, the current teacher requires new strategies, perceptions, experiences and knowledge to try to answer the multiple questions that are presented every day.

This new modality of online education is here to stay, for this reason students must also continue with the use of technological tools in the teaching-learning process since this contributes to the development of skills and competences that today's society demands, but this work should go together with the Ministry of Education to continue with the permanent training of teachers in the update on the use and application of new technological tools; as well as seeking an urgent change in the plans and programs of study.

Conclusions

According to the interviewees and the results of the survey, this unexpected change, due to the covid-19 pandemic, helped to raise awareness about the reality of the Ecuadorian teacher, who did not have training and updating in technological tools, nor did they have technological means at home, however, unexpectedly they had to change from a face-to-face teaching modality to a virtual one. This required innovation in the ways of imparting learning supported by virtual technological tools to give immediate practical solutions to their students.

At the first time of the crisis, teachers had to make use of popular technologies, especially WhatsApp, which allowed most teachers and students, especially from disadvantaged contexts, to continue with the educational process.

It is noted that in some way they had support from the Ministry of Education for the implementation of the use of digital platforms such as zoom and teams, which offer the possibility of overcoming geographical, social and other barriers of a personal nature. This favored the creation of virtual classrooms, the same ones that with the teaching experience have improved to achieve greater learning.

Future Work

The significant contribution of this research expresses the importance of valuing management in virtual education since all academic learning must be lived, experienced and shared to achieve the true learning process, because without a doubt, it cannot be achieved through theoretical contexts. This reasoning motivates to continue with this idea of research aimed at teaching colleagues. This research lead to find new didactic and pedagogical resources within a virtual classroom; since this new online education modality must continue, despite

the return of face-to-face education, digital platforms and technological tools must be the instruments of this new educational era.

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Model United Nations as an Active Learning Tool for Global Negotiation

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
Simulations have become a popular active learning tool used to facilitate the acquisition of specific knowledge and skills by students. This paper presents our pedagogical experiences of Model United Nations in English within the educational context of Japan. It specifically refers to the case study of Tsukuba English Models United Nations (TEMUN) organized between 2012 and 2019 at the University of Tsukuba within two programs of global education. The paper describes the process of adjusting the Model United Nations simulation to be used as pedagogical stimulus for the learning of global negotiation. After briefly introducing the educational context, the paper presents the TEMUN framework in looking at three aspects, curriculum design, teaching methods and the academic profile of participant students. Lastly, in discussing the student's expectations and perceptions assessed through pre-event and post-event surveys, the paper will show new research directions when using the MUN simulation as an active learning tool for global negotiation.

Keywords: MUN, Global Negotiation, Collaborative Problem Solving, Active Learning, Diversity

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Background

In an increasingly globalized world bringing new challenges that require multidisciplinary knowledge and transferable skills, Higher Education Institutions (HEI) around the world had to readjust and update their curricula and teaching methods in order to be able to foster new generations capable of tackling, complex challenges of societies and the world. The ability of Higher-Education Institutions to pursue necessary reforms often influences their attractiveness and competitiveness.

In Japan, during the last two decades, the Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been trying to address several educational problems that affected the attractiveness and competitiveness of Japanese universities. Such problems have been related to the decreasing number of international students willing to learn in Japanese universities, the preponderance of traditional knowledge-based teaching, lack of classes given in foreign languages, absence of interdisciplinary programs, inadequate curricula, lack of syllabi and programs in the English language, low proficiency of English language among Japanese students despite the constantly growing number of native teachers, etc. According to data collected from the official website, MEXT has put forward different plans and programs and has promoted several initiatives, among which are:

- Strategic Plan to Cultivate Japanese with English Abilities (2001)
- Global CEO (FY2007-2009～FY2012-2014)
- G30 Project: Establishing University Network for internationalization (FY2009～FY2014～)
- Promotion of Global Human Resource Development (FY2012～)
- Inter-university Exchange Project (Re-inventing Japan) (depending on the country is organized between FY2012～FY2023)
- English Education Reform Plan (2014)
- Top Global University Project (SGU) (FY2017～FY2028)

These initiatives aimed to encourage the universities to reshape their educational practices and convert their traditional way of teaching into new methods suitable to an increasingly globalized society. As a result, several Japanese universities have implemented inter- and multidisciplinary programs, with an increasing number of programs taught in English, expanded their joint degree programs with the universities abroad, and attempted to attract international teaching staff. In addition, instructors have been called to renew pedagogical contents and teaching methods to foster students' global mindsets and transcultural awareness more efficiently and implement complex experiences of transdisciplinary collaboration and innovative breakthrough-generating activities.

In this context, among the numerous programs promoted by Tsukuba University, Global Negotiation Program (GNP) organized at the graduate level between 2011-2015 and subsequent Bachelor Program in Global Issues (BPGI) organized at the undergraduate level since 2016 aimed to provide students with a suitable environment in which they can acquire multidisciplinary knowledge and skills transferable among various professional careers (scientific researchers, as well as business practitioners). The present paper describes the authors' experiences in adjusting the Model United Nations simulation to be used as a pedagogical stimulus for the learning of global negotiation within these two programs.

Model United Nations

Model United Nations (MUN) is one of the decision-making simulations used as an active learning tool at thousands of universities worldwide. In this simulation, participants play the role of a diplomat representing a particular country at the United Nations. The simulation traces its roots in an event (the simulation of the Model League of Nations) held in 1923 by the students of Harvard University in the United States (Muldoon, 1995). Although the MUN is widely used within international relations programs, policy studies or politics, due to its high versatility, it has also become a tool used to improve students' language or communication proficiency within English programs.

In Japan, MUN was introduced in 1983 by Sadako Ogata - who served between 1991 -2000 as the United Nations High Commissioner for Refugees - as a learning aid for students of international relations and was organized mainly in the Japanese language. Since 2001, in the above-mentioned efforts for internationalization and competitiveness made by MEXT and Japanese universities, the popularity of MUN has rapidly expanded among teachers of foreign languages (mainly English), international communication, negotiation, policy studies, etc.

Currently, MUN in Japan is organized at different educational levels (high-school, undergraduate, graduate), in different settings (in-class training, as well as extracurricular events), for several disciplines (e.g. international relations, public policy, politics, English language, communication studies, etc.) and aiming at different goals, such as increasing language proficiency or aid for content delivery.

Tsukuba English Models United Nations (TEMUN), the subject of our case study, was organized for seven years, between 2012 and 2019, at the University of Tsukuba, as a practical part of two programs mentioned earlier: GNP and BPGI. We aimed to adjust the MUN to fit the goals of these educational programs seeking to foster global mindsets and equip students with the knowledge and skills necessary in a globalized society.

Curriculum Design and Teaching Methods

Global negotiation, the core concept characterizing the two programs previously mentioned, is defined as practical competence "to actively engage in a consensus-building process to solve problems through dialogue in the international arena and intercultural environment" (GNP Pamphlet 2011). This complex definition goes beyond the limited aim of developing students' conversations skills or helping them to achieve higher proficiency and fluency in English. It highlights the fact that students should acquire multidisciplinary knowledge and transferable skills necessary to address different challenges and to build consensus through "collaborative problem-solving", a notion introduced by the OECD's Programme for International Student Assessment (PISA) in 2015 (OECD 2015). Students should be able to use their critical thinking to identify solutions based on specialized knowledge, engage in constructive dialogue, and demonstrate leadership and conflict management abilities while considering the cultural specificity of their counterparts.

Thus, we considered that competence of global negotiation is composed of three sets of learning items corresponding to Knowledge, Skills and Attitudes that have to be achieved by students through educational activities. These three sets of items, which can be seen in the following image, are tentatively arranged on three levels from high school to the postgraduate

level and also based on the estimated difficulty to achieve them (with those more difficult to achieve at the base).

Level I: A set of items ideally acquired at the level of secondary education before entering a university.
Level II: A set of items needed to be trained/acquired at the Bachelor level before going to graduate schools.
Level III: A set of items needed to be trained/acquired at the graduate level (Master and PhD).

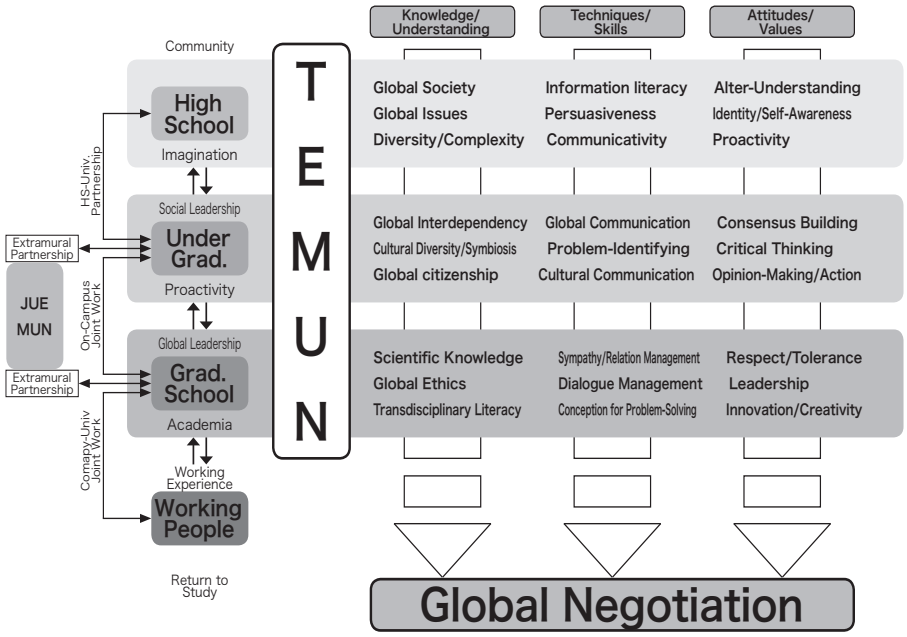

Figure 1: Pedagogic Schema of Global Negotiation Competence and TEMUN (Kida, 2014)

According to the Pedagogical schema, it is expected that all university students joining these programs have already acquired the basic level of Knowledge, Skills and Attitudes during high-school and that after taking part in the TEMUN, they will have developed the second level, which opens the path to the third level to be acquired when they will be graduate students of the program in which they are enrolled.

From the Pedagogical schema, which constitutes a conceptual framework of educational activities of MUN, we fix four educational principles in the way of teaching.

- **Content-Based Learning,** aiming to provide knowledge of a specific topic (usually concerning the agenda and the United Nations);
- **Problem-Based Learning (PBL),** aiming to encourage students to identify problems and to find solutions, even tentative;
- **Skill-Based Training,** targeting various skills needed for good communication and smooth interactions (discourse domains, written discourse script, presentation skills, negotiation framework, message delivery, PR, persuasiveness, dialogue/relation management, etc.)
- **Attitudes-Based Training,** aiming to increase cross-cultural awareness, tolerance, mutual understanding, respect, conflict management, leadership, etc.

The preparatory course and activities of the conference were organized following these principles, and we shall describe their concrete content. The format of TEMUN included two main parts: an in-class workshop for training (i.e. preparatory course) and a two- or three-day conference following the workshop. Preparatory course consisted in an intensive training of about 15 hours in which students were trained in expressions, procedures and rules typically used at a real conference of the United Nations.

The content of the preparatory course was divided into ten topics (as seen below), each of them alternating explanations and examples provided by the instructors with interactive activities and in-group discussions.

(1) Agenda and its subtopics.
(2) Mechanisms of Group Discussion: Students are divided into groups (Regional Blocs and Committees) to see if there are common points and divergences about the agenda and subtopics in each group.
(3) Introduction to the UN-type Conference: a) roles of a Regional Bloc; b) roles of a Committee; c) roles of a Delegate
(4) Rules of Procedure and Formulaic Expressions related to: a) roll-call; b) setting a time limit on speeches; c) formal debate; d) suspending the meeting e) informal debates: moderated and un-moderated debates (caucusing)
(5) Introduction to the UN-type Speeches and Debates: a) position speech; b) un-moderated debate in Regional Bloc; c) un-moderated debate in Committees; d) moderated debate
(6) Debates outcomes: a) Position Papers; b) Working Papers; c) developing a negotiation strategy
(7) Collaborative process towards the final vote and closing procedure: a) formal and informal debates on working papers; b) introducing and debating a Draft Resolution; c) closing the Speaker's List; d) voting procedures on Amendments and Draft Resolutions; e) adjourning the meeting
(8) Strategy for consensus building: writing and introducing Draft Resolutions and Amendments.
(9-10) Questions and Answers; Rehearsal 1&2.

After finishing the preparatory course the students put in practice what they have learned during a two-day conference, which was recorded and monitored by instructors (faculty advisors). If during the preparatory course, the instructors play an important role in introducing the terminology and procedures, in contrast, they had a limited role during the conference, discretely acting as supervisor, which led to an increased autonomy of the students. The conference includes an information session, which is a lecture delivered by United Nations experts and foreign diplomats, or a round table about a topic related to the agenda of the conference.

During the conference, students are engaged in a multidimensional process of learning, encompassing four dimensions:
1) assimilation of learnt knowledge and skills;
2) analysis and understanding of new information coming from other participants;
3) delivering a speech in front of a large audience and collective elaboration and production of a written text (i.e. working paper, draft resolution);
4) interactions and adaptation in which they have to readjust their reaction based on a changing environment between different types of sessions.

The outcomes of students' activities, which can be seen in the following figure, are collected by the instructors and used for analysis and evaluation.

Activity	Skills	Oral/Written Outcomes
Before conference (Research)	Information literacy Data collection and analysis Reading &Written discourse, Synthesis	Position Paper
During the conference (simulation)		
Delegate speech (Formal debate)	Presentation skill	Speech/memo
Unmoderate caucusing - regional bloc - committee	Debate, communication Mutual understanding Synthesis Consensus building Collaborative writing	Speech/ Working Paper
Moderate caucusing	Critical thinking Public interaction	
Amendment	Persuasion	Draft Resolution
Vote	Decision-making	Resolution

Figure 2: Activities and outcomes during the conference

Academic Profile of Students

Regarding the academic profile of participant students, TEMUN had three particular features when compared with other MUNs organized in Japan (Kida & Smith, 2019). The first is related to the joint participation of undergraduate and graduate students in both, preparatory training and the conference. During the seven editions of the TEMUN conference, more than half of the participants were undergraduate students, representing 60.6% (average for seven years). The graduate participants percentage varied from one edition to another, between 20% and 46% (in the 4th and 5th editions), but it never went lower than 20%. The average participation of international students for seven years was 37.7%. The number of participants per year (1 corresponding to 2012 and 7 corresponding to 2018) classified based on their academic level can be observed in Figure 3. This joint participation offered undergraduate students the opportunity to engage in interactions from which they could learn advanced knowledge. In turn, for graduate students it was valuable occasion to exercise different skills, ranging from leadership, team management and conflict resolution. "Others" participants were represented by students coming from neighbouring high schools. Such participation was allowed and encouraged in TEMUN, but it occurred only irregularly due to the additional tasks related to coordination and preparation with the schools interested in dispatching their students.

	1	2	3	4	5	6	7	Total
Undergraduates	25	22	43	30	44	64	83	311 (57.3%)
Graduates	18	16	26	31	36	23	19	169 (37.7%)
Others	0	0	0	6	0	14	0	20 (0.5%)
TOTAL	43	38	69	67	80	101	102	500

Figure 3. Participants classified based on their academic level

The second feature is related to the significant presence of international students taking part in the preparatory course and conference along with the Japanese students. During the seven editions of the TEMUN conference, the international students represented 63.8% (average for

seven years). The number of international and Japanese participants per year can be observed in Figure 4. Such a high rate is a common characteristic in MUN conferences, but in the Japanese context is relatively rare. For instance, the international participation rate does not exceed 30% in the first seven editions of JUEMUN (Japan University English Model United Nations) held during 2010-2016 (Kida & Parepa, 2019). In addition, within this framework, international and Japanese students not only work together during the final conference but also during the preparatory course. Therefore they had to perform in-class training within a team composed of members with different religions, ethnic backgrounds and languages. This aspect allowed for real intercultural interactions and facilitated a growing intercultural awareness.

	1	2	3	4	5	6	7	Total
International	27 (62.8%)	19 (50.0%)	31 (47.0%)	49 (72.3%)	59 (73.8%)	70 (69.3%)	69 (61.6%)	316 (63.8%)
Japanese	16 (37.2%)	19 (50.0%)	35 (53.0%)	18 (27.7%)	21 (26.3%)	31 (30.7%)	41 (38.4%)	182 (36.2%)
TOTAL	43	38	69	67	80	101	112	505

Figure 4. International and Japanese participants

The third feature is related to student's academic background in terms of their major. More than half of the participants were from Humanities and Social Sciences (HSS), representing close to two-thirds of all participants (63.6%). Social Sciences students represented a high proportion (60% of all HSS students). The significant characteristic of TEMUN is the presence of STEM (science, technology, engineering, and mathematics) students representing around one-fourth of all participants (around 26.9%). The percentage of students with multidisciplinary backgrounds (such as global issues) is relatively low and varies depending on editions. It reached a higher level in the last two editions, respectively 15.8% and 16.1%. The number of participants classified based on their major can be consulted in Figure 5.

		1	2	3	4	5	6	7	Total
HSS		38 88.4%	31 81.6%	41 62.1%	37 56.9%	46 57.4%	58 57.4%	70 62.5%	321 63.6%
	Humanities	19	9	14	22	16	16	29	125
	Social Sciences	19	22	27	15	30	42	41	196
STEM		4 9.3%	6 15.8%	15 22.7%	26 40.0%	34 42.5%	27 26.7%	24 21.4%	136 26.9%
	Life & Environmental	2	3	8	16	21	17	13	80
	Engineering & Technology	1	2	5	8	7	5	10	38
	Medical & Sports	1	1	2	2	6	5	1	18
Others	Multidisciplinary	1	1	10 15.2%	2	0	16 15.8%	18 16.1%	48 9.5%
TOTAL		43	38	69	67	80	101	112	505

Figure 5. Participants classified based on their major

This particularity provided students with a valuable occasion to experience trans-disciplinary collaboration. The students have shared or tested their knowledge and skills related to their major. For example, business negotiation students could use negotiation skills by engaging students in social sciences and STEM; those in policy studies could share and apply their knowledge about the decision-making process. In contrast, STEM students could develop concrete solutions to problems included in the conference agenda based on the knowledge related to their major (e.g. agriculture, health, etc.)

Therefore, the TEMUN format offered participants an environment, which was multicultural and multidisciplinary in crossing academic levels and reflecting a certain social and academic diversity. Students were able to engage in trans-disciplinary and cross-cultural dialogues in collaborative problem solving and consensus-building. After undergoing necessary training, students become aware of the complexity and difficulty resulting from various differences, aspects emulating at least partially the reality of a global and multicultural society.

Students' expectations and perceptions: preliminary results

In order to understand what are the participants' perceived needs and interests in specific knowledge, skills and attitudes to be acquired and developed, we submitted surveys to graduate and undergraduate students who took part in the preparatory course. The surveys were submitted twice, before participating in the conference (pre-event survey) and after their participation in the TEMUN conference (post-event survey).

The pre-event survey seeks to understand students' expectations. Preliminary findings of the survey of nineteen participants have been already presented in a previous paper (Kida & Smith, 2019), and are summarized below. The students are provided with the above-mentioned 27 items of Pedagogic Schema of Global Negotiation Competence. They are asked to select five items and to arrange them according to their interest, indicating which kind of knowledge, skills or attitudes they are keen to improve in taking part in the event. Here, students are not explained in which academic level an item is expected to be learned or acquired. For the current paper, we show only the finding concerning a difference of expectations between graduate and undergraduate (for other types of differences, such as HSS vs. STEM as well as Japanese vs. international students, the analysis will be done in the future).

The analysis shows that the graduate participants attach almost equal importance to three sets of items (Knowledge/Understanding = 31%; Techniques/Skills = 34%; Attitudes/Values = 35%). More precisely, graduate students indicate that they wish to improve Critical Thinking, know more about Global Issues, and acquire Dialogue Management and Problem-Solving skills, followed by the understanding of Cultural Diversity and Social Inclusiveness. They seem to be less interested in achieving knowledge of Trans-disciplinary Literacy, Information Literacy, and Relation Management-related skill, which are supposed to be learned at the primary academic level. In addition, knowledge, such as Global Citizenship and Cultural Communication, which are supposed to be learned at the intermediary academic level, scored relatively low in their answers. Also, the value of Identity/Self-awareness is less represented, probably because students consider it an already achieved item at a primary academic level.

Undergraduate students show higher expectations to learn skill-based items (43%) more than Knowledge items (31%) and Values items, which are the least represented in their answers (28%). Although all undergraduate students indicate their keen interest in Skill-based items, their choices appear very different and variable from one student to another depending on their different perceived needs. A representation of undergraduate/graduate expectations can be found in Figure 6.

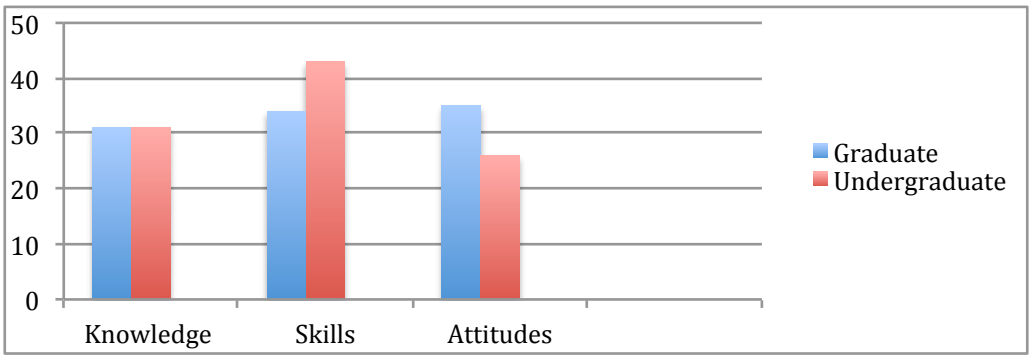

Figure 6. Pre-event expectations of undergraduate/graduate students

From the pre-event survey, we can infer that if graduate students answers indicate a similar tendency, their choice might be influenced by the contemporary trends of higher education. In fact, Critical Thinking or Global Issues are new notions that recently appeared in many universities curricula in different disciplines. In their turn, undergraduate participants, advancing in an early stage of their student career, are concerned more by acquiring concrete academic skills and techniques related to language and communication. According to their answers, they are perceived as necessary to navigate the period of university studies. Therefore, students' expectations move from skill-based and/or communicational items toward more abstract items related to values and knowledge as they advance toward a higher academic level.

The post-event survey seeks to understand students' perceptions about the learning effectiveness of the simulation for developing and acquiring Knowledge, Skills and Attitudes. In the survey, students are asked to answer two types of questions. The first type is related to the self-evaluation of their learning through participation in terms of the 27 items included in the Pedagogical Schema of Global Negotiation. The second type is related to their testimonial based on an open-ended question regarding their impressions after participation in the conference (such as how they improved their skills and/or changed values, which kind of knowledge they acquired). They evaluate own learning outcomes based on 5-scale criteria with five the highest score. In this paper, 114 students' answers are analyzed. Here, our preliminary analysis highlights differences between undergraduate (BA) and graduate (MD, master and doctor) students on the one hand and between three types of majors, specifically STEM, HSS and Multidisciplinary, on the other hand.

When examining the results based on the academic level of the participants, undergraduate students evaluate skill-based items higher than graduate students, as congruent to their expectations before the event. Unexpectedly, they considered positive outcomes in their knowledge of Global Society, Global Issues, Diversity, which differed from their expectations.

Almost all types of students positively evaluate knowledge of Global Society, Global Issues, Diversity. In contrast, it turns out that Scientific Knowledge, Leadership, Innovation/Creativity scored lower in almost all answers coming from different types of participants, suggesting that these items are considered challenging to achieve. In fact, Leadership or Creativity may be items that require extended time and various experiences in doing highly complex metacognitive operations. These items are probably difficult to learn through MUN participation, which is too short to acquire them.

As for a difference in majors, HSS students consider that they achieve better results on improving their skill-based items. Their results are higher compared to the STEM students, probably thanks to their content-related knowledge obtained in other classes of their majors (especially in social sciences). Concerning students of multidisciplinary major, who are undergraduate too, they show a specific result. First, their learning outcome about Global Issues is the highest among all students, as it is their own major. Moreover, they show a high evaluation of all Skill-based items and Attitude-based items. They consider that the simulation facilitated the achievement of attitude-based items such as Proactivity and Consensus-Building. These aspects suggest that students of multidisciplinary majors are more motivated and ready to acquire values and attitudes beyond skills and knowledge than mere undergraduate students, as they are typically learning about global issues in their regular curriculum.

Lastly, in comparing Japanese and international students, the formers tend to evaluate relatively low various items in Skills/Techniques and Attitudes/Values, suggesting that they lack confidence in their communicative competence. In addition, they see little learning outcomes in many Knowledge-based items, which are evaluated lowest by Japanese students.

A detailed view on the results of self-evaluations classified based on three criteria, academic level, Japanese/International students, the academic major can be observed in Figures 7a, 7b and 7c.

	Knowledge/Understanding								
	Global society	Global issues	Diversity	Globa interde.	Cultural D.	Global citizen.	Scientific K.	Global ethics	Transdiscip. L.
Overall	4.25	4.35	4.24	4.08	4.26	4.09	3.18	3.84	3.86
BA	4.43	4.42	4.40	4.19	4.42	4.27	3.35	4.04	3.98
MD	4.13	4.31	4.12	4.00	4.14	3.95	3.05	3.70	3.77
STEM	4.22	4.27	4.22	3.98	4.22	4.12	3.23	3.85	3.84
HSS	4.34	4.40	4.24	4.22	4.31	4.09	3.09	3.80	3.89
Multi	4.00	4.67	4.33	4.00	4.22	3.89	3.22	4.00	3.78
JP	4.28	4.08	4.00	3.68	4.08	3.84	3.00	3.44	3.92
Intl	4.23	4.36	4.22	4.01	4.23	4.03	3.16	3.80	3.86

Figure 7a: Students' perceptions post-event regarding Knowledge

	Skills/Techniques								
	Info Literacy	Persuasive	Communicativ	Global com.	Pb-identifying	Cultural com.	Sympathy/Rel	Dialogue man	Pb-solving
Overall	3.93	3.79	3.96	4.10	4.05	3.96	3.81	3.88	3.95
BA	4.10	4.00	4.17	4.35	4.23	4.04	4.02	4.10	4.19
MD	3.80	3.63	3.80	3.91	3.92	3.91	3.66	3.72	3.77
STEM	3.88	3.71	3.91	4.05	3.92	3.78	3.84	3.68	3.84
HSS	3.98	3.80	3.98	4.16	4.18	4.13	3.73	4.07	4.02
Multi	4.00	4.22	4.11	4.11	4.33	4.33	4.00	4.33	4.22
JP	3.76	2.92	3.36	3.80	3.56	3.12	3.52	3.24	3.32
Intl	3.92	3.71	3.89	4.06	4.02	3.89	3.80	3.86	3.89

Figure 7b: Students' perceptions post-event regarding Skills

	Attitudes/Values								
	Alter-understa	Self-awarenes	Proactivity	Consensus-B.	Critical think.	Opinion-makir	Respect/Toler	Leadership	Innova/Creat.
Overall	3.99	4.03	3.92	3.89	3.90	3.97	4.16	3.46	3.55
BA	4.23	4.29	4.35	4.38	4.21	4.33	4.33	3.73	3.81
MD	3.81	3.83	3.59	3.53	3.67	3.70	4.03	3.26	3.36
STEM	3.96	3.96	3.84	3.79	3.84	3.86	4.22	3.33	3.45
HSS	4.02	4.04	3.91	3.89	3.91	4.02	4.07	3.49	3.58
Multi	4.00	4.33	4.44	4.56	4.22	4.44	4.22	4.11	4.11
JP	3.92	3.72	3.36	3.60	3.24	3.40	3.96	2.32	2.64
Intl	3.99	4.03	3.92	3.96	3.85	3.96	4.14	3.37	3.49

Figure 7c: Students' perceptions post-event regarding Attitudes

Conclusion

From the moment of its introduction in Japan, MUN has started to play a significant role in the educational scene of higher education, in much need of internationalization in this globalized world. Initially, the MUN was used to help brush up Japanese students' language proficiency and communicative competence, and sometimes just as a kind of "speech contest" with a criterion of CAF (complexity, accuracy, fluency) of English. Nowadays, going beyond such a competition model or an erroneous understanding of "negotiation", MUN has put on a new look in trend featured by the concept of collaborative problem-solving, promoted by PISA in 2015. It becomes a powerful tool to foster students' more profound understanding of the diversity and complexity inherent to this world. This paper briefly introduced our experiences regarding a pilot project using MUN simulation to teach global negotiation. At the current moment where various new multidisciplinary and breakthrough programs based on innovation and creativity are being implemented, we define the notion of Global Negotiation as encompassing multiple sets of transferable skills and knowledge without forgetting attitudes and value-based items. Through the preliminary interpretation of the answers provided by the students who took part in preparatory courses and events within the TEMUN framework, we attempt to understand students' expectations and perceptions about the items encompassed in the Global Negotiation Competence. The findings of our analysis have suggested that knowledge of content, negotiation skills and attitudes-values of the students are interdependent. Nevertheless, these preliminary findings raise new questions opening a new research path: How is it possible to assess Global Negotiation Competence and some concrete criteria for such evaluation? Which learning environment or teaching methods better facilitate students' achievement of such competence? These questions will be our challenges for future study.

Acknowledgments

This research is supported by Japan Society for Promotion of Science KAKENHI Grant Number 18H00684.

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ICT in the Japanese Language Learning: Is That What Students Really Want?

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
In the last decade, one can witness the process when Information and Communications Technology (ICT) has been actively used in various fields of professional activity, including education. The COVID-19 pandemic set up new standards for educational system, where distance learning has become the reality that both teachers and students have to get used to. This research aims at assessing the effectiveness of online learning format in studying a foreign language, focused on studying the Japanese language at the University. Japanese requires a specific approach to developing learning and teaching methods. It is traditionally recommended to study the language in a form of various aspects. However, due to new realities, students often have nothing to do but to study some specialized aspects (the Japanese media, fiction, historical text etc.) by themselves, what seems to be almost impossible without getting practical recommendations from teachers. In this regard, a survey was conducted among the Japanese language learners, that was aimed at identifying the advantages and disadvantages of studying Japanese using ICT in comparison with traditional forms of in-class learning. The results show that despite the great number of online learning platforms providing typical options for learning basic grammar and character writing rules, there are practically no programs for training some specialized subjects in Japanese. Therefore, it seems extremely important to assess the students' views and needs in order to work out a new well-balanced methodology for teaching Japanese, based on the comprehensive use of both traditional learning and innovative one using ICT.

Keywords: ICT, Traditional Teaching Methods, Student Survey

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Introduction

The use of the Internet and Web-technologies has become an important aspect in teaching and learning over the past decade. It is true that such tendency encourages teachers to reconsider the existing traditional forms of education and find new approaches to teaching methods in accordance with the new requirements of educational system. Some educators note that ICT "have enabled the teaching community to redefine some of the strategies and concepts of teaching and learning. This has been done in terms of enriching classroom activities, reorganizing course structures, and providing learners with more autonomous as well as more learner-centered opportunities for learning" (Klimova, 2012).

This is equally true of the foreign languages and, in particular, oriental languages learning. However, in the latter case, it is rather hard to assume that ICT enabled learning might completely replace the traditional one, since the study of the Japanese language, in this case, requires a comprehensive approach, including the study of socio-cultural realities of the country.

Methodology and Findings

The problem of the methodology of teaching a foreign language considering the realities of "blended learning" is very important and actual. Traditionally the course on the Japanese language at the Department of Japanese studies at Saint Petersburg University is divided into several aspects such as: "Japanese writing", "Japanese Grammar", "Spoken language", "The Japanese media", "Translation of Japanese Fiction", "Historical and Modern Historical Text" etc. They are developed to acquire translation and interpreting skills, as well as skills of writing a research paper or working with documents etc. (Lelenkova, 2019). Moreover, learning the language in the form of different aspects enables students to acquire the skills that can be applied in various fields of professional activity: research, education, diplomacy, translation, business, art and cultural activities etc. (Lelenkova, 2018).

However, with the beginning of the Covid-19 pandemic, distance learning has become the preferable one, where ICT began to play a pivotal role in educational process. In the case of learning the Japanese language at the professional level it is rather hard for both teachers and students to take a comprehensive approach with a focus on studying the language in a form of aspects mentioned above.

Therefore, it is significant to take into account the opinions and needs of the students themselves, for it helps to develop and improve the existing teaching and learning methods as well as figure out the new ones according to current realities.

In this regard, a survey was conducted among the students of the 1-4th year of the Bachelor Program at the Department of Japanese Studies at Saint Petersburg University. The main purpose of the survey is to understand how students themselves assess advantages and disadvantages of studying Japanese in the e-Learning and in-class learning forms respectively.

Respondents were offered to answer the following 3 questions:
Q1. Have you ever used any online applications or programs for studying Japanese? If yes, then give some examples and explain the form of study they offer.

Q2. What are the main advantages and disadvantages of learning the Japanese language using ICT (online platforms, blogs etc.) in comparison with traditional forms of education?

Q3. What points are still relevant and useful in the traditional form of teaching the Japanese language? What points are survivals?

It is true, that the pandemic has given impetus to the development of online courses, which are now being created not just in a form of recording a lecture by a teacher, but represent vividly modern trends in relevant fields of education. In recent times, a number of specialized online platforms have been worked out which are aimed at effective learning of vocabulary and grammar rules.

Giving answers to the first question the respondents pointed out a number of online learning applications and sites which are especially popular among learners of Japanese. They are the following:

- Quizlet
- Duolingo
- Omoshiroi-nihongo.com
- Japanese-words.org.
- Jisho.org
- Bunpro.jp
- Memrise.com, etc.

In short, these online-programs allow to learn and memorize words and Japanese characters in the form of simple tasks using the Spaced Repetition system. Some of them also explain basic grammar rules and grammatical structures using specific examples. Learners are also offered to make a number of test tasks, such as filling the gaps with an appropriate word, character(s), phrase or grammatical structure, listening and comprehension test, making sentence translation from or into Japanese etc. Some of applications are aimed at the Japanese character learning and its writing practice only.

Moreover, such Japanese learning site as “Memrise.com” allows to submit one’s own learning courses, lessons, based on lexical and grammatical material that has been already studied. Thus, it helps not only to repeat the material, but also to check one’s own knowledge and correct mistakes if there are any.

There are also some online learning programs aimed at learning and training more specialized subjects in Japanese, such as the Japanese Media. Here such application as “NHK Easy Japanese News” is worth to be mentioned. It allows to read newspaper articles using a pre-compiled vocabulary list. It also has such an option like the use of an automatic built-in dictionary and some others. Learners have also an opportunity to share their own translations of the whole article or paragraphs with other users. There is also an option to make your own glossaries, lists of words and expressions to remember, etc. Such application enables to read a large amount of materials in a short time. However, it should be noted that having a regular opportunity to check the meaning of words or grammatical structures does not always result in memorizing and using them properly.

The results of the answers to the Question 2 (“What are the main advantages and disadvantages of learning the Japanese language using ICT in comparison with traditional forms of education?”) showed that **advantages** might be following:

- easy access to study materials;
- individual pace, time and place of studying (students are able to choose in what, when, where and how to study);
- opportunity of using websites or online platforms, where certain grammar rules and expressions are explained;
- opportunity of using various methods for memorizing (Spaced Repetition system, etc.);
- chance to check the correctness of answers;
- chance to submit new task options;
- training listening skills;
- more opportunities for communication with native speakers or people who learn the same language using social network, discussion tools etc.;
- opportunity for pronunciation training in one's own time;
- opportunity to read online various news and research articles in Japanese.

On the other hand, some **disadvantages** might contradict with the statements mentioned above:

- problems with technology;
- online learning programs contain test tasks that allow to practice basic skills, but do not provide the necessary cultural context and examples of their use in specific situations;
- a large number of online resources providing an incorrect information;
- a lack of useful textbooks;
- a lack of personal contact, group work and discussion;
- not having an opportunity to see the proper writing rules for Japanese characters as well as to practice its writing;
- loss of motivation to memorize vocabulary, etc. due to fast and easy access to online dictionaries;
- lower motivation to study;
- loss of communication and social skills;
- distance learning might lead to a loss of interest and involvement in the educational process.

As for the results of the Question 3 ("What points are still relevant and useful in the traditional form of teaching the Japanese language? What points are survivals?") the answers can be classified as follows:

Relevance:

- academic environment and continuity of teaching traditions;
- dividing the Japanese language learning course into various aspects (grammar, writing, spoken language, the Japanese media, historical text, reading the Japanese fiction, etc.);
- in-class learning and personal contact with a teacher: live communication with a native speaker, working with audio / video materials and training translation skills with the teacher's assistance, etc.;
- group discussion of problems on different topics in Japanese;
- online applications do not provide options for studying more specialized aspects, such as, translation in different fields (fiction, official document, media, research papers, etc.);
- priority for the traditional methods of teaching the Japanese languages, since its study is closely related to the knowledge of history and ancient traditions, culture and mentality of the people.

Survivals:

- use of a lot of printed and sometimes outdated study materials;
- teachers' distrust of online dictionaries;
- new lexical material or grammatical structures are sometimes taught apart from context use in sentences;
- lack of listening and comprehension exercises with the use of already studied grammar and vocabulary.

Discussion

The results of the survey show that despite the great number of online learning platforms providing typical options for learning basic grammar structures and character writing rules, there are still very few programs for training some specialized subjects in Japanese that were mentioned above.

Moreover, it should be noted that the use of online applications and educational platforms is focused on individual learning. On the one hand, it is convenient, as students are able to repeat difficult topics as many times as they need. On the other hand, there might be a risk of "getting stuck" at the same level, as it is hard to estimate your own language learning progress in comparison with other students learning results. It is necessary to be extremely focused and self-disciplined so as not to get distracted while using online platforms.

Another problem is that the full versions of the most of online applications are fee-based. If one has not an opportunity to pay for it, the most part of useful options remains unavailable, what makes it difficult to study the language comprehensively. Thus, despite the undoubted advantages of using ICT in learning the Japanese, i.e. convenience and ease of use, fast access to the necessary information, etc., there are still a lot of disadvantages, such as it is not always possible to write characters or to discuss a topic, estimate objectively one's own language learning results, etc.

Therefore, taking into consideration the discussion above one should not ignore the significance of traditional and well-proven methods of in-class teaching and learning.

The case is that, for learners it is almost impossible to study specialized aspects of the Japanese language on their own, as there is a large number of specialized terminology, phrases or expressions, grammatical structures etc. that requires additional explanations and assistance in order to understand their meaning and use them correctly in translation. Here, it is the task of a teacher to work out the proper methods of language skill training for learners.

It is worth mentioning such forms of training as compiling thematic glossaries, identifying and memorizing specialized terminology focusing attention to the specific situations they are used, carrying out vocabulary tests (writing dictations, etc.), definition of grammatical structures and its context usage in sentences, etc. It is obvious that the ability to make a correct and high-quality translation has never lost its relevance.

In addition, learning just the language is not enough for building an intercultural dialogue between nations. It is also the task of lecturers to encourage learners to study geography, history, including the current political and economic situation, culture and ethnography, as well as customs and specifics of daily life of the people. Such form of studying seems to be of high

importance in order to get familiar with and understand the socio-cultural characteristics of the people of other countries, that is especially true for the Japanese people (Lelenkova, 2019).

Conclusion

It is obvious that nowadays Information and Communications Technologies have become an integral part of the educational process. However, despite their wide usage and popularity among both students and teachers, the tradition of in-class learning still remains the basis on which the academic education system was created. Although we are witnessing the formation of a new type of "blended learning", it is still difficult to give an objective assessment to its purposes and advantages. On the one hand, a lot of useful online applications and programs are being created with the use of effective methods of learning the Japanese language. On the other hand, one can notice a slowdown in the intellectual development in general, since learners mostly rely on online tool options rather than use their brains potential. It might lead to the loss of the ability to communicate, translate or interpreter from or into a foreign language, do some researches and so on. For example, working on translating from and into the Japanese language requires a comprehensive use of various skills and knowledge. Therefore, it is extremely important to assess the students' needs in order to preserve and improve the existing traditional methods of teaching, while not ignoring the innovative ones with the use of ICT.

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Whitewashed Tombs: Emergency Online Learning Through the Experiences of Students with Disabilities at a Rural South African University

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The Barcelona Conference on Education 2021
Official Conference Proceedings

Abstract
The COVID-19 pandemic has induced an enormous effect on educational institutions globally. Rural institutions are at a greater disadvantage when compared to their urban counterparts which are better resourced with systems that enable the shift to emergency online learning. Challenges were particularly compounded for students with disabilities who appear to have been alienated from these rushed attempts at rescuing the academic project in South African institutions. As such, this paper employed a qualitative research approach to examine the challenges faced by students with disabilities at a rural university in South Africa in the wake of the COVID-19 pandemic. The study employed an online survey to elicit their experiences and challenges concerning learning during the COVID-19 pandemic. The findings of the study revealed that although pregnant with promise, emergency online learning has failed to deliver inclusive education for students with disabilities. Based on the findings, it was recommended among other things that educators be trained on how to facilitate learning with technological interfaces which might be unfamiliar to them, especially those that are utilized by students with disabilities for online learning.

Keywords: COVID-19, Disability, Inclusive Education, Emergency Online Learning, Higher Education

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Introduction

With the onset of the COVID-19 pandemic came the realisation that there was an urgent need to make an abrupt adoption of online learning at most higher education institutions in South Africa. Because this transition was abrupt, there have been many questions that have been asked with regards to whether emergency online learning can be regarded as the panacea to the COVID-19-induced learning disruptions (Mncube, Mutongoza, & Olawale, 2021; Dube, 2020). Protagonists of this rushed online learning argued that it was the only conceivable way out of the unanticipated disruptions which caught most institutions off-guard, while antagonists fixated on how this mode of learning was irregular and that it widened inequalities that were already extant in the global education system (Dube, 2020; Muhuro & Kang'ethe, 2021).

Before the onset of the pandemic, South Africa was already in an unenviable position as one of the most unequal countries globally. The onset of the pandemic further skewed the inequalities that already existed (Dube, 2020). Access to some essential goods and services was already titled in favour of the more affluent urbanites while the rural and township poor nursed the brunt of poverty. The prospects of emergency online learning in South Africa's poor communities diminish significantly when they are paralleled to the evidence available. Studies reveal that as of 2020, access to the internet was limited to some social groups – in fact, access to internet-enabled devices remains low in poor rural communities (Omodan, 2020; Dube, 2020). This is further exacerbated by factors such as the exorbitant costs of the internet, poor connectivity in far-flung rural areas, and frequent load shedding of electricity, all of which pose serious threats to online teaching and learning (Mncube et al., 2021).

The rushed adoption of emergency online learning also meant that there was no due regard for some unique individual needs. Traditional classrooms at universities in South Africa had already begun to make strides concerning inclusiveness yet the onset of the pandemic meant that new systems of learning had to be tested on the go (Zongozzi, 2020; Mutongoza, 2021). This resulted in the new normal of classrooms being more inaccessible for students (Daniel, 2020; Hove & Dube, 2021). Granted, some urban institutions of learning had already begun to make inroads into hybrid learning systems – thus their transition was easier and more accessible to most students. In the rural setting, most institutions there had to think of delivering learning from a distance – this had huge implications for inclusivity (Thompson & Copeland, 2020; Dube, 2020). We, therefore, set out to investigate the experiences of students with disabilities (SwDs) in a rural university in South Africa.

Problem Statement

While proponents of online learning laud it as the panacea to the learning disruptions that were occasioned by the COVID-19 pandemic, critics have incessantly questioned the efficacy of its rushed adoption in some universities in the developing world (Zongozzi, 2020). A critical facet that has been questioned has been the inability of this mode of learning, in its rushed adoption to deliver the supreme goal of equitable access (Ngubane-Mokiwa & Zongozzi, 2021; Smith, 2020). Although various legislations such as the Constitution of South Africa, the Equity and Prevention of Unfair Discrimination Act of 2004, and the Convention on the Rights of Persons with Disabilities were enacted and ratified to advance the rights of persons with disabilities, SwDs still lament discrimination and inequality at higher education institutions prior to the COVID-19 pandemic (Ngubane-Mokiwa & Zongozzi, 2021). It is argued that the rushed adoption of emergency online learning as a

solution to the loss of learning time worsened the plight of SwDs in universities (Thompson & Copeland, 2020; Beckmann & Reyneke, 2021; Toseeb, Asbury, Code, Fox, & Deniz, 2020). This was because, in some instances, no due diligence was done in ensuring equitable access (Smith, 2020). After all, institutions were rushing to complete the academic year and had very limited resources which made it difficult for them to navigate the new learning environment (Mncube *et* al., 2021). Against this background, this study sought to investigate how SwDs experienced emergency online learning at a rural university.

Literature Review

During the COVID-19 pandemic, several nations resorted to digital educational tools and virtual exchanges between students and educators, as well as among students, to provide instruction when campuses were closed (Mncube, Olawale, & Connie, 2021). As such, this school closure is argued to have a devastating impact on all students, most especially the most vulnerable ones (Dalton, Rapa, & Stein, 2020). According to Organisation for Economic Co-operation and Development (2020; p.2), students who were mostly affected by the closure of schools and the movement of teaching and learning to an online platform were "children and youth from low-income and single-parent families; immigrant, refugee, ethnic minority and indigenous backgrounds; with diverse gender identities and sexual orientations; and those with special education needs who all suffer by being deprived of physical learning opportunities, social and emotional support available in schools and extra services such as school meals". As such, families who are raising children with special needs face more stressors, on average than those with neurotypical children (Asbury, Fox, Deniz, Code, & Toseeb, 2020).

Following the closure of schools during the COVID-19 lockdown, parents and other caregivers have been in charge of completing the education of learners with disabilities. However, many of these parents and caregivers were ill-equipped to offer appropriate care and education for these children, and they frequently experienced overload and stress (Beckmann & Reyneke, 2021). In addition, parents and caregivers of students with disabilities encountered issues of inaccessibility to technology, as well as the lack of access to the teaching and learning resources proposed by the World Health Organisation (2020). Also, the United Nations Educational, Scientific and Cultural Organization (2020) adds that students with disabilities experience a variety of barriers to education during the COVID-19 pandemic. These challenges include less help and inadequately trained teachers, unavailability of adequate equipment, internet access and specially designed materials and support, as well well the lack of ICT skills and knowledge by the teachers (Mncube, Olawale, & Connie, 2021; Mutongoza, 2021).

As the COVID-19 pandemic continues to spread in many nations throughout the world, how to retain learning amid disruption has become a key concern for the global education sector (Belay, 2020). As a result, there has been a pool of literature on how institutions can be managed during the outbreak of the COVID-19 pandemic (Daniel, 2020; Hove & Dube, 2021; Mncube, Mutongoza, & Olawale, 2021), COVID-19 induced psychosocial impact on students (Shahbaz, Ashraf, Zakar, Fischer, & Zakar, 2021; Ghosh, Dubey, Chatterjee, & Dubey, 2020; Olawale, Mutongoza, Adu, & Omodan, 2021), how psychological effects of the pandemic could be lessened on students with special needs and their families, as well the type of supports families can give to students with special need (Asbury, Fox, Deniz, Code, & Toseeb, 2020; Toseeb, Asbury, Code, Fox, & Deniz, 2020; Yazcayir & Gurgur, 2021). However, there is limited in-depth research in the literature on how students with special

needs in rural institutions who continue their education through inclusive education or who study in different homes through digital platforms maintain distance education during the COVID-19 pandemic. Hence, the study sought to investigate how SwDs experienced emergency online learning at a rural university.

Research Methodology

Underpinned by an interpretivist paradigm, the study employed a qualitative research approach and a case study design. The researchers purposively selected a rural university in South Africa with the expectation that participants would report unique and interesting information regarding the experiences of SwDs. Likewise, purposive sampling techniques were used to select eleven (11) students who are registered with the university's disability unit. Thus, data was gathered using a qualitative online survey administered over a period of three weeks. Ethical issues such as confidentiality, anonymity, and privacy of participants' information were respected - this condition was disclosed and agreed upon before the start of data collection, and the consent of all participants was obtained.

Discussion and Results

This study sought to investigate the experiences of students with disabilities (SwDs) in a rural university in South Africa. As such**,** results and discussions are presented under the following sub-headings:

- Warped Assessment
- Inadequate Assistive technology
- Limited format for learning material

Warped Assessment

Research findings with regards to SwDs' experience of emergency online learning at a rural university revealed that students bemoaned that the assessment technique put in place were exclusionary. Students lamented that there was a lack of consideration in the timing of assessment, no regard for the unique needs for students with disabilities – which resulted in psychosocial challenges for SwDs. An example can be drawn from a participant who stated that,

This online learning thing is not meant for people like us. There's been a lot of discrimination experienced by us with disabilities… how can I with a special need be expected to write an online test on blackboard over a similar time span with my non-disabled peers. They are just setting us up for failure. (Student 4 – with mobility limitations)

A similar ordeal was narrated by a student who lamented,

> *I can really say that the COVID thing has worsened our plight in the community of those with disabilities. The whole thing was rushed, and we were never in the heads of those who crafted policies – our current circumstances show this. It is as if we are fighting a battle that has been lost already. God knows how we are going to complete these degrees we are studying for because, at the end of the day, our funding is tied to how well one performs in class. We are just doomed!* (Student 9 – with visual limitations)

Participants also revealed that the challenges associated with assessment had a bearing on their psychosocial wellbeing. This can be gleaned from the response of a student who posited,

> *I come from a poor family…I am the one who is carrying the hopes of my family. I have done my best since starting this degree, but this pandemic has been overwhelming – we face almost double the challenges faced by students with no disabilities. I constantly worry over tests and assessments because my unique needs are not catered for, no one bothers to ask how we are coping. I am worried about whether I will complete my degree…whether I will lose funding…whether the lecturer will understand my unique challenges.* (Student 1 – with audio limitations)

The above findings reveal that while emergency online learning was implemented to continue teaching and learning during the COVID-19-induced disruptions to schooling, the experiences of SwDs at a rural university in South Africa reveal that there was a lack of consideration for unique needs. Students revealed how their mental health was deteriorating in the wake of emergency online learning owing to the lack of consideration for the needs of minority groups. The argument by Thompson and Copeland (2020) that the plight of SwDs was worsened by the rushed adoption of emergency online learning rings true in this regard. This is especially true in rural and poor communities where students have little to no access to digital resources (Mutongoza, 2021; Smith, 2020). As such, we are of the considered view that to reduce the inequalities extant in education, a good starting point in developing learning platforms would be to include minority groups in the design and implementation stages.

Inadequate Assistive Technologies

The findings of the study also revealed that SwDs at the rural university were left to grapple with the challenge of inadequate assistive technologies. While the university was lauded for providing devices to the generality of students, the lack of consideration of the unique requirements of devices applicable to SwDs was an eyesore. The university was blamed for its inability to source hardware and software tailored to ease the burden on SwDs. A case in point can be drawn from a student who remonstrated,

> *It is not easy being a differently-abled student at this university. We are being made to look like fools – asking you to perform in an environment that pits you up for difficulties. There is a Disability Unit here, but I am now convinced that it is just a farce – to portray the university as inclusive and the like. Non-disabled students were provided with laptops, but we were never considered in those schemes. Yes, they painted the scheme as a scheme for students to access laptops from the university, but in reality, how can one be provided with a laptop that doesn't account for their unique needs? Of what use is that laptop? So, in the end, it is just the university providing for non-disabled students, not all students.* (Student 7 – with visual limitations)

Students further corroborated these sentiments by revealing that the university was also solely relying on software tailored for non-disabled students. This was aptly denoted by a student who articulated,

> *We are running an unfair race here. Equal access to education was thrown out of the window when this new abnormal came. It is abnormal that you want someone to participate on an unequal ground…when you check the platforms that have been adopted, there is almost nothing for some of us – even when options are available, we have lecturers who don't care to utilize them, or perhaps they have just not been taught about such platforms. This is very unfortunate, we are in the 21st century and we still have problems like this.* (Student 11 – with speech limitations)

Similarly, a student with a learning disability concurred,

> *There is very little that I can do on the current platform. I have been falling behind in my assignments and tests because everything is just going too fast. I feel like there is no consideration for my learning needs… although we submitted to our Head of School for special assistance, but we have received none so far.* (Student 3 – with learning difficulties)

The findings above reveal that emergency online learning experience of SwDs has been compounded by inadequate assistive technologies. While the university tries to accommodate SwDs, the lived experiences revealed that efforts have been inadequate. To this end, one can consider the view of Ngubane-Mokiwa and Zongozzi (2021) who argue that access without appropriate support is a false opportunity. While Thompson and Copeland (2020) posit that some learning platforms provide additional features to improve accessibility, the experiences of SwDs at this rural university revealed that there was no due consideration given to training such students. Perhaps Zongozzi (2020) was right in arguing that when assessing the problem of inaccessible learning material for SwDs, lecturers attitude needs to be taken into account.

Limited Format for Learning Material

SwDs also decried the format in which learning material is presented which was found to be very problematic. For instance, a participant zoned in,

> *I have not been able to study the majority of notes that has been sent for my modules because of my learning needs. The materials that I have been able to access has to be translated into Braille at my own cost, the university has not helped in this regard. So, when you talk about inclusive education, it is for the non-disabled students and not us (*Student 10 – with visual limitations)

Participants corroborated the above findings by stating that the university had not done enough to ensure inclusivity especially for students that require an interpreter. A student with speech and hearing limitations mentioned that,

> *As a student living with speech and hearing disabilities, I rely on sign language for communication. The introduction of the sudden online learning left us isolated without any assistance in terms of an interpreter. At some point, I wanted to quit my degree, but I was lucky to have family members who helped me with the translation of some of the learning content. It is a miracle that I am still enrolled.* (Student 2 – with speech and hearing limitations)

In addition, a student who believed that there is a chronic lack of capacity to support SwDs posited that,

> *As a student leader in the community of students with disabilities, we have been trying to lobby the university to consider students uniqueness. There is a challenge when it comes to online learning, we learn through online lectures and materials are made available in PDFs and PowerPoints. This format is challenging as it is not suitable for students like myself who use screen readers or voice options.* (Student 8 – with visual limitation).

Research findings revealed that during the COVID-19 pandemic, the teaching and learning at the rural university mainly cartered for students with no disabilities. As such, there were no specific measures that relate to SwDs in terms of learning materials that can assist students with different forms of learning disabilities. This finding corroborates that of Zongozzi

(2020) who concludes that during the outbreak of the COVID-19 pandemic, students with different disabilities were unable to access learning materials in accessible formats, thus excluding them from online teaching and learning. Furthermore, studies revealed that SwDs often report worries about the transition to online learning with regards to receiving poorer grades, inability to meet academic requirements, and course admission (Beckmann & Reyneke, 2021; Clark, Callam, Paul, Stoltzfus, & Turner, 2020). A similar study by Ngubane-Mokiwa and Zongozzi (2021) revealed that SwDs criticised online learning because in most cases, lecturers did not give due consideration to students diversity.

Conclusion

This paper endeavoured to investigate the experiences of SwDs in a rural South African University in the wake of the COVID-19 pandemic. Our findings revealed that although pregnant with promise, emergency online learning has failed to deliver inclusive education. This is a result of warped assessment models which fails to cater for the unique needs of SwDs, inadequate assistive technologies and limited format for learning materials. While our study is limited in terms of size coverage, we recommend that to ensure educational inclusion, educators and SwDs must be at the core of plans for prototypes of inclusive education – this will ensure equitable access to technological resources. We further concede that the future of education will be a digital one as has been demonstrated by the onset of the COVID-19 pandemic. To this end, we recommend that educators be trained on how to facilitate learning with technological interfaces which might be unfamiliar to them, especially those that are utilized by SwDs for online learning.

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