USING ED-TECH TOOLS TO SUPPORT MATHEMATICS TEACHING AND LEARNING FOR SECOND LANGUAGE LEARNERS

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Abstract: The number of refugees and immigrants has seen a dramatic rise in the last decade. It is not surprising that the implementation of an integrated 21st-century education has raised many challenges for teaching and learning of mathematics in a non-native classroom. Therefore, the objective of this study is to investigate the challenges non-native students might have while gaining 21st-century skills in math class. It also attempts to demonstrate that technology can facilitate math teaching and learning, especially where language is a burden and help students and teachers overcome challenges they face in the class. Digital tools provide 24/7 access to material for students in many different languages and consider all types of learners. It also provides the opportunity to teach vocabularies and mathematical registers, and give helpful feedback to formative and summative assessment. It provides the opportunity for more collaboration and interaction among all students and paves the way to gain problem-solving and critical thinking skills. With an increase in interaction between students using educational technologies, no learner is left behind and all can learn without the fear of being judged. This research can collaborate with UN goals offered as the 2030 Agenda for Sustainable Development which aims to build a better world for people and our planet by 2030.

Keywords: Technology, Math education, Refugee students, Educational technologies

Introduction

Having been born in the Middle East is enough to be exposed to the news of millions of individuals being forcibly displaced worldwide as a result of persecution, conflict, violence, or human rights violations. Human rights infringement in Iran, fighting in Yemen, the war in Ukraine, Conflicts in Syria, Sudan, and Iraq, and the growth in criminal activities in Central America and Venezuela have captured global attention for the dramatic rise in the number of refugees. Among these refugees from conflict-affected countries, millions of children can be found who have left their countries without language preparation. Moving to a different country or region may provide them with better educational opportunities, including schools, resources, and qualified teachers. However, with the issue of language barrier, some of them might miss out on many years of school.

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Refugee children face challenging situations before and after seeking refuge due to the varying educational systems and curricula they encounter in their home countries. Additionally, some of these children have different native languages, and others have learned different foreign languages in their previous schools. For example, certain Syrian refugees learned French instead of English. All of these factors pose difficulties for both refugees and their teachers in advancing language learning and teaching. This is because the acquisition of new knowledge and progress in language learning depends on internal elements such as individual experiences, prior knowledge, and learners' cognitive frameworks, in conjunction with sociocultural and psychological factors (ALRAWASHDEH et al. 2022). It rings an alarm bell to education authorities to be aware of potential challenges in providing education to this large number of language novices. UN has also defined one of the 17 goals of the Agenda for Sustainable Development (United Nations Department of Economic and Social Affairs, 2015) as guaranteeing that all individuals have access to inclusive and fair education of high quality and fostering opportunities for continuous learning throughout their lives and this research aims to collaborate with the United Nations' Goals.

According to Ishumi (1994, as cited in MULWA, 2015), language is a powerful instrument in the formation of concepts, the acquisition of particular perceptive abilities, and the transfer or communication of such concepts and interpretative perspectives from a source (for example, a teacher) to the prospective learner. Language is also a critical factor in formal education and language mastery or communication skill is a key condition in the efficiency and eventual effectiveness of the teaching-learning process. Klein (1998, as cited in MULWA, 2015) argues that language serves three important functions: first, language allows people to communicate with each other; second, it facilitates the thinking process; third, it allows people to recall information beyond the limits of memory. Therefore, language is not just a means of communication but also what can facilitate thinking. In addition, to gain mathematical reasoning and problem-solving solving a student must be able to competently understand and use the language in which math is taught.

Objectives

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Considering the situation that was pictured above, this project will investigate the main purposes of 21st-century math classes and what skills students are expected to learn. Difficulties and challenges that second language learners might face in math class will be discussed, as well. Then, the main objective that will be elaborated is how 6th-9th grade non-native students might benefit from learning technologies and AI to overcome language barriers and gain 21st-century skills in mathematics class.

Rational and the theoretical context

Math Education and 21st century skills

The education system has been revolutionized in the last two decades. In the 21st century, mathematics has shifted beyond being seen as just a set of rules and education has evolved to focus on equipping students with skills that are relevant to the modern world. Busaka et al. (2022a) introduce 21st-century soft skills such as critical thinking and problem-solving, creativity and innovation, communication, cooperation, entrepreneurship, and management skills. To gain these skills, students need to collaborate and interact with each other. Busaka et al. (2022a) define collaborative learning as a process in which two or more students share and contribute to each other's understanding through the completion of a given task. There is no question that collaboration requires students' linguistic skills.

Diagnosing Learning Difficulties among Non-Native Speaking Students

Many researchers refer to mathematics as a universal language which means that anyone with math understanding can solve math problems no matter in which language they speak. Let's consider a math problem in Spanish that describes a situation in which a person had a number of an item the day before and he sold a few today and the question is asking how many of this item he will have if he buys a few more the day after. Is it possible for a person with no Spanish language background to understand the problem and solve it? In addition, considering the objectives of 21st-century education, can we expect children to be engaged in creative problem-solving, critical thinking and collaboration without proper

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knowledge of the language taught and used in the class? "From the foregoing, it can be seen that language is critical to many of the processes of learning and instruction and it confers many benefits in terms of enabling us to articulate, objectify and discuss the problems that the field of mathematics presents" (MULWA, 2015). Freeman (2011) claims that teaching math concepts without providing language support is a false opportunity for non-native speakers to learn math. In other words, we cannot expect equal achievement from the ones who are not equally facilitated.

Math notations and registers

One of the key challenges that impact students' math learning in a second language is working with second language registers. Halliday (1978) defines a register as follows: "A register is a set of meanings that is appropriate to a particular function of language, together with the words and structures which express these meanings" (p. 195). There is a big difference between basic communication skills and cognitive academic language proficiency. It is not surprising that learning cognitive academic language proficiency takes everyone much longer. The complexity of mathematical language can be just as difficult as learning a foreign language. There are two main reasons for this. Firstly, young learners encounter numerous unfamiliar mathematical terms, such as coefficient, hypotenuse, and tessellation. These terms might be completely new to them. Secondly, many mathematical terms may appear familiar at first glance, like value, scale, chance, and product. However, their mathematical definitions are far more precise and intricate than their everyday meanings, making them deceptively challenging to grasp. Therefore, students should learn mathematic registers to be able to competently understand and use math language. In addition to mathematics registers, there might also be words that do not exist in students' first language or have different mathematical meanings.

Limited prior knowledge

The other challenge in second language learning class is students' inability to follow the teacher because of language problems or not having background knowledge about

a concept which might lead to failure in their academic success. When students have no idea about what many of registers mean in their first language, it might be quite difficult and time-consuming to understand what they mean in the target language, no matter how clearly the teacher explains them. "Learning math in a non-native language and the pedagogical challenges it presents is particularly difficult for students who are not academically literate in their native language" (Freeman, 2011). An ELL (English Language Learner) student wrote about his earlier years of classroom-based, teacher-led math experiences: "I'm still guessing what 'perform the operation' means when the teacher is erasing the board. So, I just stop listening and figure I can't do math" (Tran, 2005, as cited in Freeman 2011). Other than that, language incompetence can affect the pace of the class and make the class fall behind schedule.

Unequal chance to participate due to language barriers

Jourdain (2016) believes that students must understand mathematical concepts and prove that they can link mathematical knowledge with their everyday life and communicate their knowledge to others. However, native and non-native students do not always have equal chance to participate in the class:

> With regard to power relations in the classroom, both native and international students seemed to acknowledge the fact that power is unevenly distributed among graduate students depending on the nativeness of English. That is, native students who need much less effort in formulating and articulating utterances in English may gain better positions in classroom communities. (Yoon, 2013, p9)

In an interview that Yoon (2013) conducted among international students, one of them asserts that:

> For us, we are more like audience, not the, how to say, the same level participant as them. So we listen to their lecture, listen to what they speak, but actually, even when we talk, we show some comments. So I think they're more like the speakers, and we are more like the listeners. (p.10)

Yoon (2013) continues that those participants who have better language proficiency might feel superior to those with limited language skills.

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The digital learning classroom

The recent use of technology in mathematics teaching and learning can lead to a dramatic increase in students' motivation and achievements and help them overcome their language barriers to gain 21st-century skills in math classes. The following sections will discuss in what ways technologies can facilitate math teaching and learning for second language learners and can be an answer to their needs regarding their language challenges.

Virtual manipulatives

Technology tools such as interactive simulations, graphing software, and virtual manipulatives provide students with dynamic visual representations of mathematical concepts. A virtual manipulative is "an interactive, technology-enabled visual representation of a dynamic mathematical object, including all of the programmable features that allow it to be manipulated, and presents opportunities for constructing mathematical knowledge" (Moyer-Packenham et al., 2019). These visualizations aid in comprehension allow students to observe patterns, relationships, and mathematical processes more effectively. Teachers can integrate the use of visual manipulative tools into their instruction to teach new concepts, such as fractions, and provide students opportunities to engage in interactive activities during guided and/or independent practice (Shin, et al., 2017). Using Manipulatives helps to learn through visualization and physical manipulating resources and provides a common language among teachers and students. This is a way to reduce language load for non-native students in the class.

Collaborative learning through Learning Management System (LMS)

The total transition to e-learning during the COVID-19 pandemic affected the educational process. The current generation showed interest in having access to 24/7 available learning management systems (LMS) platform. Moodle is a very popular and well-known LMS platform and has been used to develop and implement e-learning courses and organize testing.

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It helps the teachers to track the students' performances, and also see whether they have done all their activities. LMS consists of Lecture Notes (LN), Learning Activities (LA), Assessment Exam (AE), Forum and Login/Logout History.

> Then according to that learning using LMS, teachers, and students have their way of building interactions with each other, collaborative responses, and collaboration. LMS also allows teachers and students to form fun new ways of communication through the use of learning media that are always updated according to the times, which are proven to increase motivation and learning achievement. Then the LMS makes students and teachers flexible to investigate, explore, and receive information related to assignments and learning activities at certain times with the same rights and speed for each student. (Furqon, et al. 2023)

This platform can also provide students with a portfolio that stores the assignments, quizzes and tests and keep a record of their activities during the term. It also provides the chance for students to review all key concepts in their first language. Online formative assessment with proper feedback in different languages could be provided for a large number of students. It also identifies students' strength and weaknesses the moment they are taught and indicates what to focus on. Online summative assessment can also be held instead of paper-based quizzes at the end of units which helps the students to look back and revise without fear of falling behind the class. LMS platform has a forum section where students can ask questions and make mistakes in a safe setting, where they can receive direct and immediate feedback. In forums, students are given the opportunity to share their diverse strategies and techniques for solving mathematical problems. Through all these activities, second language learners can take their time to understand the instruction or even use translation systems to gain a better understanding of the concept. In addition, jigsaw projects can also be designed. It breaks classes into groups that each work on part of an assignment and merge them when they have finished. It provides the chance for the students to recognize and minimize their weaknesses through interactions.

Video Tutorial and lecture recording

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According to Tarr et al. (2015), students enjoy learning at their own pace. For this purpose, they can benefit from listening in their own place and time and taking notes of what they study. It also helps them to pause the recording whenever they cannot have much concentration on the recording material or cannot keep up with the recording. Some studies suggest that second language learners as well as those with various disabilities can benefit from having access to both text and audio, as it appeals to two senses (Claret, 2016). According to Hill et al. (2002) lecture recording may benefit large groups of learners.

> Students with poor reading comprehension will not receive the maximal benefit from their textbooks. Therefore, they need to rely on other resources until their reading comprehension skills improve. Lectures help these students by providing auditory and visual clues to points of emphasis - clues not available through written text. However, students with English as a secondary language may not be able to decode the language quickly enough during a lecture to get the information transcribed into their notes. Tape recording the lecture provides them with the opportunity to hear important parts again and accurately transcribe key points into their notes. Studying with other students allows them to practice their listening and comprehension skills. In addition, they are often more comfortable asking a classmate to stop and provide clarification than interrupting an instructor in the classroom. (p.1)

Adaptive learning system

As no two learners are exactly alike, technology can provide students with content and support that are particularly helpful to their individual needs and interests. Effective teachers can first assess their students' knowledge, try to find out their strengths and weaknesses, and then attempt to adapt their lessons to meet the needs of each students. This is how a personalized learning environment can be designed for second language learners in which they can follow their own pace (FALMAGNE, 1985).

> Adaptive learning software designed with knowledge space theory maps out the details of each student's knowledge and determines whether they mastered a particular topic with that continuous assessment cycle, and it knows what they are ready to learn next based on their updated knowledge state. Such programs use this knowledge to provide feedback to learners, make learning more efficient and provide continuous growth path by offering students a selection of only the topics they are ready to learn at that specific moment in time. (YILMAZ, 2017, p.35)

This is what an ideal adaptive learning system looks like. However, it might be a little different in practice.

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Real time feedback system

Jurs (2020) believes that the learning process should provide feedback to achieve educational goals and this feedback is essential both for teachers and students to improve their work. Feedback comments should be detailed, constructive, and motivating. He continues that delays in providing feedback reduce the chance for students to understand their mistakes. Therefore, a real-time feedback application should be designed which shows the possible correct answers as well as a step-by-step indication of how to correct the errors. There is no question that good feedback can cause thinking. Real-time feedback systems in math education provide immediate feedback to students as they engage with specific math problems that have procedures to solve. The main purpose of these systems is to enhance the learning experience and support students' progress. Second language learners can benefit from this type of technology the most as language is not a concern in this process.

Enabling learning without fear of judgment

Claire Chen (2023) introduces "fear of judgment from peers" as one of the main reasons which holds students back from fully engaging in many contexts. Second language learners might "believe themselves to be behind", therefore, they are not very likely to engage in the class. Technology helps the ones who ask questions in the class stay anonymous. That is why many teachers believe that AI and EdTech tools help encourage class participation by insisting that "there is no such thing as a stupid question". In addition, with AI, for example, ChatGPT, a real-time agent can provide support to rephrase and simplify complex math concepts, making it easier for non-native students to understand them. It can break complex sentences, use simpler vocabulary, and provide clear explanations. Students can communicate in their native language and ChatGPT can translate their queries and responses into the desired language, regardless of their length. Beyond specific grammatical and punctuation corrections, ChatGPT offers Proofreading which offers general tips and guidance for improving writing skills too.

Teacher-parent meeting in their native language

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It is not surprising that when home and schools come together as a team, students normally show better attendance and behavior and get better grades. According to Paxton (2011), parental engagement has a key role in effective education for students with refugee backgrounds. However, according to the Victorian Refugee Status Report, there are multiple barriers to refugee parents participating in their children's education, one of which is language. Communication platforms foster refugee *parents'* involvement by providing the chance for them to use tools of translation.

Methodology and Analysis of results

To analyze this research, I will make inferences from the data collected from the interviewed teachers and bibliographical studies. I will compare the different theories and strategies used in the articles and the relation that may exist or not with my research objective. This research will mainly address 6th-9th grade non-native math students because at this level students encounter more complicated math registers which require better language proficiency. Therefore, these grades can be the beginning of a big challenge for math students in a non-native classroom. One-on-one interviews with school teachers who work with refugees will be conducted to see how students have been dealing with a second language in math class and what issues and successes they have had. They will also be asked what educational technology is provided in the class considering students' background knowledge and goals and in what ways it has helped math teaching and learning.

Schedule

Below is the schedule for my research. I highlight the main activities and necessary steps to be completed for the program.

Timeline	2023		2024	
	1° Sem	1° Sem	1° Sem	1° Sem

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Completion of Mandatory Courses	X	X		
Dissertation Writing		X	X	X
Literature Review and Theoretical Background	X	X	X	X
Data Production		X	X	X
Data Analysis		X		
Produce and present a Jornada		X		
Qualify, defend the thesis and revise as indicated by the committee.				X

Feasibility

Regarding the feasibility of this project, I highlight some points. I have a bachelor in computer science and English studies. I have been working as a programmer and language instructor (English for Specific purpose instructor) for a couple of years. I am quite familiar with recent educational technologies as well as challenges in language classes.

This program (PPGEM) has many professors who have carried out excellent work in this area of research, with emphasis on the level of expertise of my supervisor, which serves as a solid basis for exchanging ideas and dealing with any challenges not considered. In this way, I fully believe that the accomplishment of this work will be adequate and perfectly feasible.

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