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Developing a Multimodal Interactive Learning Environment to Enhance the Reading Comprehension of Grade 4 Students in the UAE Public Schools

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Abstract. The research aimed to develop and validate a Multimodality Interactive Learning Environment (MILE), in order to enhance the reading comprehension skills of Grade 4 students in the United Arab Emirates (UAE) public schools. The reading comprehension skills and strategies were drawn from Davis's (2013) model *Building Comprehension Strategies*, which include: making the connection, visualization, prediction and pre-prediction, asking and answering questions, inferencing, retelling and paraphrasing, and summarization. Since the international exam for Progress in International Reading Literacy Study (PIRLS) targets Grade 4 students, the MILE was developed pedagogically and technologically to address specific and well-selected activities for Grade 4 students to practise cognitive skills and strategies related to the intended curriculum and syllabus. The study was guided by a developmental and design-based research approach. The MILE was designed on the basis of the Four Components of the Instructional Design model (4C/ID); and it was validated in a public school in Abu Dhabi, UAE. The participants were 27 students from Grade 4. The research findings showed that the proper design of MILE to enhance Arabic reading comprehension is a combination of constructive learning, based on self-generated activities and cognitive strategies. In addition, the proposed MILE was designed for a progression of 200% among low-level committed students. The 'retelling and paraphrasing' skills were the easiest, whereas 'summarisation' was the hardest. Based on these findings, the research suggested some recommendations, in order to ensure the quality of the learning, and the assessment of the Arabic language in the UAE public schools.

Keywords: interactive learning environment; Grade 4; public schools; reading comprehension skills

1. Introduction

Despite the world trends for learning the Arabic language, Arabic native students are simply not interested in learning Arabic, as has been noticed in schools. Students have indicated that they feel that Arabic is a hard language to study, especially compared to English, which is widely used in the community. Although a variety of media have recently been produced for Arabic reading, such as Lamsa, Nahla Wa Nahel, I read Arabic and Asaafeer, none of these focuses exclusively on reading, but rather on providing attractive Arabic reading resources, monitoring students' participation and rewarding their engagement. Most of these materials are based on language information, rather than on skills, such as grammar, vocabulary, letters, sounds, story genres, and so forth. We observed one of our students going through a story in that kind of environment; and we noticed that she was reading the syllabus in the words, reading word by word, but not comprehending that which she had read. She had achieved the goal, which was to read; however, if students do not understand what they are reading in Arabic, their motivation towards learning the Arabic language decreases dramatically.

Training the learner on how to read or understand reading comprehension is complex. Students can show low performance in Arabic reading, but an impressive skill as an English reader. Alsheik and Mokhtari (2011) concluded that Arabic native speakers rely more on reading strategies in their second language, than when reading in their mother tongue. This is also reflected in the international exams PIRLS and PISA (Ministry of Education [MOE], 2011). The reading comprehension results for PIRLS international exam have fluctuated over the years; but these results could be improved. In the last round (see Figure 1), the average of the UAE students' performance was 450, with a 3.2 confidence level. Dubai's student performance was 515, with a 1.9 confidence level; and Abu Dhabi's student performance was 414 with a 4.7 confidence level. The average level is intermediate, and below the world average of 500 (Bosten College, Lynch School of Education, 2016).

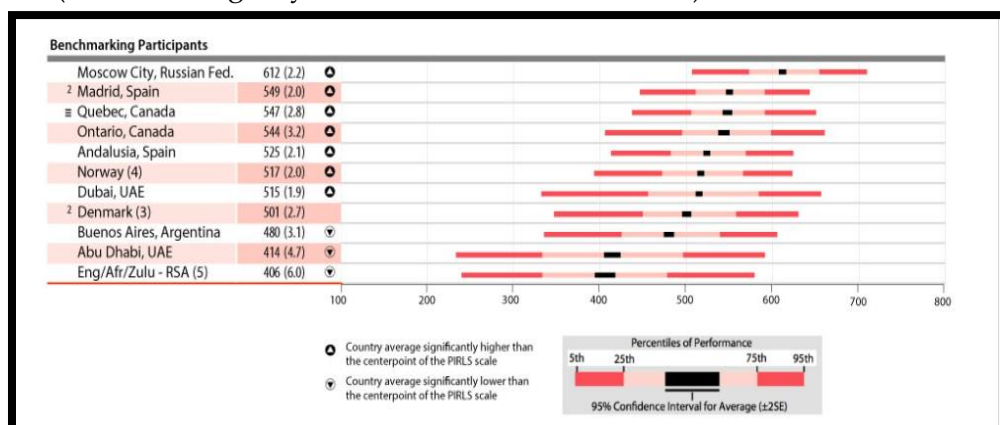


Figure 1: UAE benchmark in PIRLS, 2016

Source: <http://timssandpirls.bc.edu/pirls2016/international-results/pirls/student-achievement/pirls-achievement-results/>

The Arabic language teachers need direct and indirect support in teaching and reading comprehension. The suggested learning environment (MILE) could transform the teaching and the learning practices of the Arabic language. Discovering the gaps in any learning is fundamental to finding the proper solution. Adapting the Arabic language curriculum, based on an independent interactive technology, is one of this research's real contributions. The student's textbook content on cognitive reading skills would change teachers' approaches to teaching reading; and it would prepare the students for real life. Attracting students to the beauty of their native language and presenting it in easy and beneficial ways would change their view of this language's significance. Self-based learning is one of the best ways to motivate, differentiate and build learners' responsibility values. A MILE can support all different types of learning; and it could make learning the Arabic language more desirable.

Thus, the purpose of this research is to develop a multimodality interactive learning environment for teaching Arabic literacy and reading; since currently, the Arabic language has limited e-resources. Most of these resources are either expensive, have low-quality visuals and production, or they simply do not meet the expectations. Most current resources also concentrate on information and knowledge, rather than on practising skills and mental strategies.

2. The Problem Statement

The traditional learning approach is still the dominant approach in teaching and assessing the Arabic language in the UAE public schools. Despite new directions in learning, teachers insist on controlling the lessons and transferring the learning from the MOE textbook to the students. The MOE provides one with the developed Arabic curriculum, which is a reading strategy with specific steps to teach reading lessons. The observation for the classes exposes a huge misunderstanding of this strategy.

Technology is essential in today's learning. Despite the high-tech resources provided by government schools, most teachers use basic technology in their classes, predominantly to show videos, or to display the electronic version of the textbook on the board. Even while we are experiencing virtual learning, due to the current Covid-19 pandemic, Arabic-language teachers mute the class and explain the lesson, while all the pupils merely listen. A technological, structured model is urgently needed to monitor and promote the effectiveness of the teaching and learning process generally, and the performance in reading comprehension specifically.

Also, an innovative style of teaching and reading comprehension for the Arabic language is required. Teaching reading comprehension by separately practising each sub-cognitive skill or strategy that a skilled reader does unconsciously could enhance the reading. It creates knowledge that teaches reading comprehension in a way that positively impacts the comprehension of what is being read. The idea behind this research is to promote reading comprehension by training the students to use the skills, sub-skills, and strategies for complex reading comprehension intentionally until these become spontaneous in all one's reading. Practising will occur by solving various activities, each related to one of these skills. All of this could be presented

within a well-designed MILE, in order to practise the reading comprehension skills and strategies, which could increase Grade 4 students' achievement in comprehending what they read; and this would improve their PIRLS international exam results later.

3. The Research Questions

This research aimed to develop and investigate the effect of a multimodality learning environment on enhancing reading comprehension for Grade 4 students in the UAE public schools. This research is structured around three questions:

1. What is the proper design of MILE, in order to enhance Arabic reading comprehension?
2. What is the instructional strategy that supports the utilization of MILE in the current Grade 4 curriculum?
3. What is the impact of MILE on Grade 4 students' reading comprehension, when integrated with the suggested instructional strategy?

4. The Literature Review

4.1 Constructivist Theory and Language Learning

Constructivism has many identifications and perspectives. Philosophers did not state one constructivist theory of learning, due to the complexity of human nature, but most agreed on two central ideas: the activity of the learners, and the instruction needed to construct that knowledge. With many terms in constructivism, our research adapted Piaget's psychological (cognitive) constructivism (first-wave constructivism), in which the individual focuses on how to use information, as well as the resources and help from others, in order to build and improve their mental models.

In the research, we started with the complex learning task (the reading as a diagnostic test); then we scaffolded the needs, with the intention to achieve progress. The reading is the learning; and the problem is in our environment.

For Vygotsky, the learning does not occur in an isolated context; he focused on the cultural and social factors in constructing the learning. The constructivism in his theory is viewing progress in cognitive development as an issue of social relations, rather than as an individual task. Vygotsky posited that human speech is the main factor in the developmental process, which progresses into inner speech; and inner speech reflects egocentric speech (Harasim, 2017). In our environment, the inner speech is intended to solve problems as activities, in order to train the mind cognitively – the social element developed by the teacher's correction of the exams and his guided feedback to each student.

The constructivist generates some teaching approaches, based on four key principles (Harasim, 2017):

1. Active learning: this means encouraging students to participate and act on the learning. It is typically student-centred learning.

2. Learning-by-doing: this means engaging in the activities of the tutor. Activities could be authentic problem-solving, inquiry-based learning, whereby students formulate ideas and draw conclusions, in order to understand the real world. The teacher is a facilitator to guide the learning.
3. Scaffolded learning: scaffolding, by promoting the zone of Proximal Development (ZPD), when a knowledgeable peer or adult supports the learner in constructing knowledge, until the learner no longer needs this support. Through this social support, scaffolding stimulates and motivates the student to understand and construct new information and knowledge.
4. Collaborative learning: the basis of collaborative learning is interaction. Interaction is needed for various knowledge and sharing; since it scaffolds the learning for others, who have a different perspective or portion of the knowledge. Collaborative learning could be between learners, or between the learner and adults.

4.2 The Technological, Pedagogical, and Content Knowledge (TPCK) Model

The technological pedagogical content knowledge (TPCK) framework was built on Shulman's construct of pedagogical-content knowledge (PCK), in order to include technological knowledge around 1987. It describes how teachers' understanding of technologies and PCK interact with one another, in order to produce effective teaching with technology. In the model, there are three main components of knowledge: content, pedagogy, and technology. This integration produces the type of flexible knowledge needed. The model's mechanism is that the flaws in students' knowledge should be diagnosed, and then decisions should be made, based on the student's needs. In this model, each learning situation is unique; because the learning process will continually shift and evolve, based on the contexts. Teachers practise in highly complex, dynamic ways that require them to integrate their knowledge of student thinking and learning, the subject matter, and the technology (AACTE Committee on Innovation and Technology, 2010).

Based on Shulman's work, Mishra and Koehler (2006) developed a new interconnected framework called the Technological Pedagogical and Content Knowledge (TPACK). The intersection of the three types of knowledge, which are technological, content, and pedagogical, creates seven types of knowledge (Koehler & Mishra, 2009). There are the four main concepts in this framework. They are context, content, pedagogical knowledge, and technological knowledge (Tshuma, 2016) - see Figure 2.

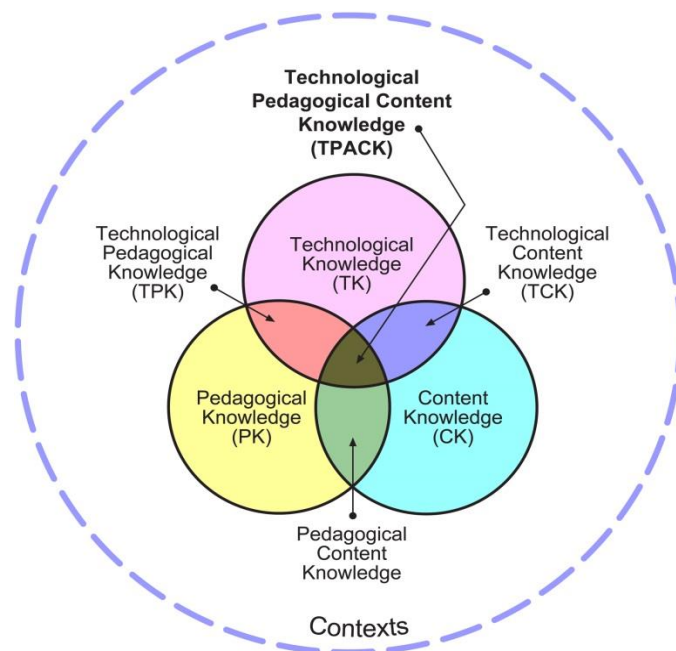


Figure 2: TPACK, (Tshuma, 2016)

The TPACK model is useful for Arabic language teachers, when they use digital tools to support and enhance the process of teaching and learning. It helps them to increase and develop the performance and achievements of students, by integrating and implementing modern and smart technology when learning language skills. In the meantime, the TPACK framework seeks to help schoolteachers to develop better techniques and strategies for discovering and describing how to implement modern technology in practice in their schools for better results and outcomes (Koehler & Mishra, 2009).

When language teachers share their experiences, knowledge, smart solutions, and innovative ideas with their students, by using any innovative technologies, they become a part of the collective learning environment. A collective learning environment is designed to achieve specific goals and to respond to students' needs (Woolley, Aggarwal & Malone, 2015). There is no doubt that students can perform and work better with support from technology, than when interacting with paper-based curricula and learning material (Woolley et al., 2015).

In this way, students' learning schema would become a plural phenomenon. This means that they think, interact, discuss and participate, in order to produce a solution or an idea that achieves the purpose of the discussion of this issue or problem (language skills). This would support them to be active, and to build a meaningful learning experience (Raelin, 2006).

4.3 A Multimodality Interactive Learning Environment

A multimodal environment is an environment with more than one mode used for representation (Multimodal, 2020). A multimodal learning environment uses more than two modes to represent content knowledge: verbal and non-verbal (Paivio, 1990). That is, 'multimodal learning environments in education comprise a concept of using modes and channels of information, such as pictures, illustrations, audio, speech, writing and print, music, movement, gestures, facial expressions, colours and much more' (Kennedy, 2020). The case for preferring multimodality is based on the premise that the human cognitive system learns better with more than mere words. In addition, the most effective learning environments are those that use a mixed-modality presentation.

According to Gilakjani (2011), multimedia presentations in these models compensate for the absence of appropriate cognitive structures in specific domains, such as communication and verbal skills in learning languages. He concluded that the multimodal learning environment approaches are needed, in order to understand the social, cognitive, cultural, and linguistic variables. Further, he recommended a swift change from print-based to visual presentations, due to the need for a quick response (Gilakjani, 2011).

Another study conducted by Sankey et al. (2010) reported that students find multimodal learning engaging and enjoyable. They affirmed that such findings improve students' progress and retention; since the joy of learning leads to life-long learning.

4.4 Teaching and Learning Reading Comprehension: Cognitive and Metacognitive Strategies

Ali and Razali (2019) reviewed 27 studies on teaching reading comprehension with cognitive and metacognitive strategies. They concluded that teachers are aware of the importance of teaching reading strategies; however, they did not know the reasons for their choices. It is important for the student that the teacher chooses the right strategy, in order to impact positively. Cognitive and metacognitive strategies for teaching reading and comprehension are significant for many languages. Our research similarly aimed to teach reading comprehension through cognitive and metacognitive strategies, although this is specifically directed at reading comprehension for the Arabic language. They analyzed the papers for many languages, generating valuable results; however, each language has specifications (Ali & Razali, 2019).

In *Aiming for Inclusivity: Teaching Reading Comprehension in First-Year Composition and Across the Curriculum*, McNiff (2020) noted that students entering college often struggle with reading. His essay addresses the importance of taking time to teach reading comprehension across the various curricula.

This essay strongly aligns with our research. It addresses the importance of taking time to teach reading comprehension across the curricula, in order to avoid deficiencies in college. It also presents a scientific way to teach reading

comprehension, based on cognitive and metacognitive skills and strategies from a student-centred perspective, although not aimed at the Arabic language, which is what the current research targets (Zhu et al., 2020).

Taouk and Coltheart (2004) discussed how teaching reading for Arabic and English has many similarities and little contrast. They explained how an Australian school approaches the teaching of reading. The students start by memorizing the letters and their shapes in the word, the short vowels, and then the long vowels. Teaching Arabic reading is based on orthography, which is the old traditional way. They argue for teaching reading by seeing the children move through a three-phase sequence, as a cognitive process. These phases are the discrimination-net phase, the phonological-recoding phase, and the orthographic phase. Attempting to teach reading by concentrating on cognitive skills is not new; however, Taouk and Coltheart (2004) affirm that focusing on cognitive skills reflects considerable progress in teaching reading.

4.4.1 Reading Skills

Having difficulty reading indicates a lack of one of the reading skills. It is a challenging process, in which all the skills should work together to achieve the reading. These skills are like muscles of the body – the more you exercise, the more flexible and fit you will become. The first reading skill is launching young readers in phonological awareness. Phonological awareness is a broad skill that includes identifying and manipulating the units of oral language – parts, such as words, syllables, and onsets and rhymes. Phonemic awareness refers to the specific ability to focus on and manipulate individual sounds (phonemes) in spoken words. Phonemes are the smallest units comprising a spoken language. Phonemes combine to form syllables and words (Broadcasting, 2020). The student can identify syllables orally, recognize the rhyme or the phonemes, count the number of syllables in the word, by clapping, and so on.

The Arabic language has 28 letters; each letter has seven sounds, one silent and six vowels. Arabic vowels have different lengths in their sounds – three are short sounds (A, O, E) and three others are long (Aa, Oo, Ee). Each learner should be able to read them all, as well as the name of each letter, such as Alef. Unlike English, the sounds A, O, E, Aa, Oo, Ee with a silent A are sounds for the letter Alef. All of the above is done by sound.

The second skill is word decoding and phonics. Decoding is the process of translating print into speech by rapidly matching a letter or combination of letters (graphemes) to their sounds (phonemes) and recognizing the patterns that make syllables and words (Reading Horizons, 2020). Phonics is one approach to reading instruction that teaches students the principles of letter-sound relationships, how to sound out words, and exceptions to the principles (Broadcasting, WETA, 2020). There is an area in the brain that deals with language processing; and it does this process automatically. Unfortunately, about 30 per cent of students do not access this part of their brain (Reading Horizons, 2020).

A lack of decoding causes difficulty in reading. It would affect fluency and vocabulary and limit reading comprehension. Therefore, decoding strategies should be taught explicitly and systematically by 'start[ing] with the simplest sound/letter concept and build[ing] up to the more complex sounds, in order to help some of the difficulties with reading (Reading Horizons, 2020). But simply, pronouncing the right sound or syllables of written words and recognizing the printed shape (the written version of the sound) of each sound or syllable is decoding, while the systematic approach or method to learn to decode is called phonics.

Unlike in English, Arabic vowels are not all letters (أ، إ، آ، أو، إي). The short vowels are symbols positioned in different places to the letter called fat-ha (َ), Dhammah (ُ), Kasrah (ِ) long sounds, they are called Mad; Mad Al Alef (آ), Mad Al Waw (و), Mad Al Ya'a (ي). That is why Arabic phonics has one form to create the sounds of the letters; each sound is a syllable. Add to that the rule, that the silent letter should not be pronounced alone. This framework of creating Arabic sounds, based on the systematic process, does not help one to memorize the sounds or the words.

Unlike English, Arabic has fewer exceptions; thus, phonics in Arabic could be more systematic and clearer, provided the student understands this process. At this level, the student can recognize familiar words quickly, figure new simple words, and so forth.

4.4.2 Reading Comprehension

Reading comprehension is a mental skill that requires establishing connections between the content of the text and the individual's prior knowledge. Importantly, 'skilled readers are active readers, they combine their knowledge of a range of processes, skills, and strategies, in order to comprehend the text written for a variety of purposes and audiences, and by using a range of text type' (Davis, 2013). The reader should intentionally practise and be aware of these skills, processes and strategies, in order to enhance the comprehension of the written text.

In *Building Comprehension Strategies for Elementary Years*, Davis (2013) explains the strategies and how to maintain and develop comprehension strategies. Each strategy has instructions, learning goals, key questions, and recommended tasks for the teaching process. Davis (2013) explains seven strategies for comprehending written text:

1. **Making connections:** readers connect the reading with their prior knowledge to understand the new material before, during and after reading. Prior knowledge could be cultural, social, academic and personal self-efficacy (understanding and expressing themselves as a skilled reader).
2. **Prediction and pre-prediction:** to anticipate and expect the actions, events and ideas that are coming up in the text; the act of anticipating meaning by calculating guesses, based on the information in the text. This prediction can be practised before and during reading. The learner can accept, reject or confirm their predictions, as they read further.

3. **Visualization:** generating visual images and mental imagery. The reader draws on his/her senses to think about what they are reading and to create mental images of the ideas and information conveyed in the text.
4. **Asking and answering questions:** readers ask questions of themselves, the text and others to what they are reading. In both asking and answering questions, students gain a deeper understanding of the ideas, actions, events, and information in the text. They learn to interpret important details central in order to comprehend the text, and to think critically about what they have read, to discuss, reflect, enquire, and reason.
5. **Inference (detective):** the reader uses their prior knowledge, along with any information in the text, in order to interpret, make assumptions, predict and/or draw conclusions about what they have read. The assumptions, interpretations, predictions and conclusions are not facts that are explicitly stated; they represent what the readers think they know, as a result of taking the information from the text, reasoning and forming inferences.
6. **Retelling and paraphrasing:** talking aloud about what they have read. Using words, phrases and ideas from the text to tell others what the text was about. Paraphrasing is like retelling; but it requires students to use their own words, in order to tell/explain what they have just read.
7. **Summarization:** making mental and written summaries of what they have read. This develops by reading more, reading complex and longer texts, and reducing the gathered information to the few most important details.

The performance of reading comprehension for the Grade 4 students encouraged the researcher to study the basic strategies of reading comprehension, in order to solve the problem of low performance in Arabic reading comprehension. Understanding and analyzing the problem is an effective way to find a scientific solution and a place to start. The multimodal materials will support reading comprehension in all aspects. They will be tested and approved, based on the Plan-Do-Check-Act (PDCA) strategy and the Four Components of the Instructional Design Model (4C-ID), as a practical, instantaneous way to ensure that the material is authentic. These resources will create a learning environment in which to practise learning independently.

The accurate measuring and close monitoring of the learning process in the environment would provide a clear image of the proper MILE for each learning situation.

5. Research Design and Methodology

This research suggests a structured design of a Multimodality Interactive-Learning Environment (MILE) to support the UAE Grade 4 students' performance in reading comprehension; and it seeks to discover the best reading comprehension strategies to improve students' reading skills. It can also support Grade 4 students in UAE public schools to participate and use the MILE efficiently, with observation, monitoring, and guidance. A structured system is prepared from English reading comprehension

instruments and international exam criteria. these are translated and adapted to Arabic language instruments.

The MILE is built and supplied with quality resources, based on researcher observation, teachers' questions, and reflections. The instructional design of the MILE is based on the Four Components of the Instructional-Design (4C/ID) model, in order to enhance the basics of individual reading-comprehension skills and strategies, to direct and promote the learning process on the basis of the students' needs.

Since the focus of this research is to produce a multimodal learning environment to promote reading-comprehension skills, developmental, design-based research is adopted.

5.1 The Research Design

This research used a developmental research design for an instructional product, in which it blends theory and practice. It is a systematic study of designing, developing and evaluating instructional programs, processes, and products that must meet the criteria of internal consistency and effectiveness (Ritchey & Klein, 2005). It implies gradual growth, evolution, and change (Ritchey & Klein, 2005).

Our design-based research blends empirical educational research with the theory-driven design of learning environments. We chose this method, in order to gain a greater understanding of how, when and why the proposed MILE works well in practice. It focuses on the development of the MILE, in order to create a learning environment to teach and enhance reading comprehension. Furthermore, this experimental research uses a covariance design, which is a pretest-posttest randomized experimental design (Trochim, 2020).

The main factor or covariate is reading comprehension performance, while the factor reducing variability is the MILE. The MILE should reduce distracting factors and so-called variability, by eliminating various factors, such as teachers' different abilities, how lessons are explained, and the effectiveness of the learning strategies used to explain the lesson.

In addition, this study was guided by an integration of the TPACK and the 4C/ID models. The teaching content was taken from Grade 4 MOE Arabic textbooks; and the learning was based on Davis's (2013) seven cognitive reading strategies and skills. The technology aspect of TPACK is the multimodal learning environment; while the pedagogical aspect is to teach the content by practising the cognitive skills of reading comprehension.

From the pedagogical aspect, this study integrates the four constructivist principles, firstly through the students' activity in the MILE, as the student must be active to learn; and practise the cognitive skills of reading comprehension by doing, such as making connections, prediction, inferencing and so on. The more the learner uses the environment, the more the learning will be scaffolded. Collaborative learning will occur through the teacher's correction of the exam and the generic feedback from each activity.

Teaching reading comprehension is complex; and it demands authentic learning situations; therefore, we chose the 4C/ID Model to guide the learning process. As already noted, we used Davis's (2013) categories, in order to divide reading comprehension into seven cognitive skills and strategies: making connections, prediction and pre-prediction, asking and answering questions, visualization, retelling and paraphrasing, summarization, and inference.

5.2 Sample

The research has not had full control over choosing the sample. Grade 4 students were chosen because, during the 2020–2021 academic year, the PIRLS exam will test Grade 4 students in private and public schools. Historically, private school students have performed better than public school students in international exams. Therefore, the research has selected a public school in Abu Dhabi, UAE.

The sample started with one section for a period of time. The chosen classroom was the whole class, which had students with different reading comprehension gaps. Then, the sample was extended to all the sections of Grade 4 students in the same school under the administrator's approval.

The sample was one classroom of Grade 4 students in the school; and it represents the population of all Grade 4 students from public schools in the same area. Sampling bias is very unlikely; as the researcher has limited control over the sample. Thus, it was acceptable when our sample became 27 students only. The school administration created accounts for all the Grade 4 students. Since it was the last week of semester 1, only 27 students committed to participate. Only five students (with high-level reading comprehension) completed the four cycles assigned on the website, while the others needed more time.

5.3 Instruments

The research attained four instruments: items test for the pre-test and the post-test, questionnaire for surveys, observation forms for evaluative observation, an interview guide for informal comments and feedback (see Table 1). These instruments were reviewed and validated by a panel of experts and approved by the ethical approval committee in the UAE Ministry of Education.

Table 1: The Research Instrument Description, Objectives, and Structures

Instruments	Description	Objectives	Structure
Items test for Pre-test & Post-test	Two videos followed by questions related to the pages of the text. The first video is of the vocabulary and the second is for reading the text aloud. The texts, as per MOE book, vary in two types of texts: stories and factual. Each question has	<ul style="list-style-type: none"> - Measure the progress during a cycle. - Facilitate curriculum learning as a technological tool. - Diagnose students' performance in reading 	Both tests are the same. They are texts provided from the first two units in MOE's Grade 4, Term 1 textbook. The questions are delivered based on Davis's cognitive

Instruments	Description	Objectives	Structure
	three icons below: a speaker to listen to the question, a space for writing the answer and a mike to record the answer. The student has the choice to listen or read the question and to write or record the answer.	comprehension based on reading comprehension skills	skills for reading comprehension.
Questionnaire for Surveys	Two surveys: one after each exam to explore if the demonstration of the strategy encourages students to read Arabic, and whether they like it. The other survey after each activity measures students' interests in each activity: topic and template.	<ul style="list-style-type: none"> - To measure the interest of the students in the activities and appropriateness of presenting MOE's reading strategy, and - Emotional Impact on the developed MILE. 	<p>First survey has a question about the student opinion with five multiple choice responses:</p> <ul style="list-style-type: none"> - I like it and it encourages me to read Arabic. - I do not like it, but it encourages me to read Arabic. - I don't know. - I like it, but it does not encourage me to read Arabic. - I don't like it, and it doesn't encourage me to read Arabic. <p>Second survey: a question 'do you like this Activity' with two choices: <i>Yes or No</i></p>
Observation form for Evaluative Observation	By monitoring and observing the flow of the MILE, the students' performance, teachers' performance in correcting exams, and time of any activity in the MILE	<ul style="list-style-type: none"> - To develop the MILE and discover which is appropriate for the learning process. - Add, remove or improve any obstacle or inconvenience for the students wisely. 	This observation was accepted by the researcher as an educational expert and the administration only

Instruments	Description	Objectives	Structure
Interview guide for Informal Comments and Feedback	Any comments from the users to be considered and adjusted to not impact the main goals or targets of the research	<ul style="list-style-type: none"> - To develop the MILE and discover the appropriate one for the learning process. - Add, remove, or improve any obstacle or inconvenient for the students wisely. 	By verbal, phone calls, WhatsApp, and any other tool.

5.4 Variables and Research Setting

This research has two main variables, dependent and independent. The dependent variable is comprehension reading performance, which is segregated into small parts of basic skills and strategies, based on English instruments that are adapted for the Arabic language.

The MILE is the independent variable; and it is built on a constructive development model (4C/ID), which would form a core pillar of the learning process. The researcher uses Davis's (2013) reading comprehension strategies, which were created for the English language, but adapted here to the Arabic language. While using the MILE, the tool was developed into a better framework, more suitable for the Arabic language, as will be explained later in the section.

5.5 Instruction Strategy

Because of the complexity of the learning situation, the 4C/ID model was the basis of the instructional design (see Figure 3):

- The learning tasks are to comprehend the reading of the text from the curriculum. During the reading stage, the student will experience all aspects of a real-life session, such as solving problems, reasoning, connecting information, inferencing and so forth. Each set (cycle) starts and ends with an assessment of reading via voice recordings that the teacher evaluates for deficiencies in the seven skills needed for improvement; then, they are tested again to monitor the progress.
- Supportive information includes the activities that emphasize the cognitive skills and strategies, such as making connections, prediction and pre-prediction, asking and answering questions, retelling and paraphrasing, visualization, summarization and inferencing. The activities vary and are inspired by Davis's (2013) approach of 'key questions' and 'the recommended learning tasks' for each skill or strategy.
- The procedural information will start with the pre-test exam. The system analyses the answers of the tests and sets up the required activities, based on students' deficiencies. The supportive activities were mapped on the basis of the deficiencies or gaps. A set of activities was prepared for each skill. The system analyses the students' answers the teacher's correction; and it assigns the needed activities. In addition, each test was followed by a short survey with five choices,

testing student satisfaction with the text and whether or not this encourages Arabic reading. Short surveys were also available at the end of each activity.

- The Part-task practice can be used for skills enrichment. This enables the administration to prepare customized activities for students by using the eight templates. This particular option provides uniqueness to the learning setting. Davis's activities are organized in eight templates or forms (see Table 2).

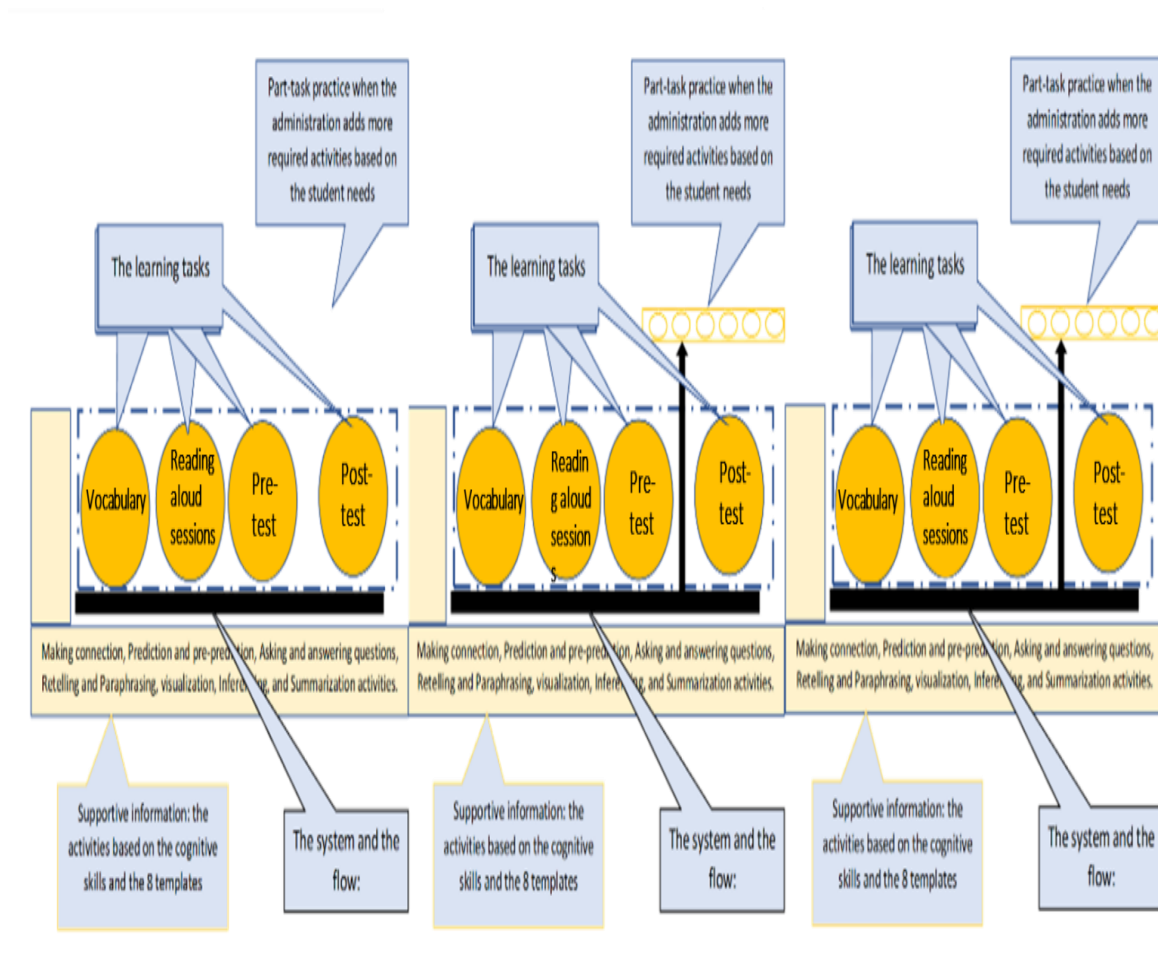


Figure 3: 4C/ID Learning environment

Table 2: The MILE Activities Template

Number	Name	Description
Template #1	Flipbook	Where the learners find the pictures of the main text they read, organized in a book frame opposite an empty page to write their text. The student should create their book by summarising what they understood about the main text, or create their book by writing their story about the same pictures. This activity mainly serves the summarization skill.
Template #2	Drag and drop	Where students must drag pictures and drop them into the main picture, in order to get oral and written feedback regarding the relationship between the two pictures to answer the main question. This activity can serve all seven skills.
Template #3	Arrange Box	Basically, a matching exercise using 5-9 stagnant pictures to be matched with an opposite set of moving pictures to answer the main question. The student must justify why they made the connections they chose. The pictures could be text, drawings, or images. This activity can serve all seven skills
Template #4	Q&A (Question & Answer)	The activity provides a medium, followed by a question that the student should answer, then a written and oral feedback that could be generic or specific to the question. This activity can serve all seven skills.
Template #5	Predict	An image is displayed, and a question is given with an open-answer field. After the learner answers the question, three possible answers to the same question are presented for the student to confirm whether their answer was one of those. If the student answers 'yes', the answer is submitted and the activity ends. However, if the answer is 'no', another field appears for the student to copy and paste their original answer. This mainly serves skills of prediction and inferencing.
Template #6	Book Card	Fields for two genres, namely story and factual texts, are provided – for example, Title, Painter, Author, Genre – to eventually create a book card.
Template #7	Recommended Answers	Basically, a multiple-choice question but with images, followed by a requirement of oral justifications for selections made. This activity can serve all skills.

5.6 The Data Collection

Data were collected to capture evidence that seeks to answer all the questions posed. In this research, both quantitative and qualitative data were collected. The data were collected in formal and structured situations through the MILE and informal situations, as elaborated below.

The upside of having a MILE is that it should provide easy access to a variety of quantitative information. Firstly, the MILE can measure pre-test and post-test scores, in order to analyse students' progress in reading comprehension skills. It can also be used to keep track of the sample size, especially in the early stages, thereby allowing the researcher to keep students, parents, and faculty interested in participating in the research. It can also help to measure students' interests with short survey questions available after each activity and exam.

Lastly, the MILE can also help to measure the suitability of the MOE strategy in the MILE. For example, the MILE measures the time taken to answer a question, and it indicates students' interest in such a question or activity through short surveys. Further, it provides a sense of whether the activity or question aids the goal of improving reading comprehension by measuring student progression in skills as the result of an activity, or in the post-test, when the same question is asked. Activities that do not seem to add value, or add value at a high cost (which is a long period of time), will be removed or replaced. Similarly, long exam questions or questions that show little to no improvement can be amended, or even removed.

Qualitative data are first collected through evaluative observations (EO), which means making an inference and judging from behaviour (Stephanie, 2013). The researcher aims to observe the entire MILE cycle, in order to evaluate the technical functionalities and progress, teachers' and students' interactions, reactions, and interest in the MILE. This helps the researcher to improve the MILE and to determine whether the MILE can be properly used to enhance reading comprehension. The data are also collected from parents and faculty members' informal comments, in order to get a sense of the quality of material and strategies in the MILE, how students honestly perceive the MILE, specific feedback on activities, perception of exams, technical functionality and more.

6. The Results

The results related to the proper multimodality (Q1). Table 3 details how students performed in each activity, as well as the average duration required for each skill.

Table 1: Skills results (N=27 Students)

Skills - in all cycles	Correct (%)	Incorrect (%)	Average Question Duration (mins)
Retelling and Paraphrasing [إعادة السرد]	85	15	4.1
Inference [الاستدلال]	74	26	5.6
Summarization [التلخيص]	66	34	8.5
Prediction, and pre-prediction [التوقع والتنبؤ]	79	21	4.4

visualization [المؤثرات الحسية]	82	18	4.3
Making Connections [صنع ربط]	78	22	4.0
Ask and answer questions [طرح الأسئلة والإجابة عليها]	76	24	4.3
Average Total	79	21	4.7

It could be noticed from Table 3 that retelling and paraphrasing is the easiest skill for fourth graders; while summarization exercises take an average of 8.5 minutes, in which they are the longest of all skillsets; and the biggest deficiency appears to be in summarization. On average, the sample showed good performance in reading comprehension skills (79% correct answers).

From informal comments and feedback, it could be noticed that summarization activities were long, so students prefer to skip them, which is not acceptable because they are one of the reading-comprehension skills. Parents informed the researcher that students prefer the shorter questions, such as 'recommended answers' and 'predicted templates; and the parents noted that the exams were somehow long, which presented a challenge at first.

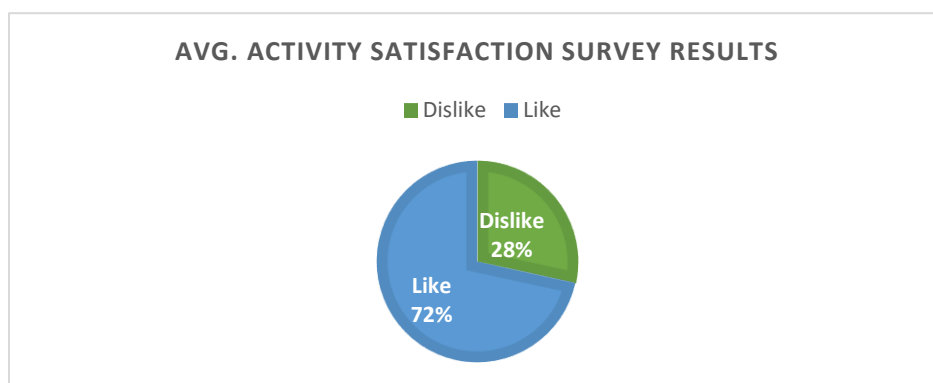


Figure 4: Activity satisfaction

As Figure 4 demonstrates that the majority of students liked the activities. All previous results impact the type of materials, activities and supported skills to develop the environment.

To answer Q2 regarding whether the MOE strategy is suitable for the environment, the data displayed in Figure 5 indicate that 45% of the students liked the text and believed it encouraged them to read Arabic. A further, 25% of students believed it was not encouraging.

From the EOs, the exams were found to take a lot of time. The exams are in-line with MOE texts; however, the observer believes they should be further shortened. They were shortened three times before MILE went live. The researcher believes a further reduction in time requires a scientific approach; the researcher needs to find a shorter

MOE text that can test all seven skillsets. Informal comments and feedback: parents noted that they like the activities because they gave the students the chance to absorb the skill in more than one method, or from different perspectives.

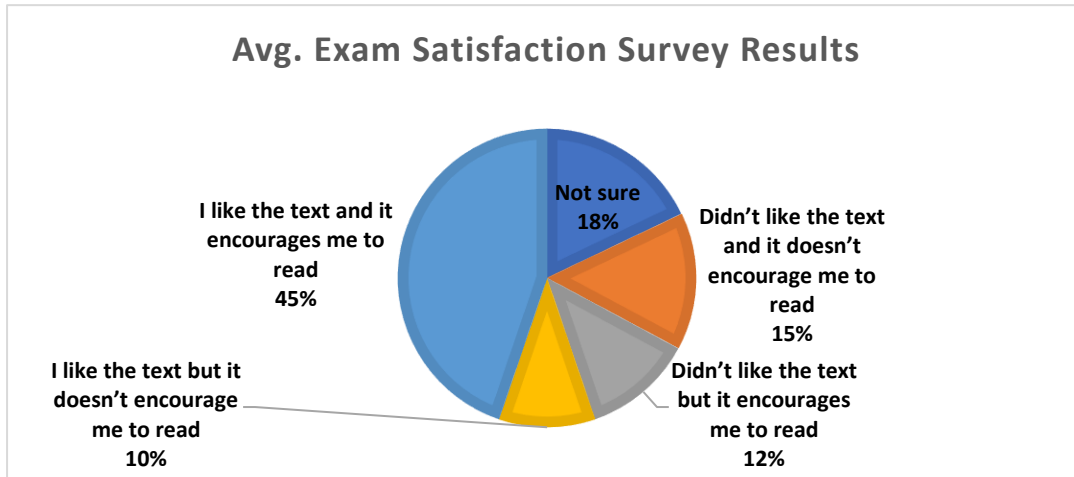


Figure 5: Average exam satisfaction survey results

To answer Q3 that addresses the impact of the environment in reading comprehension, the study found the average progression of the above is 57%, factoring in the impact of the progress of one low-performing student, who showed tremendous progress. To eliminate outliers, we considered using the median, instead of the average, which indicated a 9% progress. If we average the same pre-test scores (including outliers), the average score was 65%. Eliminating outliers results in a score of approximately 70%. Conversely, the average post-test score is 68%, and 81% if we eliminate outliers (by taking the median instead of the average).

7. Discussion

The results from the findings show that the MILE can improve the Arabic reading comprehension skills of students; but it is more efficient for medium- and low-level students. This statement applies to two questions in this research: What could be a proper MILE? and Can the MILE enhance Arabic reading comprehension? We address both of these questions in the following sections.

In addressing the first question: 'What is the proper design of MILE to enhance Arabic reading comprehension?' – we need to discuss the dynamics of the environment for this particular learning setting. The researchers have made more than one enhancement to the environment, in order to adhere to the preferences of the stakeholders. For example, the exams were shortened more than once; activities were added, based on the shortcomings discovered in the initial data analysis in the MILE and EO. The preferred templates were adopted more frequently; and video tutorials showing the set-up and registration process were prepared and shared with the parents. The researchers believe there is still, and will always be, room for improvement in the MILE, as it needs to be updated to meet the students' preferences.

The approach to teaching Arabic reading comprehension adopted in the MILE was based on enhancing cognitive skills, instead of on the traditional methods of focusing on grammar rules, handwriting and suchlike. The researchers believe the result of 9% progress is a very acceptable increase in skills, especially given that this was over the short timeframe of three weeks. As the MILE is enhanced, average post-test scores should also increase from the current median of 81%.

In addition, the researchers found that an appropriate MILE should be:

1. *Structured*: consistent, clear, systematic instructional learning supports the MILE. The consistency clarifies the steps; and it makes them easy to follow. Also, as per Vygotsky's ZPD scaffolding learning zone, the learning should consist of small additions to the learner's prior knowledge, in order to acquire the learning. Adapting the MOE reading strategy for reading lessons in a system in our MILE encouraged teachers to engage; and it convinced them that it could be implemented. Also, this structured learning explains, by example, the MOE reading-comprehension strategy.
2. *Dynamic*: each learning situation has its own needs. In our research for this school, we added many 'making connections' activities, as it was the first gap noticed for this school. The researchers increased the mandatory activities, in order to ensure the practising of this skill. Mainly competitive and motivated learners from the highest level in the school participated in the MILE. The main gaps for them were 'inferencing'; so the researcher enriched the MILE with specific activities to support this skill and keep it optional for everybody.
3. *Appropriate for low, medium and high capabilities*: the high-level learners were skipping the post-tests; since their scores in reading and testing were more than 75%; however, they have gaps in their performance that need to be supported. The researcher increased the percentage of the scores to pass the post-test. At the planning stage of the MILE, the preparation was for medium-level reading comprehension. However, it is best to be ready for the high level to provide opportunities for everybody to learn, especially as each activity generates feedback to support the thinking. The harder activities could be kept optional, but the main activities to teach the skills are mandatory.
4. *Teachers should not be able to affect student scores without passing certain tests (training not enough)*: this was not stressed, because of the time pressure. The teacher knew students from their voices, which were not taken into consideration; since the system does not show any student information (low on volunteers). One example is a student who copied and pasted the same answers, but received a lower score in the post exam (subjectivity), which could occur even if the teacher were different.
5. *Incentivize students and parents to use the learning environment*: a reward system in the MILE could encourage the use thereof. Parents and students perceive (and fear) that Arabic is a difficult language for children. A rewarding and follow-up system could encourage students to use the MILE independently; and to compete

with their colleagues without their parents' encouragement. Because there is no reward system—only the school administration—some parents try to finish the activities or post exams on behalf of their children. This necessitates an extrinsic motivation via certificates, extra credit and gifts for students who complete the cycles.

6. *Minimize technological difficulties for the user:* not doing so would discourage participation. This project faced difficulties; the crucial one was the technical problems. During the implementation stage, many problems appeared that cut into the flow of the cycles. For example, the student completed the pre-test, but the activities do not show; or the student finished the activities, but the post-test or next cycle pre-test did not appear. There were other technical problems from the parents' side. The registration was not a significant problem; but utilization through the MILE was an issue.

To solve this issue, numerous tutorials were created for parents to facilitate the learning process. Clear instructions need to be added to the MILE to ensure ease-of-use and to guide the process of learning. For example, if the student is not active for two minutes, an instruction bubble directs the learner to the next step. This should develop students' and parents' technical skills.

7. *The variety between visual and verbal resources had a positive impact.* Providing a place where the students hear and learn the proper Arabic language was one aspect appreciated by the teachers. Most native language students do not hear proper Arabic; so sometimes it looks like a foreign language for our learners. To assess and measure the impact, the research should be conducted for more than three weeks.

To summarise: the appropriate learning environment should be structured, dynamic, flexible and inclusive of all students' needs, whether high-, medium- or low-level. Teachers highly skilled in reading comprehension skills are fundamental for this type of learning or intensive observed system, in order to ensure the reliability and the authenticity of the assessment process. Technological problems should be avoided in the production stage; and the environment should have tutorials for uneducated teachers (these were consequently created).

In the environment, the results show progress in students' performance. These results reflect the learning gained from practising learning in the environment. The argument of the familiarity of the text becomes less significant, mainly because repetition is good for reading comprehension and the students were already familiar with the text in the MILE; since it was part of the curriculum which they had recently studied. The implementation of the environment occurred at the end of Term 1, and the same lessons were studied in that term.

One of the motivating factors for this MILE is aligning content with the MOE's Arabic curriculum. The MILE adopted the text in the Grade 4 MOE curriculum, which resulted in it becoming an aid to the teachers, rather than an added burden on top of

their existing responsibilities. Other e-resources usually adopt external literature, which sometimes distracts the students, or is not up to the school's standard.

However, enhancing reading by practising cognitive skills was neither proved nor disproved in this research. Many elements influenced the data, such as the teachers' understanding when reading the comprehension skills, inappropriate timing, the hectic situation of solving technical problems caused by a lack of knowledge needed for the technology developments and the parents, and the stress of adding and creating the proper activities to develop the MILE.

8. Conclusion

The purpose of this study was to discover the best learning situations for students and school, in order to enhance Arabic reading comprehension; and to test the transformation in teaching reading comprehension from traditional to technologically enhanced learning, based on practising the cognitive skills. To achieve this purpose, a technological tool (MILE) was developed to instruct the learning, based on the cognitive skills using the 4C/ID instructional learning model to ensure intensive learning in that complex learning situation.

The research indicated that each learning situation had its own circumstances; and therefore, each environment should be highly flexible and able to grow and improve under close observation. A multimodal environment needs to be as dynamic as possible.

The Arabic language could be taught by an attractive technological environment, even reading comprehension. Government and universities in the UAE should encourage these types of research, in order to support the Arabic language teaching, as soon as possible, in order to build a scientific basis, from which to serve the Arabic language for a new generation. Hopefully, these types of research and environments could change students' attitudes towards the Arabic language. The key to this research's success was the faculty, together with the parents' desire to serve the Arabic language; since they had also noticed the students' lack of interest.

Although the research revealed a predominantly positive impact and attitude, the study needs to be implemented and studied for a longer period. Changing cognitive skills needs more time than three weeks, in order to measure the real impact. As the school volunteered, this research could be continued over the next terms, in order to measure the impact and to improve the MILE. Overall, we consider this study to be a success story, mainly because the participation levels are exceeding our expectations; since students continue to use the MILE after the experimentation time.

9. Recommendations and Future Studies

1. Teaching languages is a complex learning challenge, but it is highly possible to create similar ideas and research to teach the Arabic language.
2. Ensure that the teachers participating in the evaluation system are highly qualified or closely monitored to ensure the reliability and the authenticity of the achievement. Train the Arabic language teachers well and cement their

understanding of reading-comprehension skills, before starting the correction process. The Arabic teachers need to be more accurate in the evaluation or assessment process, which reflects their understanding of the skill.

3. Decrease the exam (pre-test and post-test) length, which means not taking the whole MOE text as an exam, and building the cognitive skills questions, based on them.
4. Manage and develop the project with a team to enrich the environment and ensure efficient and qualified work. A team from the same school could impact in two ways: teachers' awareness and understanding for reading comprehension and its skillsets; and developing the right student activities for that specific learning setting. Intensive monitoring and guidance should be provided for a time, until the teachers' understanding reaches the ability to work independently.
5. Ensure the quality of learning assessment and evaluation of the Arabic language. This could be applied in many ways: monitor the teachers intensively, conduct training and follow up the implementation; or (as the researcher recommends) create a systematic approach, in order to monitor the evaluation process and to ensure the authenticity and the consistency of the correct evaluation.
6. Ensure technological efficiency and flow in the environment before going live with the school community. Repeated problems cause depression and are unacceptable to the environment.

10. Limitations

Since a MILE is a technological system, it needs a connection to the internet and access to a smart device. The user could face numerous technological issues, such as hardware problems like issues with devices (computers or iPad) or the system crashing while using the environment; and/or software problems, such as lost or weak internet, browser problems or environmental software errors. Two specific technological limitations of the environment were that it did not work effectively with phones; and the participants needed to use the Chrome browser.

Research settings can be conducted anywhere; this research setting could affect certain aspects of the research. For example, a student may be distracted at home, while using the MILE, thereby affecting their level of concentration and increasing the amount of time needed to finalize a task. To decrease this issue, the system could sign out the user, if there is no activity for 15 minutes.

The results cannot be ensured; since it is done at home with the parent; the only accurate evaluation is the reading aloud session; as the teacher hears the student's voice. No similar research on the Arabic language has been conducted to compare the results and the findings.

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