The importance of computer programming for developing primary students' future and academic skills: *Examining the time and resources allotted for it in UAE schools*

أهمية برمجة الكمبيوتر في تنمية مهارات طلاب المرحلة الابتدائية الأكاديمية والمستقبلية: دراسة الوقت والموارد المخصصة لها في مدارس الإمارات العربية المتحدة

by
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ABSTRACT

Purpose- As the era of technology continues to evolve, programming education has garnered a growing amount of interest. Programming has an important role in preparing students and arming them with the language of the future. The purpose of this study is to demonstrate the importance of programming, discuss the pedagogical philosophy of how programming is taught, identify the barriers to the proper implementation of programming education in UAE primary schools, and finally find solutions to overcome these barriers.

Methodology- The study adopted a mixed methods approach to collect both quantitative and qualitative data. Thirteen ICT teachers, from different schools in the UAE, were interviewed in the qualitative study to investigate their perception of the teaching of programming to primary students. A questionnaire was in the quantitative study. The questionnaire distributed to parents who have kids in primary school in the UAE received responses from 499 parents. The primary goal of the questionnaire is to validate the interview results as well as understand the parents' perspectives towards their kids' experiences with the programming being taught at school.

Findings- The analysis of data revealed that the good application of programming education in UAE schools is yet to be accomplished. There is a need to reform the teaching of programming in primary schools in the UAE and to raise awareness about it and its importance in the schools.

Implications- One significant implication is that teaching programming should be taken seriously by educational policymakers and school leaders as a core subject that should be taught to all students. The study also contributed to the growing body of literature on the value of programming skills and the role of the appropriate curriculum in developing these skills. It also makes some recommendations to the MOE, the school inspections team, school managers, and teachers in order to improve education programming and overcome challenges in UAE primary schools.

Originality/ value- This study provides new insights at both practical and scholarly levels. It can shed light on the field's expansion prospects. The outcomes of this study may assist educational policymakers in better implementing programming education, particularly in primary school. Moreover, it helps teachers better prepare for the problems that primary students may encounter with learning programming in schools.

Keywords: programming, coding, block-based coding, computational thinking, TAM.

خلاصة البحث

الغرض- مع استمرار تطور عصر التكنولوجيا، اكتسب تعليم البرمجة قدرًا متزايدًا من الاهتمام. تلعب البرمجة دورًا مُهِمًّا في إعداد الطلاب وتسليحهم بلغة المستقبل. الغرض من هذه الدراسة هو إظهار أهمية البرمجة، ومناقشة الفلسفة التربوية لكيفية تدريس البرمجة، وتحديد العوائق التي تحول دون التنفيذ السليم لتعليم البرمجة في المدارس الابتدائية في الإمارات العربية المتحدة، وأخيرًا إيجاد حلول للتغلب على هذه الحواجز.

المنهجية- اعتمدت الدراسة نهج الأساليب المختلطة لجمع البيانات الكمية والنوعية. في الدراسة النوعية، تمت مقابلة 13 مدرسًا ومدرسة لتكنولوجيا المعلومات والاتصالات من مدارس مختلفة في الإمارات العربية المتحدة للتحقيق في تصورهم لتدريس البرمجة لطلاب المرحلة الابتدائية. وفي الدراسة الكمية، تم توزيع استبيان على أولياء الأمور الذين لديهم أطفال في المدرسة الابتدائية بدولة الإمارات العربية المتحدة. وقد تلقى الاستبيان إجابات من 499 ولي أمر. الهدف الأساسي من الاستبيان هو التحقق من صحة نتائج المقابلة وكذلك فهم وجهات نظر أولياء الأمور تجاه تجارب أطفالهم مع البرمجة التي يتم تدريسها في المدرسة.

النتائج- كشف تحليل البيانات أن التطبيق الجيد للتعليم البرمجي في مدارس الإمارات العربية المتحدة لم يتم بعد. هناك حاجة لإصلاح تدريس البرمجة في المدارس الابتدائية في دولة الإمارات وزيادة الوعي بها وأهميتها في المجال المدرسي (مديرو المدارس، والمعلمين، والطلاب) ومجال المجتمع (أولياء الأمور).

الآثار- أحد الآثار المهمة هو أن البرمجة التعليمية يجب أن تؤخذ على محمل الجد من قبل صانعي السياسات التعليمية وقادة المدارس كموضوع أساسي يجب تدريسه لجميع الطلاب. كما ساهمت الدراسة في تنامي عدد المؤلفات حول قيمة مهارات البرمجة ودور المناهج المناسبة في تنمية هذه المهارات. كما يقدم بعض التوصيات إلى وزارة التربية وفريق التفتيش على المدارس ومديري المدارس والمعلمين من أجل تحسين برامج التعليم والتغلب على التحديات في المدارس الابتدائية في الإمارات العربية المتحدة.

الأصالة/ القيمة- تقدم هذه الدراسة رؤى جديدة على المستويين العملي والعلمي. يمكن أن يلقي الضوء على آفاق التوسع في المجال. قد تساعد نتائج هذه الدراسة صانعي السياسات التربوية في تحسين تنفيذ برامج التعليم، لا سيما في المدارس الابتدائية. علاوة على ذلك، فهو يساعد المعلمين على الاستعداد بشكل أفضل للمشاكل التي قد يواجهها طلاب المرحلة الابتدائية في تعلم البرمجة في المدار..

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Special appreciation is extended to all ICT teachers and parents who agreed to participate in my research and who did not spare their time, effort, or knowledge to help me understand the research problem at hand. I regard this study as a joint effort with them because they are the driving force behind comprehending, evaluating, and even locating solutions to the study topic at hand.

It was the first time for me to write an academic research paper when I joined the British University in Dubai in January 2021. It was really difficult for me at the beginning, but now with pride, academic research has become one of my first priorities and stems from my passion. Therefore, I would like to express my respect and thankfulness to all the academic staff in BUiD who assisted me in reaching this stage. In addition, I would like to extend my deep gratitude to Dr. Rawy Thabet, who laid the foundation stone on which my research papers were built and was consistently supportive and helpful during the DTC lectures.

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1 CHAPTER ONE

INTRODUCTION

This initial chapter provides an overview of the significance of programming to primary students that affects their academic and future skills. This chapter also includes the problem statement and study rationale, as well as the purpose, questions, and delimitations, as well as the study structure.

1.1 Study Overview

Over the past decade, the rapid development of technology has heightened the need for programming as a core skill for early-age students in their learning process. Under these rapid changes, many countries revised their educational policies in order to include more computer science and programming education in school curricula. Previous studies have reported that programming (also referred to as coding) is an essential skill that all students should master in order to meet the needs of the 21st century (Abiodun & Lekan 2020; Vico, Masa & Garcia 2019; Kim & Ko 2017; Kanbul & Uzunboylu 2017; Manches & Plowman 2017). There is little surprise that the importance of programming has become more critical, especially after COVID-19 as it proved the necessity for all students to be technology literate and armed with the language of the age to cope with the future demands and be ready to face any future crisis. Furthermore, programming and computational skills encourage students to improve their academic performance while also strengthening their creativity, critical thinking, and a variety of other life skills.

This study focuses on the importance of programming for primary students' future and academic skills because when kids are introduced to programming early, they develop an understanding of how digital technology works and learn how to develop their skills. The study also highlights the issue of the lack of time and resources allocated to this crucial skill in United Arab Emirates schools and investigates ICT teachers' perceptions of the mentioned issue, with the intention of finding out what would be the barriers that prevent them from teaching programming efficiently. Additionally, the study intends to make some recommendations to educational institutions and teachers on how to better teach programming to primary students.

The idea behind the present study was triggered by the researcher after more than four years of working with ICT teachers and primary students in the UAE. The researcher's role was to supervise the ICT teachers while teaching programming to primary students and support them to successfully complete this process during a programme that is organised by one of the UAE's governmental organisations to train the young students in the basics of coding, problem-solving, programmatic thinking, and artificial intelligence. The researcher was observing the students' attitudes and passions towards programming and their ability to absorb their concepts, trying to understand the reason behind their level of diversity and the challenges they face in learning programming. And that was figured out after many years of experience with both students and ICT teachers that the school has the main role of enhancing or quenching the students' skills in programming. Therefore, the researcher decided to widely investigate this topic in her dissertation due to its importance and efficacy in students' academic and future lives.

1.2 Statement of the problem

Technology permeates nearly every part of our kids' lives; therefore, understanding it is more important than ever (Sanger et al. 2021). More recent attention has focused on considering programming as essential as reading, writing, and arithmetic to young students. However, students still face challenges in learning programming in UAE schools. The schools in the UAE do not allocate sufficient resources and time to teaching the primary students the main concepts and skills of programming. Furthermore, they consider programming as a subsidiary skill and basically deal with information and computer technology (ICT) subjects as an activity that can be dropped or ignored at any time. This could be due to time constraints in schools or a preference for other courses such as math and physics. Nowadays, primary students become computer and internet literate before they learn how to read and write. However, they lack an understanding of how computer technology works (Kaplancali & Demirkol 2017). This leads to creating a generation that is passively consuming technology. Therefore, UAE educational policies should revitalise the educational system by widely integrating programming into the primary school curriculum and raising awareness of its benefits and potential applications; additionally, educational leaders and teachers should capitalise on children's enthusiasm for technology and guide them in the right direction to build their computing knowledge and transform them from passive consumers of technology to innovators and active creators.

1.3 Rationale of the study

Highlighting the importance of programming education is one of the current trends that many studies have discussed before. Numerous research has been conducted on how to implement ICT in education; the integration of computers and laptops into the classroom; teaching programming to middle and high school students, etc. However, there is a noticeable gap in research on the impact of programming on primary students that affects their performance, thinking, and future skills (Kanbul & Uzunboylu 2017; Vico, Masa & Garcia 2019; Lewis 2020). In addition, to the best of the researcher's knowledge, no research has been found that surveyed how primary schools teach programming to younger students in the UAE context. Little is known about the time and resources allocated to programming in UAE primary schools, and it is not clear yet why some students lack an interest in learning programming and perceive it as a complex skill that they cannot absorb like other subjects. This indicates a need to investigate the issues of programming education that exist in many of the UAE primary schools. Therefore, the current study seeks to explore the time and resources allotted to programming in UAE primary schools, as well as the barriers that prevent UAE teachers from properly teaching programming to primary students. The study also intends to fill the literature gap, contribute to the educational knowledge base, and generate some recommendations to schools on how to better teach programming to primary students.

1.4 Study purpose and questions

The aim of this study is to identify the hurdles preventing the proper implementation of programming education in UAE primary schools. The study aims to investigate the perspectives of both the ICT teachers and parents towards programming education, the atiitudes of the primary students towards it, as well as the times and resources allotted to programming in their schools. To this end, the study is driven by attempts to answer the following main question:

Do primary schools in the UAE properly implement coding or programming education and provide it with the needed time and resources?

To answer the above research question, the following sub-questions have been raised:

- What are the ICT teachers' perceptions of programming being taught in UAE primary schools and its impact on students' performance?

- What challenges do ICT teachers experience in teaching programming to primary students?
- Do UAE schools allocate adequate time and resources for teaching programming to primary students?
- What are the parents' opinions regarding programming education for primary students?

1.5 Delimitations

Delimitations are elements that narrow the scope of a study and establish its boundaries (Bloomberg & Volpe, 2012). Delimitation is required for the main aim to not be too broad and for the author to achieve all specified goals. It assists in focusing on the fundamentals and avoiding delving into other topics when writing a research paper. The most important delimitation of this study is to specify the investigations into British, American, and governmental schools only. Any other kinds of schools are not considered.

The second delimitation is to include only articles that are relevant to the methodology of teaching programming, authors' perceptions of it, and the challenges students have faced, and only within the past five years in the literature review section, with the aim of writing an accurate and effective literature review that supports the validity of the findings.

1.6 The structure of the study

The overall structure of this study takes the form of six chapters, including this introductory chapter, which begins with a general overview of the study, then defines the statement of the problem, the rationale for choosing to investigate this study, the aim and research questions, and the delimitations.

Chapter two includes the literature review and covers the conceptual framework, which delineates the main concepts allied to the foci of the current study; the theoretical framework, which introduces the theories that explain why the research problem under the current study exists; and a review of related and recent literature that is relevant to the study being investigated.

Next, the methodology section is presented in the third chapter, in which the research will be pursued to get the results. The research methodology describes the research type and approach, data gathering methods, participants, and procedures the researcher follows to carry out her

investigations.

Chapter four is the data analysis and results, which comprises the gathered data from semi-structured interviews and questionnaires undertaken during the third chapter.

What follows is the discussion chapter, which discusses the results and draws comparisons between them and the recent studies.

Lastly, the conclusion chapter summarises the basic findings, limitations, possible implications, and recommendations for future research.

2 CHAPTER TWO

LITERATURE REVIEW

This chapter presents an overview of previous research on the importance of programming to students. The content of this chapter also acknowledges similar studies to broaden our understanding of the challenges primary students may face in learning programming in the school context. This chapter begins with a conceptual framework that delineates the main concepts related to the current study, followed by a discussion of the theoretical framework that underpins this study; what follows is an account of the recent literature review that investigated the same topic. Studies from literature are discussed as follows: First, the importance of programming is highlighted for students' academic development and future achievement. Then, the usefulness of block-based coding for young students is discussed. Afterward, the researcher reflects on the different perspectives for teaching programming to younger students. Finally, the programming status in local and global educational policy is investigated.

2.1 Conceptual Framework

In order to provide a more comprehensive knowledge of the programming concept, some of the main definitions that are utilised in the literature review and throughout the study are defined. The definitions are obtained from numerous sources and are appropriately cited. Based on the purpose of this study, the following terms are involved: programming, which consists of block-based coding and text-based coding; and computational thinking. To start with, programming can be defined as the ability of a person to successfully apply and cultivate computational thinking capabilities (Piteira, Costa & Aparicio 2018). There is a large volume of published studies referring to programming as coding. However, Sun, Hu, and Zhou (2021) emphasise that programming is not limited to code. Coding was regarded as one of the subtasks of programming; in addition to writing and maintaining code, it also entailed significant computational and problem-solving skills. There are numerous definitions of computational thinking in the literature, but there is a consensus among researchers that computational thinking is a mental process that employs abstraction, generalisation, decomposition, algorithmic reasoning, and debugging (Webb et al. 2016). It also provides the conceptual underpinnings required to solve problems efficiently (Shute, Sun, & Asbell-Clarke 2017). This

view is supported by Kong and Wang (2021), who write that programming is one of the most effective approaches for developing computational thinking (CT).

There are two different forms of programming: text-based and block-based coding. The literature makes use of a variety of definitions to distinguish between them. Price and Price-Mohr (2018) define text-based coding as that type of programming that is based on texts written using a keyboard and saved as text files, whereas block-based programming is based on images. In recent years, there has been a significant amount of literature referring to block-based coding as visual and graphical-based coding (Basawapatna 2016; Chao 2016; Erol & Kurt 2017; Yukselturk & Altiok 2017; Sáez-López, Román-González & Vázquez-Cano 2016; Weintrop & Wilensky 2017; Techapal 2017). It is appropriate for elementary and junior students (Morris, Uppal & Wells 2017) and can be solved simply by dragging and dropping the blocks to make logical sequences (Chen et al. 2019). Therefore, the study will focus more on it throughout the investigation.

2.2 Theoretical Framework

The theoretical framework is a blueprint that is frequently "taken" by researchers in order to construct their own study inquiry (Grant & Osanloo 2014). It serves as the basis upon which research is conducted (Adom, Hussein & Agyem 2018). Many researchers have stated that the theoretical framework gives a common perspective or lens from which to view the problem and select a suitable research strategy, analytical tools, and processes for the research enquiry (Ravitch & Carl 2016; Grant & Osanloo 2014). And thus, it improves the significance and generalizability of study findings (Akintoye 2015).

2.2.1 Technology Acceptance Model (1989)

The Technology Acceptance Model (TAM) proposed by Davis is the most intriguing model in relation to the purpose of the study. TAM concentrates on two primary factors that influence an individual's propensity to accept new technology: perceived usefulness and perceived ease of use (Boot & Charness 2016). According to Davis, Bagozzi & Warshaw (1989), the first factor "perceived usefulness" is defined as the subjective likelihood that employing a given application system will improve a prospective user's work performance within an organisational setting, while the second factor "perceived ease of use" is defined as the extent to which a prospective user anticipates the target system to be effortless. These two factors are

determinants of consumers' attitudes about adopting new technology, which can influence their behavioural intention to adopt the technology (Cheng 2019). Students who view coding as being excessively difficult to learn are unlikely to learn it. In contrast, students will be more likely to learn and acquire coding if they perceive its usefulness and easiness and view it as giving necessary future abilities and being simple to grasp. According to Chao (2016) and Kong, Chiu, and Lai (2018), students may lack interest, confidence, and objectives (Kert, Erkoc &Yeni 2020) in programming learning due to the misconception that programming requires complex concepts. Their empirical study results also showed that students who were more interested in programming thought it was more meaningful, had a bigger influence, had more creative self-efficacy, and had more programming self-efficacy.

Other important aspects of the TAM model include attitudes toward utilisation, which can be defined as the user's desire to use the technology. The mix of perceived usefulness and actual utilisation predicts the attitude toward use.

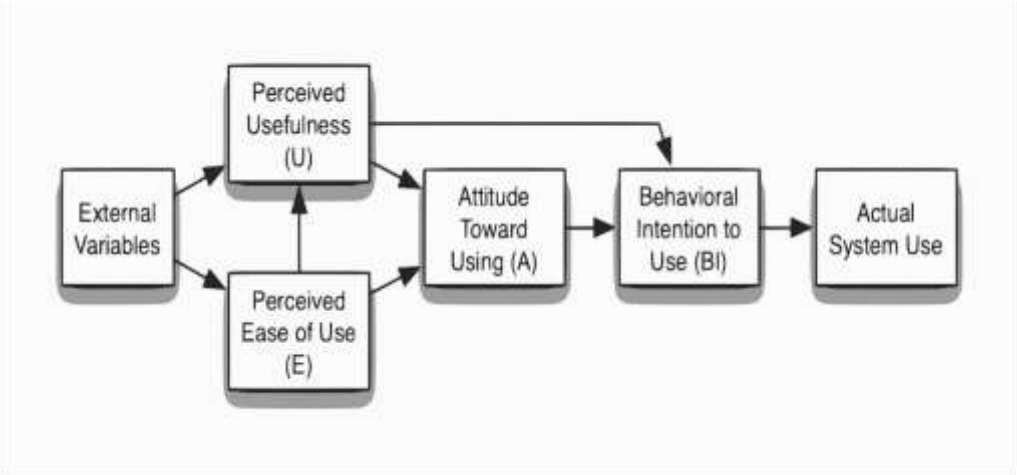

Figure 1. Technology Acceptance Model (Davis, 1989)

Even though TAM was initially proposed to anticipate users' acceptance of technology in the workplace (Davis, Bagozzi & Warshaw 1989), it has been increasingly verified as a theoretical model to investigate primary students' adoption of educational technology in different countries (Cheng 2019).

2.2.2 Piaget's Theory of Cognitive Development (1971)

The Common Underlying Piaget's Theory of Cognitive Development is, very naturally, also relevant to the goal of this study. According to Piaget's theory of cognitive development, children go through a succession of stages in their mental growth. From infancy until puberty, children go through four distinct stages of cerebral development. Each stage is distinguished by changes in how children see and relate to the people and objects in their surroundings.

Stage	**Feature**
Sensorimotor Stage (Birth – 2 years)	During the first two years of life, motor movements and sensory input contribute to a child's environmental awareness. Infants acquire knowledge of their environment through their senses, perceptions, and motor abilities.
Preoperational Stage (2 – 7 years)	Young children can think in terms of symbols. There is the ability to create a single thing, such as a word or an object. However, thinking remains egocentric, and infants have difficulties considering the perspectives of others.
Concrete Preoperational Stage (7 – 11 years)	They tend to think in very literal, physical ways. However, they still struggle with abstract concepts and hypothetical situations.
Formal Preoperational Stage (11 years and over)	Children acquire the ability to consider abstract topics and evaluate hypotheses logically.

Table 1. Piaget's theory of cognitive development.

Primary school students (aged 6–11) can be categorised mostly under the concrete operational stages. Children in the concrete operations stage, which lasts from seven to eleven years, engage in symbolic play and learn to manipulate symbols; they do not comprehend concrete reasoning and struggle with logic and mental transformation of knowledge. They are only capable of abstract and logical thinking once they have reached the formal operational stage (Kawada et al. 2019), in which children begin to organise their thoughts, apply logical thinking skills, and

rely less on direct physical representations of concepts (Relkin, de Ruiter & Bers 2021). Thus, when developing a programming curriculum for younger students, both curriculum developers and teachers should consider the process of children's cognitive development.

2.2.3 Papert's constructionism theory (1972, 1980)

In his constructionism theory, which has been applied and documented widely in computing and technology literature, Papert (1972) supports the idea that children programme the computer rather than the computer programming the children. He pioneered the concept of computational thinking and emphasised its power of empowerment, arguing that by providing children with access to computers, a sufficiently clear and intelligent programming language, and peripheral devices capable of producing on-line real-time action, we can give them unprecedented power to invent and carry out exciting projects. He felt that students would have a deeper understanding of science, mathematics, and technology via hands-on experience in computing. However, Papert did not suggest a criterion for gauging children's empowerment in programming.

In 1980, Papert, in his ground-breaking book "Mindstorms: Kids, Computers, and Powerful Ideas," ushered in a new era in which children utilised computer programming. He argues that children's engagement in programming could influence how they learn and have a favourable effect on their cognitive abilities.

Papert has shown that a programming language should have two characteristics: on the one hand, it should allow for an easy and intuitive introduction to programming ("low floor"). On the other hand, it should enable users to carry out sophisticated and large projects ("high ceiling").

These theoretical approaches go well together to serve the goal of this study, which is to consider programming as a critical skill for students' academic and future success.

The spread of computing and its advanced technology, especially those that are connected to school education, necessitates academics to build new theoretical frameworks to explain the proliferation, its measurement, deployment, and integration into the educational and cultural setting.

2.3 The importance of programming

2.3.1 Programming impacts on students' academic development

Programming is rapidly becoming the most important addition to education in recent years. It has been demonstrated to hasten students' cognitive development (Brackmann et al. 2017; Zhang & Nouri 2019). More recent attention has focused on the necessity of programming provision in the primary students' curriculum. Manches & Plowman (2017) claim that programming is as essential as reading and writing; it fosters the development of diverse abilities such as science, mathematics (Turan & Aydoğdu 2020; Scherer, Siddiq & Sanchez 2018), and STEM (Gunbatar & Karalar 2018; Master et al. 2017; Mouza et al. 2016; Saez-Lopez, Roman-Gonzalez, & Vazquez-Cano 2016; Kucuk & Sisman 2017). It also enables the students to understand how computers work (Arfé et al. 2019; Manita, Durão & Aguiar 2021; Relkin, de Ruiter & Bers 2021; Román-González, Pérez-González & Jiménez-Fernández 2017). While students are learning to code, they not only learn to code but they also learn a lot of other educational outcomes such as critical thinking, social skills, problem-solving, and self-management (Popat & Starkey 2019; Chao 2016; Martín-Ramos et al. 2018; Schanzer, Fisler & Krishnamurti 2018; Scherer, Siddiq & Sanchez 2018) in order to empower students with the ability to apply critical thinking skills in an information society. In the same vein, Psycharis & Kallia (2017) stated that programming provides several benefits for students' cognitive capabilities that are applicable to many courses like Mathematics, Engineering, and Science besides shaping students' basic programming concepts. In a quasi-experimental study, which set out to validate the usefulness of teaching programming to school students, Psycharis and Kallia (2017) found a considerable difference between the reasoning skills of students who took the programming course and those who did not. Furthermore, the course dramatically improved students' self-efficacy and problem-solving scores in mathematics.

Learning programming, in addition, promotes the students' computational thinking skills (Chen et al. 2017; Marcelino et al. 2018; Yadav, Stephenson & Hong 2017; Popat & Starkey 2019). Computational thinking skills are among the key skills that students should have in the twenty-first century (Pereira, dos Santos & Odakura 2018; Sophia & Tewes 2019; Abiodun & Lekan 2020). The positive relationship between programming and computational thinking is widely supported by many studies (Marcelino et al. 2018; Moreno-León et al. 2016; Pérez-Marín et al. 2020; Sáez-López, Román-González & Vázquez-Cano 2016). Nouri (2019) conducted a meta-analysis of 55 empirical investigations and offered evidence of the development of

computational thinking skills via Scratch programming. In another meta-analysis study by Scherer et al. (2020), who synthesised 139 treatments of computer programming training, he discovered that computer programming had a significant impact.

Despite the general consensus that exists regarding programming as a core skill that improves students' academic achievement, some researchers argue that students still face difficulty in acquiring specific topics in it (Chao 2016; Sáez-López et al. 2016), resulting from insufficient self-efficacy for the majority of students (Yukselturk & Altiok 2017). Students may have little interest and confidence in programming learning because they believe it demands sophisticated concepts and skills (Chao 2016). Research concludes that programming confidence increases with practise (e.g., Gunbatar & Karalar 2018; Shim, Kwon & Lee 2016; Tsai et al. 2019) and suggests that the programming learning environment should be improved to face these difficulties (Sáez-López et al. 2016) and consider Piaget theory in developing the content.

2.3.2 Programming impacts on students' future achievement

Numerous studies have emphasised the significance of coding as a core competence in the twenty-first century (Costa & Miranda 2017; Pereira, dos Santos & Odakura 2018; Sáez-López, Román-González & Vázquez-Cano 2016; Rich et al. 2019; Kong & Wang 2021). Kong & Wang (2021) describe programming as an indispensable form of literacy in the digital age. Almost every paper that has been written on programming education includes a section in relation to its value to students' future progress (Matthee & Turpin 2019; Kaplancali 2017). Programming education is tightly linked to a variety of abilities that students must learn for their future, including creativity, critical thinking, and problem solving (Cheng 2019; Korkmaz, Cakir & Ozden 2017; Doleck et al. 2017). According to Piteira, Costa & Aparicio (2018), these skills prepare students to cope with the learning evolution and information society.

In terms of university level, it has been found that having any prior programming expertise improves students' attitudes towards programming and grades in introductory college computer science courses (Chen et al. 2019). Lin, Chang & Tsai (2016) and Psycharis & Kallia (2017) explored the relationship between self-efficacy skills and reasoning skills needed for the students' future skills and programming and found that the three concepts are positively correlated. Additionally, programming develops personal skills such as social abilities and self-management or active learning (Scassellati et al. 2018). Nonetheless, there is a scarcity of studies on the importance of social skills in computer science education (Webb et al. 2017).

As far as jobs are concerned, contributions from research done in the last 5 years have attempted to relate students' efficiency in programming to obtaining good jobs. They argue that experience gained at an early age influences future employment selection; therefore, it is critical to begin computer science education in primary schools (Noh & Lee 2020). However, little research has been conducted to determine how primary school students benefit from computer education (Chen et al. 2017).

According to the US Bureau of Labour Statistics (2022), information technology jobs will grow by 13 percent over the next decade, far faster than the average for all occupations. There is a need to investigate the cognitive and affective effects of computer science and coding instruction on students, given the growing emphasis on teaching coding. Similarly, Sheehan et al. (2019) maintain that the number of jobs in the information technology industry will increase by 12.5% over the next decade; correspondingly, the inclusion of computational thinking in school curricula should increase. Although perceptions of future jobs and competencies required for Industry 4.0-induced changes differ depending on the sector in which the expert works, there is widespread agreement that job profiles related to programming, mechatronics, robotics, data analysis, Internet of Things, design and maintenance of smart systems, process analysis, and bionics are the new job profiles required in smart factory systems (Jerman, Pejić & Aleksić 2020; Benešová & Tupa 2017; Tytler et al. 2019).

2.4 Block-based coding for younger students

Two terms are mentioned in the literature under the umbrella of programming or coding: text-based and block-based coding. Text-based programming is a difficult and arduous undertaking that is challenging for young students to grasp (Chen et al. 2019), in which the students must learn algorithms and logical thinking to correctly enter programming commands, which is not appropriate for their age (Karaliopoulou, Apostolakis & Kanidis 2018). Therefore, programmers have developed block-based coding with graphical environments to assist young students in absorbing it without learning the complex syntax of a programming language. Students can develop a powerful program in a multimedia context with minimal effort using block-based coding.

Block-based coding has been largely explored in a programming education context (Chen et al. 2019) to improve primary students' skills and positively affects their academic accomplishment, efficacy of computational thinking skills, and conceptual knowledge levels

about programming (Aksit & Wiebe 2020; Kert, Erkoc & Yeni 2020; Tsai 2019). Yukselturk and Altiok (2017) examined the connection between block-based coding and self-efficacy and discovered a strong beneficial effect of block-based coding on the self-efficacy of learners. It comes as no surprise that young students enjoy learning coding using the visual and graphical interface of block-based coding (Basawapatna 2016; Chao 2016; Erol & Kurt 2017; Yukselturk & Altiok 2017). It motivates them to achieve better results in basic programming concepts when they focus on the end-task instead of details (Price & Barnes 2017). Some researchers argue that block-based coding is suitable and helpful for young students who are supposed to be more enjoyable and less overwhelmed by cognitive concepts than in text-based coding (Sáez-López, Román-González & Vázquez-Cano 2016; Weintrop & Wilensky 2017). Instead of being frustrated by syntactic errors, students can more readily explore sophisticated computational concepts, which may promote higher "programmability" and greater diversity in computational engagement (Bau et al. 2017).

Furthermore, research has shown that teachers can use block-based coding in the classroom to teach a variety of subjects, as many graphical languages for young learners were created with entertaining, social, storytelling, and visually appealing elements (Dehouck 2016), and art, music, and interactivity can be used to create games, stories, and applications (Price & Barnes 2017). In these contexts, block-based coding can be used to solve problems, and it allows coding to be taught in primary schools. One of the most popular applications for the block programming language used by primary schools is Scratch, which was created by MIT Media Lab's Lifelong Kindergarten group (Sáez-López, Sevillano-García & Vazquez-Cano 2019). Despite the widespread and efficacy of scratch use in primary students' environments, Kawada et al. (2019) draw our attention to examine alternative programming languages (apart from Scratch) in order to provide some variety to programming instruction. He also suggests using educational robotics to introduce the basics of programming concepts to preschool-aged children.

Notwithstanding the many advantages of block-based coding for youngsters that have been mentioned in prior studies (e.g., Cheng 2019; Basawapatna 2016; Chao 2016; Erol & Kurt 2017; Yukselturk & Altiok 2017), many authors are doubtful about their long-term benefits. Techapalokul (2017) claims that the absence of syntax in graphical programming languages encourages undesirable practises such as incomprehensible naming, lengthy scripts, and

redundant or unneeded code. Such practises were suspected of being detrimental to the eventual move to a formal programming language (Alturki 2016; Román-González, Moreno-León & Robles 2019). Notwithstanding, these claims were denied by some empirical studies conducted among students who learned block-based coding and then solved the same activities in text-based coding and revealed that students whose first language was graphic did better than those whose first language was textual (Chen et al. 2019). Importantly, the majority of students said their prior expertise with block-based programming aided them in designing programmes in a text-based environment (Kanidis, Karaliopoulou & Menounou 2016). Falloon (2016) also questioned its impact on problem solving skills and pointed out that there is no considerable difference in the problem-solving skills of students before and after block-based programming courses in primary schools. However, a recent study by Kong & Wang (2021) emphasized that block-based coding in particular is extremely beneficial for fostering the learning of problem-solving skills.

2.5 Perceptions of teaching programming to young students

Although extensive research has stressed the necessity of programming, few studies exist which investigate this necessity for early-age students (preschool) (Rich et al. 2019), and some disagree about the age at which the students should be exposed to programming. Consequently, the generalizability of published studies on this topic is questionable.

On the question of primary students, there has been a growing and widespread interest in providing primary students with the information and abilities required for programming in recent years (Cheng 2019). In an important study by Coşar and Özdemir (2020), they concluded that computer programming education for young students is a new emerging field and bringing together the necessary elements to achieve success in this field and the application of information about the method of investigation is critical. They propose that children should be taught how to build computers, programmes, and computer games rather than simply using computers. Computers can be utilised not only for games, amusement, and access to the Internet, but also as a tangible instrument for students to improve skills in areas such as problem solving, logic development, and critical thinking. Likewise, Durão (2021) holds the view that it is vital for students to master the principles of computing at an early age. Thus, researchers have increasingly recognised the vital necessity of providing sound assessment methods capable of statistically capturing the critical components of programming instruction in the K–

12 context (Kong & Wang 2021), in addition to long-term investigations to determine the most successful teaching approaches in programming (Szabo et al. 2019).

Despite the generally positive perceptions of programming for young students, there are also some noted challenges, such as the complicated thinking abilities required to apply logic principles and solve problems (Noh & Lee 2020), especially when the audience consists of primary school students with weak or no literacy abilities (Szabo et al. 2019). Hence, traditional teaching methods do not appear to be adequate for assisting students in overcoming these obstacles (Dawson et al. 2018). Hence, teachers must recognise the need for developing and implementing new teaching and learning approaches that can improve their students' learning experiences (Alammary 2019), such as collaborative work and student-centred teaching approaches (Alturki 2016). Another element that appears to negatively hinder the proper programming education of primary students is the principals' attitudes towards this skill. Kong & Wang (2021) discuss how principals can affect this learning process either positively or negatively. They assert that principals who have a better understanding of programming education have clearer expectations for how to implement programming education in their schools, which leads to increased support for programming education implementation. In their endeavour to find a solution to this issue, they assert that understanding school administrators' perceptions of programming education is crucial for properly promoting and implementing programming in K–12 education.

2.6 The status of programming in educational policies

Increasingly, contemporary education policy processes are distributed across borders, sectors, organisations, industries, technologies, individuals, and objects. Globally, national education systems have hastened the implementation of a large policy focus on 'learning to code', programming, and computing in schools. Programming software and applications provided by industry, start-up groups, and computer science are becoming standard in all levels of compulsory education (Williamson et al. 2019; Gulson et al. 2017). Many countries' educational policies modernise computer science curricula by including programming instruction into elementary school and general education (Chen et al. 2017; Seow et al. 2019). They propose policies to promote coding skills in education. Several countries, notably the United Kingdom, the U.S., Finland, Australia, Greece, and France, have made programming education mandatory

beginning in primary school (Rich et al. 2019).

Previous president Obama announced the "Computer Science for All" project in 2016 to empower US children in kindergarten through high school to learn computer science and gain the computing skills required to engage in the digital economy as producers, not simply consumers (Price & Price-Mohr 2018; Smith 2016; Tran 2018). This policy sought to train students to be technical innovators and engaged citizens in an increasingly technologically advanced environment. The policy emphasised the importance of learning computational thinking from kindergarten to high school. In 2017, the administration of Donald Trump directed the US Department of Education to allocate $200 million annually to K-12 computer science education, with extra funding from Amazon, Facebook, and Google. Code.org hailed this as a success for its non-profit organisation (Dickey 2017).

In the United States, venture capitalists and technology entrepreneurs play a crucial role in coding education. The non-profit organisation Code.org, founded by Silicon Valley 'angel investors' to promote the 'Hour of Code' in US public education, has been identified as a new prototype for Silicon Valley education reform: a social-media-savvy entity that pushes for education policy changes, develops curricula, offers online coding lessons, and trains teachers—touching nearly every aspect of the education supply chain (Singer 2017). Over the last year, 31 states have adopted 50 computer science education policies, with 21 states continuing to fund computer science education. (Code.org 2021). Approximately 30% of all students in the United States have enrolled in Code.org (Code.org 2019). Enrolment has progressively increased from 10,000 teachers and 500,000 students in late 2013 to one million teachers and 36,000,000 students at the end of 2018 (Rich et al. 2019).

In the same line, computer programming is now mandated to be taught in elementary schools in England as part of the National Curriculum (Larke 2019). It is widely recognised that England has played a prominent (if not pioneering) role in the worldwide revival of policy interest in coding in schools (Williamson et al. 2019; Bocconi, Chioccariello & Earp 2018).

The education politician Tomas Tobé argued provocatively that pupils should be able to learn coding and programming instead of arts and crafts in order to be better prepared for the job market, elevating the profile of coding education in Swedish schools during the 2014 general election campaign. Then, in 2016, a national IT education policy was ratified, including the programming curriculum features hastily developed in February and March, a topic that

required intensive teacher professional development activities. Programming, or coding, has been incorporated into existing math, technology, language, and social science courses and implemented by schools by the middle of 2018 (Williamson et al. 2019).

In Europe, Finland has made algorithmic thinking and programming a first-grade cross-curricular requirement. In 2014, the development of a new National Core curriculum for elementary and junior high schools incorporated learning objectives related to parts of computer technology and programming, as well as the development of problem-solving skills in the context of a real-world situation (Seow et al. 2019). Beginning in August 2019, all secondary school students in Taiwan have been obliged to develop computational thinking skills (Hsu 2019).

Computer coding was to be incorporated into the Australian curriculum by 2020, supported by a $9 million "National Coding in Schools Centre" that would train teachers, provide tools, and promote classroom integration (Williamson et al. 2019).

Countries in Asia, such as Japan and Korea, plan to make programming a required component of school education. Japan announced plans to make computer programming mandatory for all primary school students by 2020; middle school students in 2021; and high school students in 2022. (Japan Times, 2017). South Korea trains students for the creative economy through initiatives like the Software Education Initiative. Modifications to the curricula will be implemented at all levels of education, from elementary to university, with a focus on the development of skills, technology, and creative expression through programming. The new programme became mandatory for elementary and lower secondary students in 2018 (APFC 2017).

Computer studies have been taught in Indian schools for the past two decades. However, there is considerable diversity in both the selection of topics and the handling of specific issues. Typically, the emphasis is on application-specific usage and skill-based information. There is insufficient emphasis on critical thinking skills with broad application, such as computational thinking and 21st century skills (Iyer 2019).

Since the fall of 2016, coding has become a mandatory, cross-curricular activity in Finland, beginning in the first year of school and spanning both primary and lower secondary education (Wu et al. 2020). Coding, like reading, writing, counting, and drawing, is listed as a learnable skill in Finland.

Seow, Looi, Wadhwa, and Wu (2019) examine Singapore's CT educational strategy, which

employs a pragmatic approach based on an eco-system, with a focus on fostering students' interests and allowing schools to opt in rather than making Computational Thinking education compulsory. Singapore's policy provides excellent prospects for educational stakeholders with coding interests.

With respect to the United Arab Emirates, the ministry of education (2015) highlighted the significance of coding in the UAE Vision 2021, which emphasises science, technology, and innovation as the primary growth and development drivers. Continuous attempts are made to accommodate advancements in the sector in order to align the educational system's outcomes with international norms and requirements. According to Al-Karaki et al. (2016), these initiatives are motivated by the UAE government's objective of promoting knowledge and innovation through the implementation of an intelligent educational system.
Software and digital materials (e.g., courseware, digital textbooks, online learning platforms, learning management systems), as well as hardware, network infrastructure, telecommunications, and Internet networks to support these technologies, and even robotics, are all examples of policy initiatives for using education development, according to science, technology, and innovation policy (STI) (STI policy 2015). However, there is an ambiguous vision of how these resources are used and applied in schools, in particular, primary schools. STI policy is a bit general, focusing primarily on the goals, targets, and resources that the country provides to achieve these goals, but it should also focus on demand, evidence, implementation, and delivery in each section, particularly education, as it is a complex process with many factors to consider. It also requires a heuristic framework in order for us to evaluate it properly and professionally.

2.7 Conclusion

To summarize, there is agreement on the critical need to equip students with programming skills for academic development as well as to meet future and job demands. However, teaching kids to programme is a complicated procedure, indicating that learning to programme is challenging. Therefore, in giving programming instruction in elementary schools, we must determine its efficacy (Noh & Lee 2020). Teachers who want to modify students' perceptions or attitudes toward coding must be able to measure these changes in order to assess the performance of various coding programmes (Sáez-López et al. 2016). Although teachers have long recognised

the benefits that programming may provide to young pupils, the perspective of programming education among K–12 school leaders has rarely been investigated. To effectively promote and implement programming in primary schools, it is also crucial to first understand how school leaders see programming education. Robotics and block-based programming, which involve robot manipulation, may be suitable ways for such education. It has also been argued that novices' difficulties may be the result of unreasonable expectations rather than inherent subject complexity (Andrew 2016). Consequently, programming should be taught in the early school years, considering the abovementioned theories in developing the content and teaching approaches to properly apply the programming education process to younger students.

3 CHAPTER THREE

METHODOLOGY

This chapter extends the discussion to reveal the research methodology. It outlines information about the study approach, paradigm, research design, instrumentation, participants, and sampling. The three aspects of data analysis are qualitative and quantitative data gathering and analysis, and the overall interpretation of the mixed method approach. This chapter also discusses the data's validity and dependability, as well as the ethical considerations that were considered before the research.

3.1 Overview of the research paradigm

According to Patel (2015), a research paradigm is the set of common views and agreements among scientists over how problems should be viewed and addressed. It is a mode of thinking, or a collection of thoughts based on study data for the researcher (Kivunja & Kuyini 2017). The mixed methods approach used in this study is generally said to be grounded in the pragmatist paradigm (Feilzer 2010). Therefore, the research technique in this study is conceptualised using the pragmatism paradigm. Morgan (2007), Cherryholmes (1992), and Creswell (2014) considered Pragmatism to be the philosophical basis for Mixed Methods research. A combination of qualitative and quantitative techniques, according to pragmatism, is required to provide a thorough knowledge of the situation and produce common meaning. Qualitative research is used to provide insights into an issue, describe an experience, and explain and interpret relationships, whereas quantitative research is used to provide numerical data regarding attitudes and opinions, as well as generalise results from a larger sample population (Dörnyei 2007).

3.2 Research design

This study utilises a mixed-method approach to report on both ICT teachers' and parents' perceptions of the programming being taught to primary students at UAE schools. A mixed-method approach incorporates the benefits of both qualitative and quantitative research (Creswell 2018). One of the most useful features of mixed methods is the ability to triangulate, which refers to the use of several data sources to investigate the problem from various

perspectives (Creswell 2014). Hanson et al. (2005) provide a formal and operational description of mixed methods research as "the collection, analysis, and integration of quantitative and qualitative data in a single or multiphase study". Qualitative data is often open-ended, with no predetermined responses, whereas quantitative data, as seen on questionnaires or psychological tests, is typically closed-ended.

Although there are many designs that exist in the mixed-methods field (Creswell 2014), the researcher found that exploratory sequential mixed methods is the ideal model that fits the study purpose. It is a mixed-methods strategy involving a two-phase project in which the researcher collects qualitative data first and then follows up or builds on this database with quantitative data gathering and analysis. The exploratory sequential technique begins with a qualitative research phase in which the researcher investigates the perspectives of participants (Creswell 2014). The data is subsequently examined, and the results are used to build on the second, quantitative phase. The qualitative phase may be used to create an instrument that is best suited to the sample under study, to select appropriate instruments for use in the follow-up quantitative phase, or to describe variables that must be included in a follow-up quantitative study.

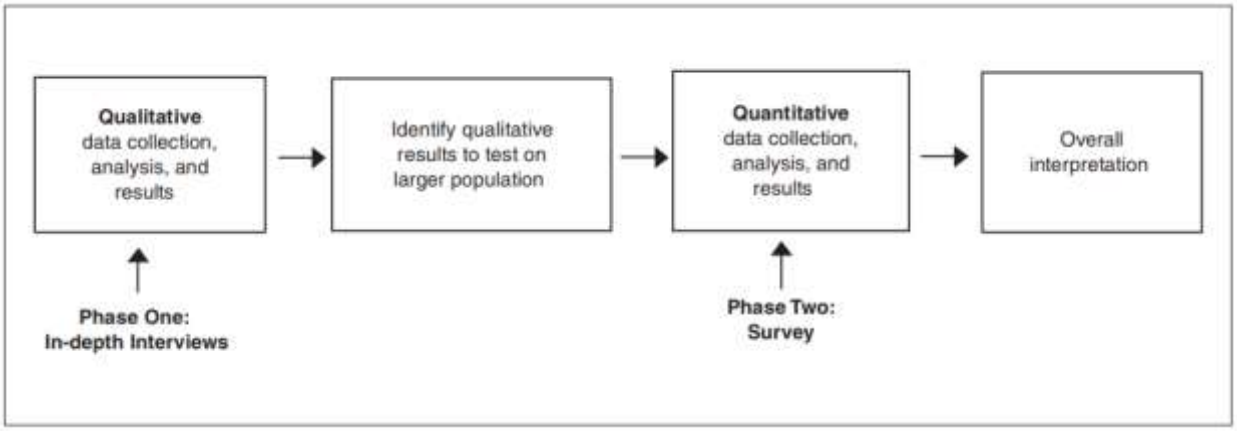

Figure 2. Fuentes' (2008) sequential exploratory mixed methods design

Cohen et al. (2018) emphasise that the guiding premise must be appropriate for the purpose. Thus, to answer the current research questions effectively, it is necessary to employ both qualitative and quantitative research approaches. This study encapsulates four research questions. Questions 1, 2, and 3, which are "What are the ICT teachers' perceptions of programming being taught in UAE primary schools and its impact on students' performance?" "What challenges do ICT teachers experience in teaching programming to primary students?"

and "Do UAE schools allocate adequate time and resources for teaching programming to primary students?" call for qualitative analysis to get detailed information about the mentioned research issues. While the quantitative study validates the previous three questions as well as answers Question 4, "What do parents think about teaching programming to first graders?"

3.3 Data Collection procedures

The first phase of the data collection process is getting ethical approval to make sure that the research objectives and plan adhere to the Research Ethics Committee. Once the researcher got the approval, she explained the study goal to the participants and started collecting and analysing qualitative data via semi-structured interviews according to the approved procedures. The highlighted themes in the interview were used to build on the quantitative instrument to further investigate the study subject (Schoonenboom & Johnson 2017). In the next phase, the questionnaire was shared with a wider sample size, then the data was analysed to clarify qualitative analysis findings and provide context for the research findings. On the basis of data interpretation, integration was established, and all data from both the qualitative and quantitative components of the study were analysed to determine their dependability. The two methods' findings were then merged, and the results were reported. The data collection procedures are outlined in Figure 3 as follows:

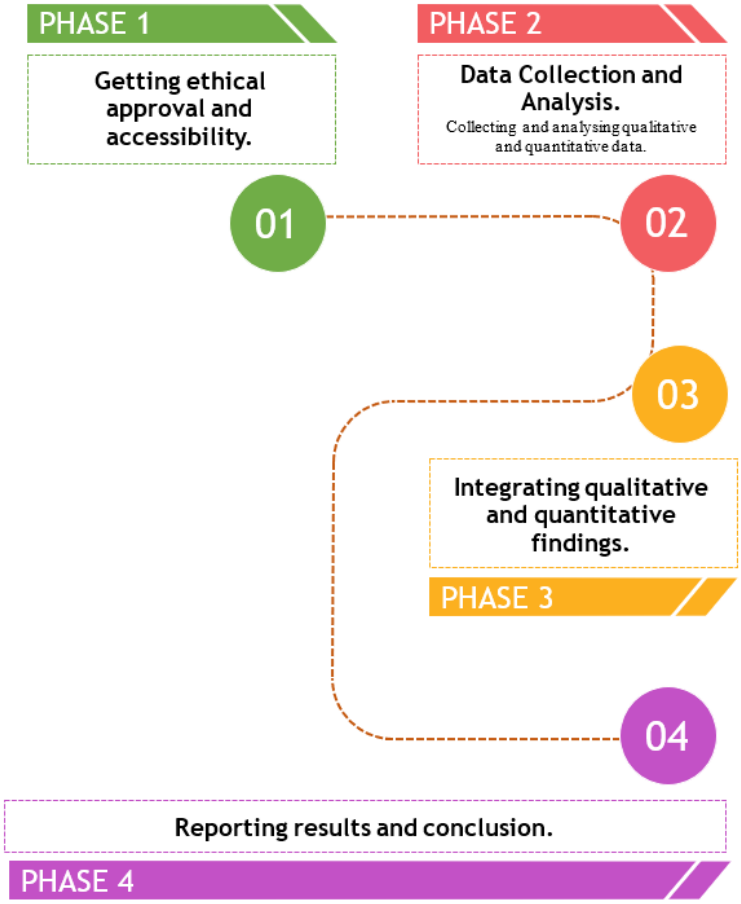

Figure 3. Data collection procedures

3.4 Qualitative Approach

3.4.1 Interview method selection

Interviews are the most popular instrument for collecting qualitative data (Pope & Mays 2006; Bengtsson & Fynbo 2018; Fritz & Vandermause 2018). The interview consisted of the interviewer, who controls the conversation and asks questions, and an interviewee who responds to those questions (Shepherd & Griffiths 2021). The interviewee perspective is one of the most important approaches in qualitative research, and it is the best option for any descriptive or exploratory study (Wilson, Williams & Hancock 2000). The interview is an excellent way of getting thorough information on people's perspectives, ideas, and experiences on a certain issue (Easwaramoorthy & Zarinpoush 2006). There are three sorts of interviews: structured, semi-structured, and unstructured (Shorten & Moorely 2014). In a structured interview, the researcher asks closed-ended questions and provides a standardised inquiry, and

the responses of large numbers of respondents can be simply coded. Surveys benefit greatly from this style of interviewing. While in the unstructured interviews, the researcher focuses on open-ended questions that can be altered based on the participant's response, and there is no guidance provided. The third kind is the semi-structured interview, in which the questions are more flexible, and the researcher can mix between both open-ended and closed-ended questions. The purpose of the interview was to get descriptive information about programming education in UAE primary schools that had not been explored in previous literature. To achieve this objective, a qualitative analysis based on semi-structured interviews appeared to be the optimal way to obtain the ICT teachers' knowledge of the phenomenon under research.

The semi-structured interview is the instrument used to collect the teachers' experience and opinions regarding the study issue. It is appropriate for the study and aids the researcher's understanding of a phenomenon through open dialogue with participants (Dörnyei 2007). A well-planned interview guide is required to ensure comprehensive coverage of the investigated phenomenon (Arthur et al. 2012). Hence, the interview was guided by semi-structured interview protocols and provided with props, prompts, and follow-up questions.

3.4.2 Sample Selection

Cohen, Manion, and Morrison (2002) state that excellent research not only relies on a sound technique but also on a proper sampling strategy that the research uses to gather input for the research issue. Prior to the commencement of a study, sample selection is a crucial aspect of research design that can decide whether research questions will be answered. A study is strengthened by a proper sample selection and size, thereby conserving significant time and resources. The sample and sampling procedures are determined by the qualitative research topics. We ask "why" and "how" inquiries to shed light on and comprehend complicated human psychosocial concerns (Green & Thorogood 2009). This sort of research frequently involves a limited number of participants in order to investigate deeply felt emotions, experiences, and held views. The researcher can choose a small representative sample from which everyone responds on behalf of a group or theoretical sample. The number of samples is less significant than the interviewee's capacity to provide fresh information on the study data (Juma 2020). The sample was determined based on the judgement sampling approach, where the researcher identifies and chooses participants based on the researcher's judgement and practical knowledge. The framework of selection can be created using factors found in the literature and

practical knowledge of the phenomenon. This is a more methodical strategy that can boost sample credibility by involving a diverse group of participants, such as individuals with extensive experience or a unique understanding of the research issue (Allison & Calvin 2014). The qualitative component of the study consisted of a convenient sample of participants. The participants were ICT teachers (N = 13) from different schools and Emirates in the UAE. ICT teachers are the most important factors who can be relied upon to get a clear view regarding the purpose of the study and can help in figuring out solutions to overcome the research problem which is allocating short time and resources to teaching programming in some schools in the UAE. The teachers were males and females from different nationalities and aged from 25 to 40 years old. Because this study focuses solely on ministerial, British, and American schools, the sample of teachers was chosen based on the schools in which they work. Three were chosen from schools that follow a British curriculum, five from a school that follows an American curriculum, and five from a school that follows a ministerial curriculum.

3.4.3 Piloting the semi-structured interview

The interview framework was first created as a list of questions that were adopted from the literature and adapted to fit the purpose of the study, then validated by sending it to an expert to review and approve. After that, it was piloted to a sample of the population. Piloting interviews are an important part of the research process since they might identify potential problems with the study. It enables the interviewer to steer the conversation toward the research topic and collect the most comprehensive data possible. Pretesting allows a researcher to modify the phrasing or terminology of the question and its instructions. Furthermore, he ensures that all of the questions are simple to grasp, and he can determine whether they are in the correct order or not (Bell 2005). In actuality, this interview format consists of a set of predefined open-ended questions. These questions encourage cooperation and allow the interviewer and interviewee to form a relationship; the researcher can also have a good understanding of what interviewees believe (Cohen et al. 2002). In addition, additional questions arise from the conversation between the interviewer and the interviewee. Consequently, a semi-structured interview method could provide a profound understanding of the research issue.

3.4.4 Interview Considerations

During the COVID-19 Pandemic, the internet became very popular for interviews. As a result, e-interviews supplanted in-person interviews as a result of safety concerns (as suggested by

research ethics committees) and the inability to conduct in-person interviews (Oliffe et al. 2021). Many software applications succeeded in conducting the interview in a suitable manner. It provided more flexibility and, additionally, saved time for both the interviewer and the interviewee. According to Archibald et al. (2019), participants prefer Zoom interviews rather than in-person interviews because of the many benefits it provides, such as ease of building rapport, comfort, and a user-friendly interface (Oliffe et al. 2021). Therefore, the interviews in this study were conducted online via the Zoom client application, adhering to the safety and security measures suggested by research ethics committees and based on the researcher's and interviewees' preferences. The researcher and interviewees determined the proper time two days before the interview. To avoid any misunderstandings about the interview protocol, the participants were given appropriate information before agreeing to participate in the interview. The researcher took the interviewees' permission before the interview to record. For the interview duration, 11 interviews took from 45 mins to 1 hour, while 2 took approximately 30 mins.

3.4.5 Qualitative data analysis

This study adopted the six-phase framework proposed by Braun and Clarke (2006): Phase 1: Familiarize yourself with the data. Generate starting codes in Phase 2, and search for recurring themes, words, and patterns in Phase 3. Phase 4: Looking into themes; Identify and categorise topics in Phase 5. Phase 6: Compose the final study report. Thematic analysis and NVivo software were used to analyse the interview data. The data analysis procedure began with the manual transcription of the interviews. Following the completion of the interview transcriptions, the researcher distributed the transcripts to participants for content verification. Participants were also requested to take notes, revise, and add additional information to the transcripts. The researcher has read each transcript separately and divided them into sections and tables based on themes and ideas (See Appendix A) before uploading them to NVivo. NVivo is a strong qualitative analysis tool that allows the researcher to follow segments of interviews and the ideas they contain without losing access to the source material (Sepasgozar & Davis 2018).

After the researcher identified the similar concepts and ideas and arranged them into themes, the data was uploaded to NVivo to generate codes from highlighted important phrases. These codes were utilised to identify and capture an intriguing aspect of the data. The final interview

themes have four main themes as follows: the teachers' perspectives on the importance of programming; the challenges teachers face in teaching programming to primary students; time and resources allocated for programming; and recommendations for better teaching the programming.

3.5 Quantitative Approach

3.5.1 Questionnaire method selection

The quantitative method is a research strategy that relies heavily on data collection and analysis (Bryman & Alan 2012). The questionnaire is one of the most commonly used descriptive methods in social science research, particularly in educational settings (Cohen et al. 2002). In contrast to qualitative research methods, which aim to comprehend (Punch 2009), quantitative research data seeks to make numerical generalisations of a phenomenon (Creswell 2014). They explore the views of a number of people and provide a numerical summary of the outcomes to the researchers (McMillan & Schmacher 2010). The current study employs a Likert-scale questionnaire based on a five-agreement rating scale (strongly agree, agree, neutral, disagree, and strongly disagree). It is applied to a larger population to generate results that can be generalised. It is preferable to have both open-ended and closed-ended questions in a survey since it gives participants more options for expressing their opinions than merely a quantitative survey (Johnson & Christensen 2012). Therefore, the researcher added an open question at the end of the survey for the participants to freely add their thoughts and recommendations if needed. Following that, a specially designed questionnaire (See Appendix B) was distributed to parents with children in primary school in UAE schools. The researcher has informed the participants about the ethical considerations, such as their anonymity, and a promise that they will bear no harm or responsibility. Additionally, she promised to guarantee and protect their rights to privacy. Finally, she defined the time they needed to answer all the questions, which ranged from 5 to 10 minutes.

The questionnaire was designed in accordance with the three theories that underpin this study: the Technology Acceptance Model (TAM) (Davis 1989), Piaget's Theory of Cognitive Development (Piaget 1971), and Papert's constructionism theory (1972, 1980). The questionnaire includes nine compulsory closed-ended questions and one open-ended question at the end of the questionnaire to examine students' perceptions of the programming's usefulness and usability as well as their intention to use it in the future from parents' perspectives. It also

includes a question that investigates the students' cognitive ability to understand the programming curriculum being taught to them at school. Additionally, it has questions that check on the parents' awareness of the necessity of the idea that children programme the computer rather than the computer programming the children. In addition to that, the questionnaire has questions to be answered by the parents themselves about their perception of programming and if they feel confident in supporting their kids or not, because traditionally, it has been argued that the parents' passion for any technology is correlated to the kids' passion to learn it. An online questionnaire was used to assess parents' perceptions and students' attitudes towards programming. The Google Forms tool is used for producing the online questionnaires because it is straightforward to codify. The Likert scale is a forced-choice scale that is used in a questionnaire to get a series of answers that go from the most extreme to the least extreme. It is a powerful and simple instrument. A positive expression (strongly agree) in the questionnaire indicates complete agreement, and a negative phrase (strongly disagree) indicates complete disagreement. Furthermore, there is also a rationale for combining negative and positive statements is that a response may be required to evaluate each part on its own merits (Maher 1993). To prevent confusion, questions were related whenever possible. The researcher created two versions of the questionnaire (Arabic and English) so that she could guarantee a larger number of respondents. Then she translated the Arabic responses to English and finally combined the Arabic and English responses to form the findings and make the analysis. The first part of the questionnaire explores the goal of the study and general questions to determine the demographic data of the respondents such as age, gender, and nationality, whereas the second part highlights the parents' level of estimation of the importance of computer programming to their kids' academic and future achievement as well as highlights the challenges that may hinder the kids' willingness and ability to learn to program. The questionnaire at the end includes a thankful phrase for the participants for their help and cooperation.

3.5.2 Sample Selection

Voluntary response sampling was used because it was a cost-effective and time-efficient way to collect the necessary data from parents. The reason for distributing this questionnaire to the parents and not the students themselves stems from the researcher's unwillingness to expose the children at this age to the Likert-scale questions. According to Zeman et al. (2006), the

emotional development of children is interdependent with their social, neurophysiological, cognitive, and linguistic development. Consequently, the scale that employs a Likert style to evaluate emotional states may be challenged with concerns regarding whether the states are internally distinguished by the child and their cognitive capacity. Turning again to Piaget, certain types of judgments are difficult for children throughout the concrete operations stage (7–11 years of age), in which the child still develops the capacity to form judgments and reason about the physical world (Piaget 1954). Thus, it would seem that the use of Likert scales for assessing judgments about intangible or abstract concepts such as internal feelings and tangible or physical materials is really challenging (Mellor & Moore 2014). Therefore, the questionnaire was distributed to the parents—mostly mothers—because they are the main factor the researcher can depend on to get information about the students' experiences and perceptions.

Choosing the appropriate sample size entails anticipating that the sample size will be large enough to provide adequate "power" to the investigation. A study's "power" can be defined as the likelihood of properly detecting that the intervention creates a treatment effect if one exists (Shorten & Moorely 2014). For determining the current study sample size, the whole population size is unknown, as the study target parents are from the UAE, which makes it hard to determine their exact number.

Where the population is unknown, the sample size can be derived by the infinite population sample size formula by calculating the minimum sample size required for accuracy in estimating proportions, considering the standard normal deviation at a confidence level of 95 per cent (1.96), the proportion selecting a response or option (50 per cent = 0.5), and the confidence interval (0.05 = 5). The formula is:

$$\mathbf{S = Z^2 \times P \times (1-P) / M2}$$

Where:

S = sample size for infinite population

Z = Z score. It is determined based on the confidence level. If we consider confidence level 95% then Z score = 1.96.

P= % of population probability (assumed to be 50% = 0.5)

M= margin of error. It means a miscalculation or change of circumstances. It takes 5% (0.05).

So, according to this formula:

$= 3.8416 \times 0.25 / 0.0025$

$S = 384.16$

Thus, 384.16 participants are representative of the unknown parents in UAE.

3.5.3 Piloting the online questionnaire

The questionnaire was amended and piloted with four participants before it was distributed. Spelling problems and confusing sentences were spotted and reworded throughout the piloting phase. The questionnaire was originally designed in English, but it was later decided to convert it into Arabic to avoid any misunderstandings, given that the bulk of participants were Arab nationals. The Arabic translation was validated when developing the question items to assure the survey's legitimacy. After deleting the perplexing questions, just ten items remained.

3.5.4 Quantitative data analysis

The quantitative phase was employed to generalise the results of the qualitative study. The link has been sent to the parents the researcher knows, as well as shared with her connections on different social media platforms like Facebook, the parents' WhatsApp group, and LinkedIn. The questionnaire statistical data was analysed using SPSS version 23. A cohort of 35 parents took part in the study (70% mothers and 30% fathers); their ages ranged from 25 to 45. To ensure the study's validity, parents who responded with a strong agreement or agreement were counted. Many parents felt more comfortable answering the questionnaire in their mother tongue, especially in the open-ended question at the end. Many of them freely shared their ideas and some suggestions, which were considered and added to the study results.

3.6 Mixed-methods Integration

To classify this study approach as a mixed-method approach, data from qualitative and quantitative methods has been integrated and connected to obtain the final results. To expand upon the qualitative findings, the researcher explored all possible variables and added them to the parents' questionnaire and focused on the extent to which the qualitative interview findings were corroborated with the quantitative questionnaire to investigate the convergence of findings across both methodologies. The main reasons for choosing to integrate the qualitative and quantitative methods and to include different participants (teachers and parents) in the study are

to increase the validation and generalisation level of the study and to avoid the bias that may happen from the teachers when they represent their own school. The researcher seeks to have real and accurate results towards the research goal, which is to investigate the primary students' attitudes towards programming, the role of the school strategy in affecting this attitude and explore the adequacy of time and resources allocated to programming in primary schools.

3.7 Ethical Considerations

It is asserted that the problem of research misconduct might be created by improper participant treatment and deceptive techniques in conducting the study and publishing its results (Howe & Moses 1999). In this regard, researchers must accept responsibility for carrying out the research properly. Additionally, in all aspects of their studies, they should encourage significant value and respect for all humans. In the current study, prior to conducting the research and collecting data, the researcher acquired permission from the research ethics committee. Throughout data collection, processing, and reporting, ethical considerations were accounted for. The purpose of the study and its possible advantages were explained to all participants. Before the study began, participants were assured of their confidentiality and informed that their participation was entirely voluntary and anonymous. Potential participants got the opportunity to ask questions regarding their position in the research and how their data and information would be used at this stage. Moreover, to ensure that the participants understood that they had the option to participate or not, the researcher informed them that they might withdraw from the study whenever they wanted.

4 CHAPTER FOUR:

DATA ANALYSIS AND RESULTS

Regarding the purpose of this research, this chapter discusses the major findings from both the qualitative and quantitative stages. As previously stated, the qualitative data were collected from the semi-structured interviews and analysed using theme analysis and NVivo, whereas the quantitative data were collected from the Likert-scale questionnaire questions and analysed using SPSS. This chapter is divided into two sections. Section one summarises the key findings from the semi-structured qualitative interviews. Section two presents the quantitative findings and analyses from the online questionnaire.

4.1 Qualitative Results

Qualitative results regarding ICT teachers' perspectives on the programming being taught to the primary students at their school were collected through online interviews via Zoom. The researcher interviewed 13 participants from different schools and emirates in the UAE (3 teachers from British schools, 5 from American schools, and 5 from Ministerial schools). The interview time was approximately 30 to 60 minutes for each teacher.

	Gender	Age	Nationality	Emirate	Curriculum
Teacher 1	Female	30-35	Palestinian	Ajman	Ministerial
Teacher 2	Female	25-30	Palestinian	Ajman	Ministerial
Teacher 3	Female	25-30	Egyptian	Abu Dhabi	American
Teacher 4	Female	30-35	Palestinian	Ajman	Ministerial
Teacher 5	Female	30-35	Palestinian	Ajman	American
Teacher 6	Female	30-35	Egyptian	Sharjah	British
Teacher 7	Female	30-35	Egyptian	Sharjah	Ministerial
Teacher 8	Female	35-40	Egyptian	Dubai	American
Teacher 9	Female	30-35	Egyptian	Sharjah	Ministerial
Teacher 10	Female	30-35	Palestinian	Ajman	British
Teacher 11	Female	35-40	Pakistani	Dubai	American
Teacher 12	Male	30-35	Syrian	Abu Dhabi	American
Teacher 13	Male	35-40	Pakistani	Sharjah	British

Table 2. Demographic Data of teachers

The key research question was the importance of programming for primary students and the challenges teachers face when teaching it, and participants were asked fifteen questions to gather information for it. After the interviews, the questions were categorised and analysed using NVivo version 12. The data was managed by directly inputting the documents into the software. NVivo was utilised to help with data coding into themes and subcategories. As part of the research design, a preliminary list of codes was created. The most repeated words in the examined documents were then visualized using a query tool.

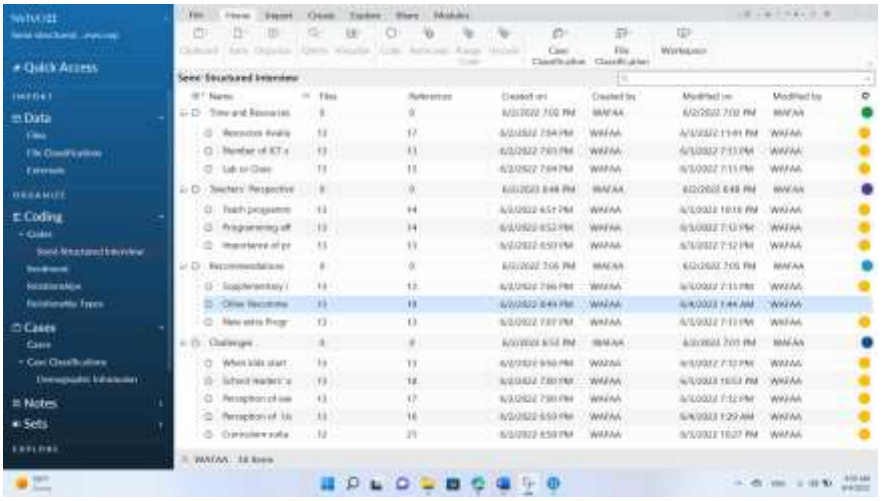

Figure 4. Development of tree codes and subcodes in NVivo

The following figure shows a word cloud made up of the most commonly occurring words or topics from the reflective notes.

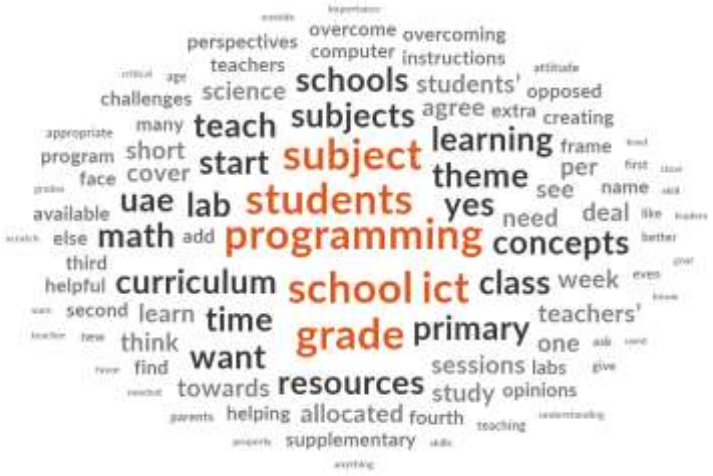

Figure 5. Word cloud from reflective codes

The researcher merged the responses and identified the frequency of thoughts to comprehend their perception and recognise patterns. The final four themes were as follows:

First Theme: Teachers' Perspectives on the Importance of Programming.

The second theme is the challenges that ICT teachers face in programming education.

The third theme is the allocation of time and resources to ICT subjects in UAE primary schools.

Fourth Theme: Suggestions for improving programming education.

4.1.1 First Theme: Teachers' Perspectives towards the importance of programming

The first theme is to look into ICT teachers' perspectives on the value of programming. It consists of three questions. The first question asks teachers if they believe programming is important for all kids. They all agreed that programming is an important ability that all students should acquire. Some of them provided the following grounds to support this importance:

It is based on logic and helps students solve big problems with small steps in their early stages. Therefore, it helps them make good and reasonable decisions in their future lives. (Teacher 1)
It is the language of the future. It helps the students develop their critical thinking skills and opens a wide range of possibilities for them. (Teacher 11)
All students should learn it because technology is booming everywhere around us. (Teacher 7)
It enhances logical and analytical thinking and prepares them for the AI age. (Teacher 9)

The second question asked teachers whether they were in favour of or opposed to teaching programming to elementary students. This question was unanimously approved by all teachers, and some of them elaborated on the necessity of programming education at the elementary level as follows:

The earlier the students start learning programming, the more they will be able to apply and get used to the concepts. Also, learning to programme early enhances math skills, memory, and complex thinking. (Teacher 1).

When young students learn to programme early on, they will regard it as a fundamental skill and will be able to absorb all of the required skills. (Teacher 10).

Despite unanimity on this topic, a few respondents emphasised the necessity to alter and simplify the curriculum to accommodate the talents and needs of each age group as follows:

I am in favour of teaching programming to primary pupils. However, they should begin with simple principles so that the students can readily learn them. Unfortunately, the grade 1 curriculum dives right into the programming tools with little introduction. The programme covers computational and logical thinking, how robots move, and computing theory. In grade three, students begin with Scratch (the opposite should happen). (Teacher 5)
Yes, but only if they simplify it and categorise it into steps so that the students can absorb it.

(Teacher 13)

Yes, but from grade 3 only if the school follows the same curriculum, because the curriculum of a ministerial school is very hard, and students cannot absorb it properly. If they develop a simpler curriculum, I do agree that the students start learning programming in grade 1. (Teacher 3)

The last question in this theme is: Is programming helping students do better in other subjects? All of the teachers believe that there is a beneficial relationship between programming and other courses such as math and science. Teacher 7 remarked that the programming minimises their math calculation error rates. Teacher 4 wishes to integrate programming into all subjects. She added that in many sophisticated countries, programming is integrated into all topics. Scratch is one example of a programming language that is used to teach kids English (a block-based programming language). Scratch, for example, allows kids to learn how to create and read a tale (storytelling). The teacher believes that this will be difficult to implement in the UAE because other subject teachers are not equipped to use programming software; thus, all teachers' abilities must be improved in order to integrate programming into all disciplines.

4.1.2 Second theme: Challenges in programming education

The second theme is to investigate the difficulties that ICT teachers experience when teaching programming to primary children. Because issues vary by school depending on curriculum, implementation, and policy, the researcher will present the findings in three sub-sections based on the school curriculum.

- **British schools**

Not all British schools teach primary school students programming in the same way. This was obvious from the teachers' responses to the fourth question, which revealed that one school teaches programming in grade 1, another in grade 3, and the third has removed programming ideas from the ICT curriculum since 2019.

The fifth interview question is to determine whether the curriculum is appropriate for the age and level of understanding of primary pupils. According to one teacher, the curriculum is appropriate; however, the problem is in school implementation, as follows:

This curriculum should be taught in a lab because it is supposed to be practical. However, I have to teach it theoretically because the school only has one lab for the whole school (grades 1 to 12). As a result, most of the time, I have to teach it in class. (Teacher 2).

The other teacher expressed hope that the curriculum would be revised because it is inappropriate.

In response to the responses to this question, the researcher posed the two following questions:

How do the students feel about programming class?

Is the purpose of learning programming evident to your students?

The teachers' responses reveal a common discontent with the students' attitudes in programming class. One teacher blames the parents and the Ministry of Education for their effect on the students' lack of programming enthusiasm. She indicated that:

Parents underestimate the value of programming. They are requesting a worksheet for their children to memorise without understanding to only answer the exam questions. The mothers' perspectives are influenced by the MOE, which regards ICT as a secondary topic. (Teacher No. 2)

When teachers were asked if their students recognised the utility and worth of programmes, they responded negatively. The majority of students in these British schools do not appreciate programming, which influences their attitudes toward it.

Teacher 2 stated that just 2 out of 30 teachers in each session see programming as useful. However, teacher 6 believes that if this curriculum is taught properly, students will recognise its value because, as she mentioned, students in the UAE are fortunate to be able to interact with technology in a variety of settings, such as shopping malls, exhibits, and so on, allowing them to relate programming to real-life applications.

This theme's final topic seeks to understand how British school leaders approach ICT subjects that involve programming ideas, since, as literature reveals, they play a crucial part in the success of this learning process if they support it. Sadly, the responses were startling. The three school authorities (principal, department heads, and supervisors) treat ICT as a subsidiary subject. The ICT teachers lamented that even teachers of other subjects underestimate their value as ICT teachers because ICT is an unimportant subject from their point of view. Teacher 2 explained:

To accommodate the Ramadan schedule, my school cut half of my sessions in order to keep the other topics on track.

Another issue raised by teachers' answers is that the ICT grade has no bearing on the total grade. Even if the students did not answer any questions on the exam, the teacher must give them at least 80% or higher. The ministry of education has also classified it as category B. The Ministry of Education associates ICT with physical education and the arts. As a result, many students consistently state, "I don't want to work on this session, and I don't care because you have to give me a decent grade at the end, and it won't influence my overall score."

Another point raised by teachers is that when inspections come to the school, they do not enter the ICT teachers because ICT is not part of the inspection requirements.

- **American Schools**

Students in American schools begin learning programming in grade one. Overall, the responses for curriculum compatibility were satisfactory. The teachers observe that the American curriculum is current and properly mapped to the kids' abilities. However, teacher 8 believes that the curriculum should be streamlined so that kids can understand it. The other teachers recommend focusing on one ability at a time in order to master it.

Most teachers reported that the students enjoy programming class. However, teacher 8 indicated that her kids are uninterested in programming class.

Although there is a strong interest in coding education in American schools, most students are unaware of its significance and utility. Some students love programming classes because they believe it is merely a game. Only one teacher stated that children realise the importance of programming, whereas the rest stated the reverse.

Unfortunately, even in middle school, 20 to 30 percent of students are interested in and understand the importance of programming. I am constantly asked by grade 4 pupils why we are studying programming, why we are utilising it, and even by their parents why they are studying it. One mother said she would rather her son study PowerPoint than all of this meaningless programming. (Teacher 11)

Teacher 7 claims that the boys are knowledgeable about coding, while girls don't have any passion for it. She believes that girls do not understand the purpose of programming. In her opinion, it is because of her parents' influence. Parents in this area believe that programming, IT, and cybersecurity are only for boys.

Concerning the school leaders' attitude toward the ICT subject, only one teacher stated that it is treated as a secondary subject, but the other teachers emphasised that the school leaders value this subject and participate in numerous competitions to improve the students' programming and technology skills.

- **Ministerial Schools**

In ministerial schools, students begin learning programming in grade one, exactly like in American schools. In contrast, the rate of satisfaction with the curriculum is not at all satisfactory. All teachers were dissatisfied with the computer science and programming curriculum given in primary schools. In contrast to the nature of the subjects, the curriculum is rigorous and very theoretical, particularly for the first two years. Here are some replies from teachers:

The content of this subject in grades 1 and 2 is about recycling, sustainability, and simple colouring and drawing. (Teacher 1,10,12).
It is not appropriate. About half of the curriculum is theoretical, which it is not supposed to be. It is hard for grades 1 and 2. Students at this age require something they can touch and see results from in order to understand. The students in my school learn to programme in Scratch by grade 3. (Teacher 3).

The curriculum starts with teaching students the abstract concepts of programming and computational and theoretical logical thinking, which is very difficult for the students to understand. To the extent of teaching them the algorithms in grade 2, which is a complex concept for them, in grade 3 they start working on block-based programming using Scratch. In my opinion, the opposite should have happened. We should start with Scratch in the first two grades, and then in grade three, we may be able to teach them these abstract concepts and skills. (Teacher 5).

The students at ministerial schools dislike the programming class, which is to be expected given the teachers' past remarks about its complexity. They dislike it because they cannot comprehend the sophisticated concepts that are irrelevant to their level of comprehension. Only one teacher reports that the students enjoy programming despite its complexity.

Regarding the question of whether the students perceive the programming usefulness or not, only one teacher indicated that the students perceive the value of programming, while the remaining four totally objected to that. Their objection responses are as follows:
Teacher 1: No, neither parents nor students perceive the usefulness of programming.
Teacher 12: If it is applied properly, they will perceive its usefulness. But sometimes the school doesn't provide the tools to help them do so, because without practise they will feel it is useless.
Teacher 3: Not really, because as I mentioned in grades 1 and 2, they study only theoretical parts.
Teacher 5: No, not clear. The students learn about energy and renewable energy in detail in ICT subjects that are related to science, and they are not aware of their relationship with computers. The students usually ask about the relationship between what we learn and the main subject.

The last question on this theme is: how do school leaders deal with ICT subjects? Ministerial schools were not better than British schools in terms of principals' interest in programming; they deal with it in the same way of underestimation; they equalise it to PE and art; they allocate their time to other teachers.

Instructor 12: The worst thing is that the school occasionally requests that I leave my session to do another task not related to my position or role, or delegate it to another teacher who teaches math, science, English, or Arabic because they need more time.

The programming is not deemed significant in most schools. Sometimes they take kids during the class to train them in specific dances in preparation for a party or celebration. Unfortunately, this occurs after the supervisor's and principal's consent.

4.1.3 Third Theme: Time and Resources allocated to Programming

In this theme, teachers were asked about the time and resources allocated to the ICT subject,

which covers programming fundamentals. The teachers said that the primary students take two sessions per week and agreed that this is not enough time to cover all basic concepts. The two sessions do not always include programming; they have complete terms that do not include any programming principles. Teachers at ministerial and British schools reported that more than half of these sessions are held in classrooms rather than labs since there is only one lab for the entire school (grades 1–12), and they rarely find it available to take children there. The situation was much better in American schools, where the school provides kids with tablets in the classroom and labs if they wish to study there.

The frequent complaint from British and ministerial schools was that the computers are old and need updating, and they also do not receive the required support if there is any issue with the devices from the IT support team. Instead, they throw this responsibility on them to try to fix the equipment. When I asked the teachers what they wanted to see more of in the computer lab to be able to explain this material efficiently, their answers were between new devices, kits, IT support team availability, and buying new kits and software. One teacher's response was shocking. She *said we want a computer lab first and then we will look for extras.*

Regarding American schools, all teachers were content. They claim that the school supplied them with all the resources, including equipment, kits, tablets, and software.

4.1.4 Fourth Theme: Recommendations for enhancing programming education

This theme's purpose is to propose solutions to the obstacles that prevent effectively teaching programming to elementary children. The researcher suggested two strategies to check their applicability, and the final question was left open for teachers to add their own suggestions, if any.

The first suggestion is to provide additional teaching outside of school to cover all the missing programming concepts. Eleven teachers vehemently opposed the concept, arguing that parents would not aid or support it, and that it would burden the teacher as much as the pupil. However, teachers 7 and 9 agreed with the following:

Teacher 7: *Yes, we can perfectly allocate supplementary instructions to them outside the school*

and online. It is a good idea, and everyone should be supportive.

Teacher 9: *After COVID, the school still supports online resources, so we can do that.*

The second recommendation is to add a new basic subject called "programming," which would be independent of the ICT subject and would be taught once a week. Most teachers agreed with this advice because they understand the importance of programming and that it requires a set amount of time to cover all of the ideas linked to it.

Although the majority of teachers supported this recommendation, the following two teachers opposed it:

Teacher 6: No, I believe that focusing on programming more and incorporating it into other subjects is adequate.
Teacher 7: I think it would be better if they integrated programming with other subjects. Maybe we need to do so at the middle level.

Some teachers added some recommendations to change the schools' view of this subject and improve the learning process in it. Teachers 6,5, 7,12, and 13 argue that the inspection team has a main role in changing this view. If they add the ICT subject to their criteria, the school will do their best to provide the resources and time for it.

Teacher 2 states that we need to spread awareness about its importance. Also, if the ministry of education paid some attention to it and considered it a core subject and categorised it as group A, it would help a lot.

"Many advanced countries integrate programming into all disciplines," says Teacher 4, Scratch can be used to teach English. For example, Scratch is used by children to learn how to create and read a tale (storytelling). However, the other professors in this class are not competent to utilise programming software. We must increase the other teachers' skills so that they can include programming in their topics.

4.2 Quantitative Results

Collected quantitative data sets were analysed using SPSS. The number of responses was counted to find the number and percentage of same-type responses. The goal of the quantitative questionnaire was to validate the findings obtained from the qualitative component of the study to check if the programming curriculum in primary schools in the UAE is appropriate for the students and how they perceive its usefulness. In addition, their attitude towards it. Another thing that was so important to be validated is that the recommendations raised by the researcher to overcome the main research issue, which is categorising ICT subjects (which contain programming skills) as subsidiary subjects, and not allocating enough time and resources to them. The researcher's goal is to know also if the parents perceive the value of programming and if they will support these recommendations. These questionnaire findings were collected using Google Forms. The first 4 questions were to obtain the demographic information of the respondents, followed by 9 Likert scale questions. A five-point Likert-scale was used to categorise nine items into five categories, and all statements required a response of (strongly agree 1, agree 2, neutral 3, disagree 4, or strongly disagree 5). The respondents were 499 parents (mothers N = 445 and fathers N = 54), with a gender distribution of 89 % of females and 11 % of males.

The nationalities of the parents were diverse. Nevertheless, the Emirati and Egyptian nationalities were the most prevalent in comparison to other nationalities. Table 3 shows the demographics of participants' parents:

Participant	**Frequency**	**Percentage**
Male	54	10.8
Female	445	89.2
Ethnicity		
Emirati	115	23.0
Egyptian	205	41.1
Palestinian	35	7.0
Jordanian	54	10.8
Lebanese	4	.8
Lebanon	11	2.2

Moroccan	9	1.8
Omani	1	.2
Pakistani	3	.6
Saudi	2	.4
Somali	1	.2
Sudanese	15	3.0
Syrian	33	6.6
US	1	.2
Yemeni	2	.4
Candian	1	.2
Algerian	3	.6
Indian	1	.2
Iraqi	1	.2
British	2	.4
Child's school curriculum		
Ministerial	155	31.1
British	222	44.5
American	122	24.4

Table 3. Demographics of parents

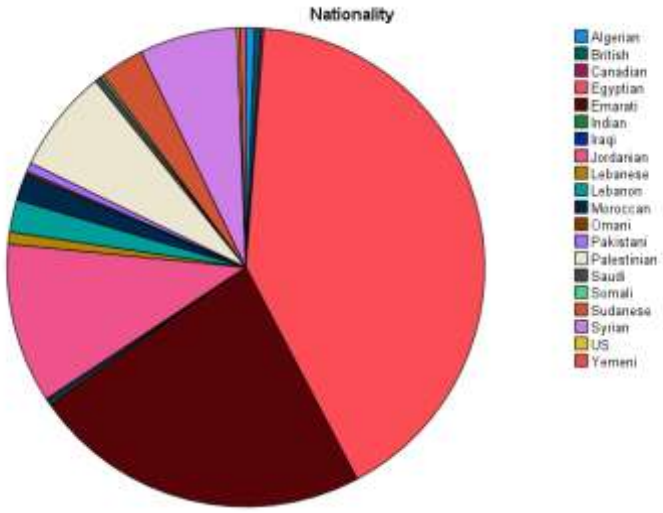

Figure 6. Parents' Nationalities

To integrate the parents' replies with the instructors' responses based on the school curriculum and compare the programming curriculum followed by the three schools covered in this study, the school curriculum was also an important component to consider (American, British, and Ministerial Curricula). There were 222 respondents with children in British schools, 122 in American schools, and 155 in Ministerial schools.

The first item in the questionnaire is designed to ensure that parents believe programming is beneficial to their children's academic and future development. The results show that the majority of participants believe programming is important; however, 7.6% were unsure, 2.4% disagreed, and 0.4% strongly disagreed.

Programming Affects students' Academic and Future achievement

	Frequency	Percent
Strongly Agree	277	55.5
Agree	170	34.1
Neutral	38	7.6
Disagree	12	2.4
Strongly Disagree	2	.4

Table 4. Programming Impact.

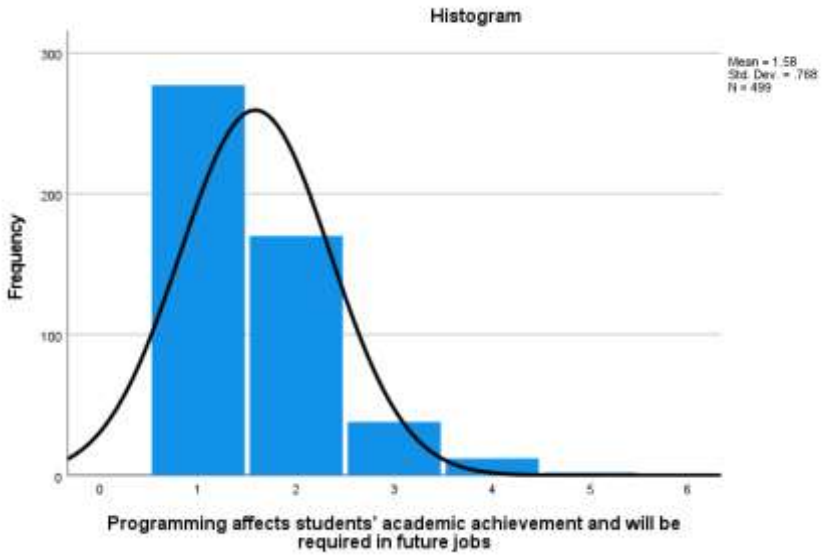

Figure 7. Programming Impact.

The second question stems from the first. Do parents realise the usefulness of programming and believe that every young student should study it? The agreement rate is 89.9%, with 7.2 percent neutral and 3 percent disagreeing with teaching programming to young students.

Every student in the primary stage must learn to program

	Frequency	Percent
Strongly Agree	248	49.7
Agree	200	40.1
Neutral	36	7.2
Disagree	15	3.0
Strongly Disagree	0	0

Table 5. Programming Necessity

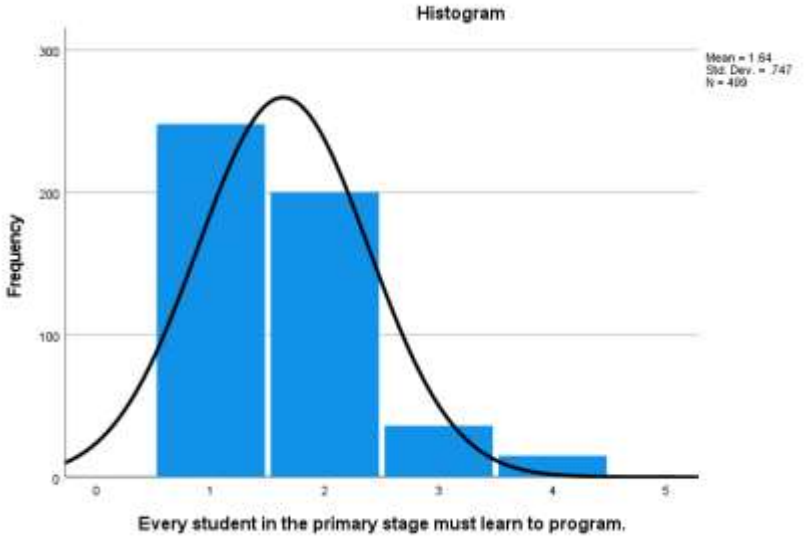

Figure 8. Programming Necessity

For item 3, which includes the third question that asks the participants if the goal of teaching programming is not clear in their kids' school, the scoring was reversed, ranging from 1 (strongly disagreed) to 5 (strongly agreed). The scoring of an individual response was classified as a "positive" response if the response was "strongly disagreed with or disagreed with" in this reverse coded question. While nearly half of the participants reported that the purpose of teaching programming is not clear in their children's school, 29.3% reported neutral responses, and 19.2% reported that the goal of programming is clear in their children's school, as follows:

The goal of programming is clear in my kid's school

	Frequency	Percent
Strongly Agree	11	2.2
Agree	85	17.0
Neutral	146	29.2
Disagree	170	34.0
Strongly Disagree	87	17.4

Table 6. Programming goal (Reverse)

The fourth question was to validate the programming curriculum's suitability by asking if

primary students could understand the programming ideas being taught to them at school. The map below depicts the relationship between the school curriculum and the kids' capacity to comprehend.

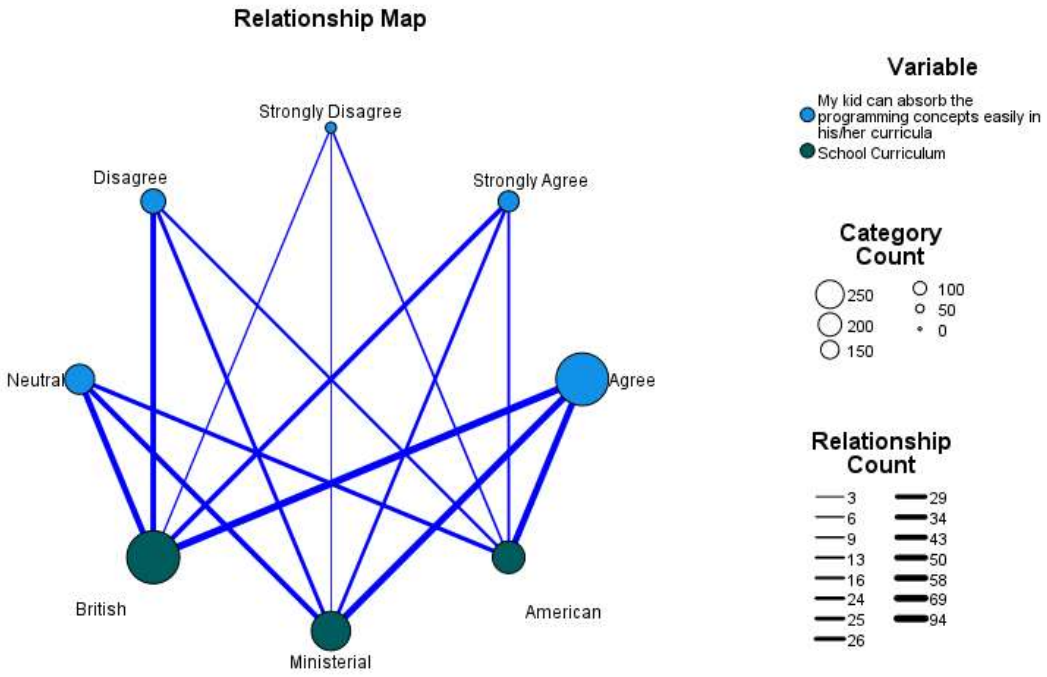

Figure 9. Relationship Map

Surprisingly, many parents responded that their children could absorb programming subjects in school, whether they attend American, British, or ministerial schools. In all three schools, the ratio of satisfaction to dissatisfaction is roughly comparable. 60 percent of parents were satisfied with ministerial schools, which ranked best in terms of parental satisfaction. Parents in British schools were satisfied with their children's programming retention at a rate of 55.4%, placing American schools in second place with a score of 58.1%.

But as expected, there was a correlation between the clear goal of programming and students' ability to absorb programming concepts. Students are better able to understand coding in schools where the aim and benefit of coding are evident.

		Students' ability to understand	The school's obvious goal
Students' ability to understand	Pearson Correlation	1	.185**
	Sig. (2-tailed)		<.001
	N	499	499
The school's obvious goal	Pearson Correlation	.185**	1
	Sig. (2-tailed)	<.001	
	N	499	499

Table 7. Correlation 1

The fifth and sixth questions are designed to validate the initial research recommendation's applicability. Would parents be able to support their children if we gave them supplemental instructions outside of the school framework, or would they need workshops or training to do so? 65% showed the ability to guide their kids, while 16.6% showed that they could not provide any guidance in programming.

I can guide my kid in programming

	Frequency	Percent
Strongly Agree	93	18.6
Agree	236	47.3
Neutral	87	17.4
Disagree	67	13.4
Strongly Disagree	16	3.2

Table 8. Programming Guidance

Despite the high percentage of parents who report that they can provide guidance to their children, the majority of parents (90.4 percent) agreed that they needed training to assist their children in their programming study, while 6.8 percent were undecided and selected neutral

options, and 2.8% disagreed.

I need a workshop to support my kid in programming

	Frequency	Percent
Strongly Agree	254	50.9
Agree	197	39.5
Neutral	34	6.8
Disagree	12	2.4
Strongly Disagree	2	.4

Table 9. The need for programming workshop

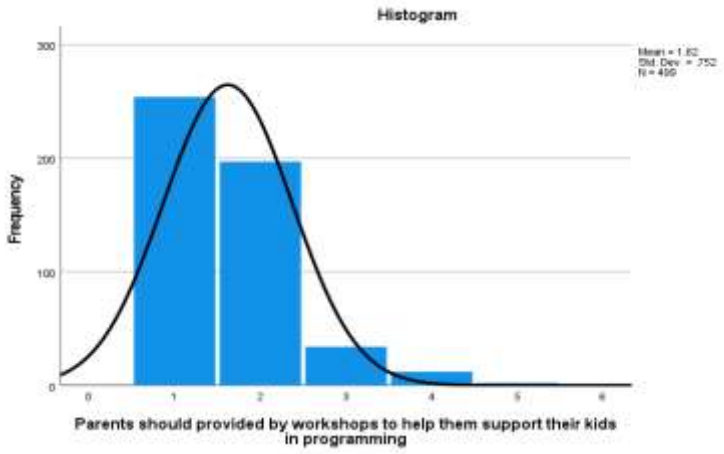

Figure 10. The need for programming workshop

The final two questions concern the second research recommendation, which is to devote more time and resources to programming and to make programming a new required topic in order to cover all programming ideas. Both questions obtained a high level of agreement (93.4 percent and 85.8 percent, respectively) as follows:

Allocating more time and resources to programming

	Frequency	Percent
Strongly Agree	274	54.9
Agree	192	38.5
Neutral	20	4.0
Disagree	11	2.2
Strongly Disagree	2	.4

Table 10. Increase time and resources

Add a new programming subject

	Frequency	Percent
Strongly Agree	231	46.3
Agree	197	39.5
Neutral	43	8.6
Disagree	22	4.4
Strongly Disagree	6	1.2

Table 11. New programming subject

The questionnaire items were divided into two main categories, which are the "perception of the programming value" and "proposed recommendations for better programming education". The items under each component were computed together using the "compute variables" function in SPSS as a single variable. Specifically, all items relating to the parents' perception of programming value were added up to the variable "perception", which expresses the level of parents' understanding of the programming value and usefulness, and the same step was taken with the items under "recommendations," which express their level of satisfaction and support of the solutions recommended by the researcher. Table 11 below shows how parents' perception of programming importance is positively correlated with their acceptance of the new solutions proposed to solve the research issue.

		Parents' Perception	Recommendations Acceptability
Students' ability to understand	Pearson Correlation	1	.506**
	Sig. (2-tailed)		<.001
	N	499	499
The school's obvious goal	Pearson Correlation	.506**	1
	Sig. (2-tailed)	<.001	
	N	499	499

Table 12. Correlation 2

The researcher provided an optional open question at the end of the questionnaire, asking participants to add their thoughts or recommendations, if any. Some of them expressed their ideas and recommendations, which are included in Appendix C.

DISCUSSION OF THE RESULTS

The study addresses the pedagogical concerns regarding teaching coding to primary students; the focus of this paper is to emphasise the importance of programming that enhances students' skills. Additionally, it aims to explore the ICT teachers' and parents' perceptions of the programming and the students' attitudes toward it and identify the barriers to the proper implementation of programming education in UAE primary schools. The results of both the interviews and the questionnaire are discussed in this section in the context of the research questions posed in the presented study. The responses of ICT teachers show that they are aware of the importance of programming and willing to properly teach it to all students from the primary level. However, they admitted that they face some challenges that hurdle them from doing so. The positive responses of most of the parents show that they have a positive attitude towards the programming and the necessity of integrating it into their kids' curriculum at an early age. However, the responses of some parents to the final question suggested that they are confused about programming and technology. There is a lack of knowledge of programming as a concept.

Looking back at the qualitative findings, the teachers agreed that programming is an essential ability that should be taught to all students, and they all agreed that it should be taught to primary

students. Furthermore, they believe it has a favourable impact on other disciplines such as math, physics, and many others. These findings are consistent with the majority of the literature, which emphasises the importance of coding in kids' academic and future skills. Learning to code at an early age makes it easier for children to understand, learn, and apply coding later in life. Furthermore, early coding experience will ignite children's interest in developing skills like direction, movement, and math (Lekan & Abiodun 2020). However, teachers are dissatisfied with the time and resources allotted to it, as well as its classification as a B category and equalisation with PE and art activities. Results indicate that the lack of time and resources devoted to teaching programming in primary schools is not the only challenge teachers face; the perception of school leaders, other teachers, and parents regarding the computer subject, which includes programming concepts, is a greater obstacle. These findings are consistent with the research, which shows a link between school administrators' attitudes about computing and the success of this teaching process (Kong & Wang 2021). It was clear from the results that American schools are the most successful in applying programming for primary students because the directors and leaders of these schools' value and allocate resources to this skill, as opposed to British and ministerial schools.

The programming curriculum is also crucial in understanding children's enthusiasm for it. The more appropriate the curriculum is for their age and way of thinking, the easier it is to understand. According to the findings, American school teachers were also the most satisfied with the programming curriculum. This affects the children's satisfaction and passion for it. American schools began to teach children block-based programming, which has a graphical interface and is simple for children to comprehend since it uses gamification to keep kids interested. Teachers at the British schools included in this study did not agree on the curriculum's suitability in their schools. The first instructor stated that the content is inappropriate for the age of the children and must be spoken, while the second teacher considered it appropriate, and the third teacher's school does not teach programming to primary school students but instead teaches them digital literacy. This is consistent with most of the literature, which has emphasised the effectiveness of block-based programming as a starting point for primary students (Aksit & Wiebe 202; Kert, Erkoc, & Yeni 2020; Tsai 2019; Basawapatna 2016; Chao 2016; Erol & Kurt 2017; Yukselturk & Altiok 2017).

In the ministerial schools, teachers uniformly agreed that the curriculum was inappropriate for young children, resulting in kids who were uninterested in the subject and saw it as confusing

and difficult. These difficulties could be ascribed to a lack of understanding of fundamental programming concepts as well as a lack of ability to apply programming skills (Chao, 2016). They begin with the students in a very early year, in first grade, with abstract concepts about computers and programming that are difficult for children to understand. For example, they introduce the algorithm to grade 2 children and begin block-based programming with them in third grade. These findings reflect Piaget's (1971) Theory of Cognitive Development, which asserts that students at this age struggle with abstract concepts and hypothetical scenarios. Based on this, the curriculum must be modified to meet the age and level of comprehension of the students.

In accordance with Davis's (1989) TAM model, students should see the utility and ease of programming before learning it because this will reflect on their love and passion for it. A specific question was asked to determine how children see programming and whether schools educate children about it and its importance, as well as the ease of usage, such as whether it is linked to real life. Few teachers stated that children grasp the purpose and value of programming, but most of their responses were shocking, explaining that students, even in American schools, do not understand the importance or purpose of programming. Teachers point out that students regard it as a game and make no connection between it and real life. Other factors, according to the findings, influence students' comprehension of the utility and purpose of programming. Parents have a large influence on their children, as some parents do not realise the value of programming and believe that it is a male-dominated field and that women should focus on science or math instead. These findings are consistent with the findings of Kong, Chiu, and Lai (2018), who found that guys were more interested in programming than girls.

As for the study recommendations, the first recommendation, assigning supplementary instructions outside of school time to help students cover missed programming concepts, was categorically rejected by most teachers, who claimed that no one of the parents would support them, and that it would increase the burden on them and the students. Only two teachers who favour the notion believe it is appropriate, particularly after COVID-19, which requires students to learn in a variety of learning modes and situations, so we may take advantage of online learning and assign additional tasks to students. Teachers overwhelmingly supported the second option, which is to separate programming from ICT studies and make it a core subject with adequate time and resources. However, two professors out of thirteen protested, believing that

focusing more on programming and integrating it with other courses is adequate.

Thus, the first three research questions were answered by the abovementioned results. The results of the questionnaire validate the previous findings and provide an answer to the fourth question, which examines the parents' perspectives on programming education for primary students.

Surprisingly, the questionnaire findings revealed that most parents are aware of the importance of programming and its impact on their children's future, and even agreed that students should begin learning programming in primary school. Few of them disputed its significance or the necessity to investigate it. This result contradicted the responses of teachers, who indicated that most parents are unaware of the value of programmes and negatively impact their children. However, the questionnaire's final question, which invited parents to share their thoughts, revealed that some parents conflate the concept of programming with technology in general. Rather, some of their comments were not appropriate. One parent, for example, chastised the researcher for bringing up such a topic, believing that she meant television programmes such as Netflix and that she wanted to teach such programmes in school to children and make them watch them during the school day. This reflects some parents' lack of understanding of the concept of programming itself, which is reinforced by the teachers' comments. More research is needed, however, to understand the parents' perspective on the matter and to ensure that they are not confused between the two terms (programming and technology). The responses to the third question, which investigates the clarity of the purpose of school programming, suggest that the purpose of school programming is unclear in the majority of UAE schools. This result supports the qualitative outcomes. This conclusion is similar to Kert, Erkoc, and Yeni's (2020) finding that one of the most frequently asked questions by novice programming language learners is "Why are we learning this?" A lack of real-world relevance in learning objectives might severely impact student motivation. Students with a greater interest in programming regarded it as having better significance, effect, creative self-efficacy, and programming self-efficacy.

In terms of the primary school curriculum's suitability for primary school children, the majority of responses suggested that the children can grasp it. However, the researcher cannot confirm this result since he feels that parents are confused about programming and technology, as evidenced by their responses to the final question (See Appendix D). Some parents believe that they can support and assist their children in programming. The clear majority, however,

recognised the need for training programmes and workshops to assist and educate them on this subject. This was in keeping with several teachers' suggestions that awareness and training sessions be provided for the mother, especially because she is the students' primary supporter throughout their educational journey. On the latter two recommendations, providing greater time and resources to teaching programming, creating a separate new subject for programming, and mandating its study at the elementary level, there was unanimity. The rate of rejection was extremely low relative to the proportion of supporters of both plans.

5 CHAPTER FIVE

CONCLUSION

5.1 Major Findings

This study attempted to understand how the programming curriculum is taught in primary schools in the United Arab Emirates. Do children, principals, teachers, and parents realise its importance? Assisting teachers to teach coding is a major success factor. Additionally, analysing their attitudes toward coding is crucial, as is identifying the type of assistance they receive, as well as the challenges they face. The main objective of the researcher is to highlight the importance of programming and expose the challenges that hinder ICT teachers from teaching this skill properly and highlight the lack of resources and time allocated to it in UAE schools, aiming to attract the attention of officials and decision-makers to take the appropriate decisions to enhance this learning process. Given the findings, it appears that teachers in American schools are comfortable teaching coding and have been given resources to help them and their students, whereas teachers in British and Ministerial schools are dissatisfied with how their schools deal with programming and have not been given enough resources to prepare the children and help them master this skill. Nevertheless, the programming is not taught properly in the three mentioned schools. Moreover, the curriculum is not appropriate in most schools. Although the results of the interviews showed that schools with the American curriculum teach this skill better than the other schools mentioned, they do not give it enough time. ICT classes are only conducted twice a week in most UAE schools, and most of their studies are theoretical as opposed to the nature of the curriculum. Regarding the proportion of programming within the entire ICT subject, the findings show that it is taught only in the last month of the academic year, or at least for one term, while students are saddled with other theoretical notions unrelated to this subject for the remainder of the year. Unfortunately, all of the teachers agreed that the ICT subject, which includes the concepts and programming skills, is considered a minor subject. Even if some schools value it, it is still classified as a subsidiary topic. As a solution to these mentioned issues, it appears that integrating programming with other courses and giving more time and resources to it may be beneficial to students' acquisition of programming abilities. However, the optimal solution is to develop a new programming subject and commit additional time to it. In terms of curricular content, block programming tools (such as Scratch) may be a

better option for early primary students to learn how to code.

Although the majority of the questionnaire results confirmed the validity of the interview results, the results contradicted what British and ministerial schoolteachers reported, as most parents confirmed that their children enjoy programming and can understand the curriculum assigned to them by their school. However, as previously said, the researcher believes that some parents mix up programming with technology.

To conclude, this study confirms that programming is the language of the future, and this generation must realise its importance in order to be able to coexist with the future associated with it. Contrary to what some parents misunderstood (See Appendix D), if students were able to master this language, they would be on top of technology and in control of it, not the other way around. This study is fully consistent with Papert's constructionism theory (1972, 1980), which states that students should programme the computer rather than the computer programming them. Parents who are opposed to programming should understand this theory and realize that learning to code will enable students to be in control of the technology that is conquering the world and not just consumers of it, as is unfortunately the case with most of our students.

Looking at the literature, we find that all developed nations are interested in programming in particular and give it adequate attention, whether in school or external workshops or even through their electronic platforms, and that the majority of these nations recognise programming as a fundamental subject taught to students in elementary school. When comparing the policies of these countries on teaching programming with the policies of the United Arab Emirates, we will find some deficiencies in teaching this subject in the Emirates. Educational policies must be reviewed by decision makers in the UAE to adequately integrate programming into students' curricula and provide the required resources for it.

5.2 Implications for action

Based on these findings, this study proposes many courses of action that might be used to try to overcome the problems indicated earlier in the research and to assist and support teachers in this educational process:

The first step is to raise parental understanding of the notion of programming, followed by its importance for students and its positive impact on their academic and future lives, as well as designating relevant seminars for them to help their children.

Second, based on the success of the first proposal, we can assign extra tasks to students and capitalise on the remarkable development in the educational process during the Corona time by organising more online workshops for students outside of school.

Third, committing sufficient resources and time to programming, renewing, and expanding computer labs in schools so that students use programming in practise.

Fourth, providing a suitable percentage of educational robot bags to elementary school pupils since these bags influence their passion and love for programming when they see the results of their efforts in front of their eyes.

Fifth, the programming curriculum for primary school kids must consider their mental and cognitive growth at this time in order to produce a curriculum that corresponds to their level of comprehension and can be easily absorbed and expanded upon in the later phases.

Sixth, this proposal is for ministerial schools: an explanation of ICT (or Design and Technology, as ministerial schools refer to it) in Arabic should be considered, because, as teachers have indicated, students learn all subjects in Arabic except technology, which includes programming. It is taught in English. As a result, the students struggle to understand the programming, and it is challenging for them because they basically don't understand the English language. According to the teacher's words, they cannot form a word or sentence in the English language, so how can they understand an entire subject that contains new concepts?

Seventh, integrating programming with other subjects. Programming can be combined with other subjects to achieve the maximum benefit from it.

Eighth, all teachers in each school should be made aware of the role of computer teachers and the importance of programming in increasing students' academic performance, including in their own courses. They should support them and not take their time or undervalue their subjects.

Ninth, on a large scale, the school inspection team should look at this material, and when making a visit to the school, they should include visiting ICT classes and inspecting the laboratories. This, based on teacher consensus, will compel schools to pay attention to and support this material.

Lastly, on a bigger scale, the Ministry of Education should promote this subject and consider the following proposal: establish a new subject devoted only to programming, isolate it from the ICT subject, and make it a core subject covering all programming principles and skills.

5.3 Limitations and Future Recommendations:

The findings of this study serve as the basis for recommendations for academics who plan to investigate the significance of programming to young students; the correlation between the programming curriculum and students' ability to master programming concepts; and a comparison of the strategies and policies employed by schools in programming education.

While this study has substantial contributions, the findings are subject to some constraints that may have an impact on the study's validity and generalizability. The first reason is specific to the sample of the questionnaire participants. Through the comments of some of the participants, the researcher realised that it was important to explain to these participants what programming means before they start the questionnaire. Some people do not understand this concept and mix it with some other concepts, and this may have an impact on their choices, which may not be accurate enough. The researcher suggests including a sufficient concept of programming for participants in future research before they start the questionnaire. He also suggests that a question about the participant's educational degree be included, as the researcher believes through the participants' answers that their degree of education is a key factor in supporting their children in programming.

The number of participating teachers from British schools was only three, including a teacher from a school that does not teach students programming in the primary stage, so it is not possible to rely on his perceptions to adequately comprehend this stage in the absence of empirical evidence confirming or refuting his perceptions. Therefore, more research is required to explore and comprehend broadly with a broader group of teachers working in British schools to gain a more accurate understanding of how these schools implement programming education for primary students.

The study did not consider the teachers' experience and efficacy, which may have an impact on the learning process. According to several studies, some teachers lack skills in teaching coding. Future research must give information on teachers' competencies in teaching this subject. Future research may also look towards integrating coding with other topics such as math and science.

There is a little inconsistency between some of the results of the questionnaire and the interview. In future research, the researcher suggests relying on classroom observations to verify the level and behaviour of students towards programming and integrating the results with the results of interviews or surveys to obtain more accurate information that can be generalized.

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APPENDICES

5.4 Appendix A: Interview Transcripts

Teacher 1:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, it is necessary, but sometimes it overwhelms the young students. The curriculum needs to be simplified so that the students can absorb it.

Q.2 Are you in favour or opposed to teach programming to primary students?

Yes - Grade 4 is appropriate.

Q3. Is programming helping students do better in science and math?

Yes, sure

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

From grade 4. However, I see that they should learn critical thinking and problem-solving skills and start learning Scratch in grade 5.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

They begin with Scratch, which is appropriate for grade 4 students. However, the curriculum should build students' computing, critical thinking, and problem-solving skills earlier so that, by the time they start learning to program, it will be ingrained in their way of thinking and will not require extra work on their part. I was surprised by the 11th graders. They didn't know the difference between a bit and a byte, so they don't understand the basics of computers. In math and science, on the other hand, students start learning the basics early so that they can build on them later.

Q6. Is the goal of learning programming clear to the students in your school?

No. Many students usually ask why we study programming; they don't know the usefulness of it.

Q7. What is the students' attitude towards programming class?

They are not interested. There are only a few students who are interested.

Q8. How do school leaders deal with D&T subjects?

The school promotes technology and competes in robotics competitions.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study D&T subjects?

2 sessions per week, but it is not enough; coding necessitates more time.

Q10. Are you Teaching ICT subject in Class or Lab?

Most of the classes in the lab

Q11. Do you find all the resources you need available to teach the students programming properly?

Yes, all resources are available.

Q12. What do you want to see more in computer lab? Everything is available.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, it will overwhelm both the teachers and students.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, sure.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

No.

Teacher 2:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, it enhances logical and analytical thinking and prepares them for the AI age.

Q.2 Are you in favour or opposed to teach programming to primary students?

Yes, it builds up their logical thinking skills and can be integrated with STEM to make students compatible with the technology era.

Q3. Is programming helping students do better in science and math?

Yes, especially in math. They are correlated.

Second theme: The teachers' opinions of the programming curriculum used at their

school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

Since 2019-2020, they don't take programming at all at primary level nowadays based on the new syllabus.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

As I mentioned, Cambridge recently dropped programming and replaced it with digital literacy. The teachers hope to teach computer science instead because of its importance, but they need the head's approval.

Q6. Is the goal of learning programming clear to the students in your school?

When the students ask, the teacher replies clearly — it depends on the teacher's methodology.

Q7. What is the students' attitude towards programming class?

Before 2019-2020, when they were learning programming, they were interested.

Q8. How do school leaders deal with D&T subjects?

They deal with it as a subsidiary subject. Actually, all schools in the UAE deal with this subject as a subsidiary subject. ICT is not considered as a core subject. Let's give an example: when inspections visit our school, they don't enter the ICT teachers because ICT is not in the inspection criteria.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study D&T subjects?

2, programming not included.

Q10. Are you Teaching D&T subject in Class or Lab?

2 sessions – 1 theory in class and 1 lab practical

Q11. Do you find all the resources you need available to teach the students programming properly?

Because of COVID restrictions, they don't have access to the lab. We are facing some difficulty, and it is slowly coming up. Maybe next year the school will be able to provide computers in the lab for all students. For the applications, they are up-to-date, but I cannot say I am fully satisfied (because of COVID restrictions).

Q12. What do you want to see more in computer lab?

No.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to

programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

After Covid, the school still supports online resources, so we can do that.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, once per week can be done, but it depends on the school's leadership.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

No.

Teacher 3:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, I do agree.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, but from grade 3 only if the school follows the same curriculum, because the curriculum of a ministerial school is very hard, and students cannot absorb it properly.

If they develop a simpler curriculum, I do agree that the students start learning programming in grade 1.

Q3. Is programming helping students do better in science and math?

It is based on their passion. If they love the programming, they will be able to relate it to other subjects.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

From grade 1.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

It is not appropriate. About half of the curriculum is theoretical, which it is not supposed to be. It is hard for grades 1 and 2. Students at this age require something they can touch and see results from in order to understand. The students in my school learn to program in Scratch by

grade 3.

Q6. Is the goal of learning programming clear to the students in your school?

Not really, because as I mentioned in grades 1 and 2, they study only theoretical parts.

Q7. What is the students' attitude towards programming class?

They only start to be excited in Grade 3 when they study scratch.

Q8. How do school leaders deal with ICT subject?

They deal with it as a subsidiary subject, and they usually take from my sessions and give to other teachers (I mean the core subject teachers). And also, if they have celebrations, they take students out of the session to train them.

Parents also don't care about this subject or its value, and this affects the students and even the teachers. To be honest, when we see this school and the parents' attitude, it affects us. I see that if the school spread awareness of the usefulness of programming, the parents may care.

It also does not affect the total grade. ICT teachers must give students an 80 or higher even if they did not solve anything. They deal with computers like PE, art, and music.

Unfortunately, the management mindset is that the computer is not important because the inspection does not attend to ICT teachers as it is categorised as group B.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study D&T subjects?

For grades 1–2, there are two sessions per week, and for grades 3–5, there are two to three sessions per week.

Q10. Are you Teaching ICT subject in Class or Lab?

We have only one lab, so the students attend one class in the lab per week. I try to convince the students to bring their tablets with them to practice; some respond positively, and some do not.

Q11. Do you find all the resources you need available to teach the students programming properly?

No, the school doesn't support us and doesn't provide all the resources needed.

When I need to buy or update a specific piece of software for the students, they refuse to buy it. Instead, they tell me to download it with workaround solutions, or try another free one.

Q12. What do you want to see more in computer lab?

Support from the school and adding practical parts to the curriculum, or even better, dropping the whole theoretical part from the curriculum and replacing it with a practical one.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to

programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, the parents will not support us. Not only because they don't want to be supported, but also because of their level, especially in programming. Most parents lack the ability to support their students in this subject. (Researcher: educate or qualify parents, raise awareness).

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, sure, especially if they make the curriculum suitable for the students' age.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I see that the curriculum is complex and not appropriate for the primary students' age. It would be better if we adhered to something simpler and more engaging like the one used by one of the national programs in the UAE that teaches young students programming. Many of my students were enthusiastic and engaged in programming, and they learned a lot in this program (UAE Program).

I felt the difference after this program, and she hoped that if they gave this program to all students, not only Emirati students.

Teacher 4:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, sure.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes.

Q3. Is programming helping students do better in science and math?

Yes, sure it affects their skills in science and math subjects.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

They start from grade one, and they start with Scratch. 40% of the curriculum is about programming.

Q.5 Is the programming curriculum in your school appropriate to the students' age and level of understanding?

The curriculum is appropriate, but the problem is in the implementation. This curriculum should be taught in a lab because it is supposed to be practical. However, I have to teach it theoretically because the school only has one lab for the whole school (grade 1 to grade 12). So, most of the time, I have to teach it in class.

Q6. Is the goal of learning programming clear to the students in your school?

No, it is not clear. 2 out of 30 only perceive the usefulness of programming. We need to spread awareness about its importance. Also, if the ministry of education paid some attention to it and considered it a core subject and categorized it as group A, it would help a lot.

It is mainly from home. The parents don't consider this subject. They are asking me for the worksheet for their kids to memorize without understanding. The mothers' attitudes stem from the MOE. because it considers ICT as a subsidiary subject. The interest of the ministry is what influences the interest of the parents.

Unfortunately, despite what happened in the media and everywhere in the UAE, there is a defect in this learning process. Suffice it to say that most students don't buy the ICT book; they depend on only the worksheets. Of course, this has not happened in other subjects.

Q7. What is the students' attitude towards programming class?

The students feel interested because of the gamification strategy and feel very excited and happy when they see the outcome of their program. However, even if the students are interested and try to study programming, the mothers forbid them from focusing and studying it. They ask them to go and study another subject better. This, of course, affects their attitudes and passion.

Q8. How do school leaders deal with ICT subjects?

They deal with it as a subsidiary subject. They usually cut from my sessions to allocate to other subject teachers if needed. In Ramadan, when they adjusted the time, she cut my sessions short to keep the same time for other subjects. I sadly say that even the other teachers' view of the ICT subject is very inappropriate.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subject?

2 sessions.

Q10. Are you Teaching ICT subject in Class or Lab?

Class, there is only one lab in the entire school from grades 1–12.

Q11. Do you find all the resources you need available to teach the students programming properly?

No, the teacher who does all of these tasks, I have to search for a solution or fix the PC if needed

Q12. What do you want to see more in computer lab?

Actually, we need a lab.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, but it is not easy to apply in the UAE.

Q14. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

No.

Teacher 5:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, because it teaches them problem solving.

Q3. Is programming helping students do better in science and math?

Yes.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

In my school, the students start learning programming from KG. We are using code.org in KG. They begin learning about AI in grade 5.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

Yes.

Q6. Is the goal of learning programming clear to the students in your school?

Sure, they know the results of their work because they integrate it into specific kits or games, so they perceive that many students, when they are asked about their future job, want to be in the cybersecurity and IT fields. They know the future in IT.

Q7. What is the students' attitude towards programming class?

They feel happy after struggling with the code and solving it.

Q8. How do school leaders deal with ICT subjects?

It has some value, but not as a core subject like math and science.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subjects?

Once a week. Not enough at all. To finish one project in programming, she needs at least one month and a half.

Q10. Are you Teaching ICT subject in Class or Lab?

In class or lab, the school provides iPad even in class for every student.

Q11. Do you find all the resources you need available to teach the students programming properly?

Labs, tools, kits, everything

Q12. What do you want to see more in computer lab?

Nothing.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

We need to apply it properly; we need to motivate and encourage them very well, because I will take from the student's time and break, so I have to give him something in return, such as incentive, support and encouragement.

It is based on the teacher also. He/she will not accept doing extra work at home without something back to motivate him to do it.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, sure. It deserves

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

The content of the ICT curriculum clearly depends on the mindset or mentality of a supervisory or leadership attitude. That's why you may see two schools follow the same curriculum and policy, but the content of ICT is totally different! Because if the management is not persuaded by it, it will not give it any attention.

In many advanced countries, they learn programming in all subjects. One example is teaching English using scratch. For example, when you learn how to write and read a story (storytelling), go and do the same but on Scratch. So, they apply or integrate the coding in all other subjects, but here, of course, the other subjects are not qualified to use programming software. We need to improve all other teachers' other subjects to integrate them with other subjects.

Teacher 6:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, because it is based on logic and helps students solve big problems with small steps in their early stages. Therefore, it helps them make good and reasonable decisions in their future lives.

Q2. Are you in favour or opposed to teach programming to primary students?

Sure, the earlier the students start learning programming, the more they will be able to apply and get used to the concepts. Also, learning to program early enhances math skills, memory, and complex thinking.

Q3. Is programming helping students do better in science and math?

Programming helps people get better at math and complex thinking, and it is a key part of STEAM lessons and projects.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

The subject itself is from Grade 1, but they start to teach students about programming from Grade 3.

Some students don't have the computer skills, and the teachers are trying to make extra and personal efforts from their personal time to teach them these skills. Because they start learning programming in school with a very theoretical content that is far from the programming

concepts, they start learning how to program directly in Grade 3.

The content of this subject in grades 1 and 2 was about recycling, sustainability, and simple colouring and drawings.

So, it is hard to start after that directly with them and give them programming concepts like variables found in Scratch and require them to submit a full project at the end of the year. (There is a big gap).

When they start programming in grade 3, they don't know anything about computers, not even how to turn them on and off, so how could they absorb these concepts?

So, the teacher has to teach them first how to use the mouse and keyboard and type on the computer, and this may prevent her from covering the content she is supposed to cover.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

The curriculum is irrelevant to their age or level of understanding. The students learn theoretical parts like the motor types in this subject! And only in the last term of grade 3 do they start learning about programming, which is not enough at all.

The problem also is that from grades 9 through 11, the students have a very strong curriculum in computing with different programming languages like Python. If the students didn't have the basics from grade 1, they would not be able to understand and deal with these skills in grade 10. (There is a big gap between how they start and how they are supposed to be.)

Q6. Is the goal of learning programming clear to the students in your school?

No, neither parents nor students perceive the usefulness of programming.

Only 2% of students may comprehend what the teacher is explaining in programming for the first time.

Q7. What is the students' attitude towards programming class?

The problem in the ministerial school strategy is that the students are not able to read or write till grade 4. As a result, the language is a very big challenge for them to learn programming in grade 4. I am trying my best to build good relationships with them and plan extra activities to get them excited about the class. But, of course, they are still uninterested and do not pay attention in the same way that they do in core subjects such as math and science.

Q8. How do school leaders deal with ICT subjects?

As a subsidiary subject, and that's because the ministry of education categorizes it as group B, success is mandatory on it, and the parents know that, and this reflects clearly on the students.

This is because parents don’t pay attention to this subject. I have to convince the mother that this is an important subject to push their kids to study or focus on it. Not only parents, we are facing the same issue in other core subjects like math, science, and English. Other teachers see that they can use the ICT sessions if they need extra time for their subjects, and unfortunately, the school leaders are not helping them on that.

In the ICT subject also, students can’t fail. They know at the end that they will not fail or get a low mark even if they didn’t solve any questions in the exam.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subject?

3 sessions per week. Most of the sessions are theoretical. Only in the last term do they study practical parts.

Q10. Are you Teaching ICT subject in Class or Lab?

This depends on the management view, not on what the curriculum needs. I usually explain in class using my computer and if the students bring their tablet, they can apply. If they don't, then he only listens to the teacher without application.

Q11. Do you find all the resources you need available to teach the students programming properly?

Yes, labs are available, but sometimes we face internet issues.

Q12. What do you want to see more in computer lab?

I need more support from the IT support team. They come to school only once a week. This overwhelms D&T teachers because if any student or another teacher faced any technical issue, they ask the D&T teacher to help. Sometimes they ask me to go out of my class while I am explaining to solve this issue.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No way, parents will not support it.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, sure

Q15. Is there anything else you want to add to this topic that I didn't ask you about?
No.

Teacher 7:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?
Yes, sure.

Q2. Are you in favour or opposed to teach programming to primary students?
Yes, she should start learning it earlier. When young students learn programming early on, they will regard it as a fundamental skill and will be able to absorb all of the required skills.

Q3. Is programming helping students do better in science and math?
Yes, it is very related to physics and math. Unfortunately, a lot of physics and math teachers lack computer and coding skills, and that hurdles them from delivering the information in their curriculum to the students properly.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?
From grade 1, they start learning programming.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?
In my school, they teach them computing concepts in grades 1 and 2, then they start learning Scratch for the first time in grade 3. They felt that they were forced to study this skill and found it hard and complex.

Q6. Is the goal of learning programming clear to the students in your school?
Yes, because they relate it to the robotics and real-life applications of artificial intelligence.

Q7. What is the students' attitude towards programming class?
Most of them are not enjoying it. Let's say 30% of the students are enjoying it.

Q8. How do school leaders deal with ICT subject?
The deal with it as a subsidiary subject is because it is categorised as group B, or activity. It is not possible to fail. Even if the student didn't submit a project or pass the exam, the teacher has to give him at least 70%. So, there is no credibility at all in their grades.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study D&T subjects?

The primary students have 3 sessions per week. They are not enough at all to cover all the basics of programming.

Q10. Are you Teaching D&T subject in Class or Lab?

Based on our need to program, sometimes the curriculum does not mention programming for the whole term.

Q11. Do you find all the resources you need available to teach the students programming properly?

I can say that 70% of the resources are available, but unfortunately, the computers in the lab are old.

Some new applications couldn't be installed on these old systems of PCs.

There are educational kits which engage the students in this learning process. There is one kit for every class. However, it is not enough for the whole class. The time of the session is wasted in moving the kit from group to group so that all apply. I think we should at least have like 5 or 6 kits for each class to give one to each group.

Q12. What do you want to see more in computer lab?

New PCs and kits.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, it is not applicable.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, sure – or they may dedicate more sessions to it in the week.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

No.

Teacher 8:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, because it is the language of the future. It helps the students develop their critical thinking skills and opens a wide range of possibilities for them.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, in favour.

Q3. Is programming helping students do better in science and math?

Yes, when the students study programming, they automatically integrate different subjects like math, science, and English.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

The students start from Grade 1. They start with Scratch Junior.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

The American curriculum correctly mapped to the students' skills. The students' passion may affect the learning process, but I think the curriculum is in line. However, I think in every term we should focus more on one particular skill to be able to master it.

Q6. Is the goal of learning programming clear to the students in your school?

Unfortunately, 20 or 30% of those who are interested in electronics care about programming and know the value of it, even if they are in middle school. I always get inquiries from grade 4 students asking why we are studying programming, why we are using it, even the parents asking me why they are studying it. One parent said that she wants her son to learn PowerPoint instead of all that useless programming.

Q7. What is the students' attitude towards programming class?

The students start to study to program Minecraft by grade 4. When they heard that they would be taking Minecraft, they jumped with happiness, but when I told them you have coding, they didn't feel excited. We do need more guidance and awareness.

Q8. How do school leaders deal with D&T subjects?

Is it up to the teacher to make it important or not? We need more awareness that CS and programming are the future.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subjects?

1-4 lessons per week

Q10. Are you Teaching D&T subject in Class or Lab?

Anywhere, they have an iPad.

Q11. Do you find all the resources you need available to teach the students programming properly?

We have iPads that are always available, and our apps are always up to date.

Q12. What do you want to see more in computer lab?

Everything is available.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

It depends on parents' mindset. Some will support it, and some will not. So, it would be better if we had it within the school time.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, it is necessary to concentrate on programming skills.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

No.

Teacher 9:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, sure.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, in favour.

Q3. Is programming helping students do better in science and math?

Yes, they are related to each other.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

They begin learning programming in third grade and begin with Scratch.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

Not at all It should be updated, particularly for the upper grades, and the number of available resources, such as robots, should be increased because it is insufficient for all students.

Q6. Is the goal of learning programming clear to the students in your school?

If it is used correctly, they will recognize its utility. But sometimes the school does not give them the means to do so, because without practice they will feel it is useless; but, if they work on their own, they will comprehend and consider how they could utilize and relate programming to real-world applications. As you can see, the robot is not far away, and students in the UAE are fortunate to be able to interact with technology in numerous locations, such as shopping malls, exhibits, etc.

Q7. What is the students' attitude towards programming class?

They are usually enthusiastic.

Q8. How do school leaders deal with ICT subject?

This subject is treated as a subsidiary subject by school administrators, and it does not affect the overall grade because it is categorized as category B and comes from the ministry of education, not the school. Because of this, school administrators respond in this manner. The Ministry of Education equates ICT with P.E. and the arts. As a result, many students state, "I don't want to work on this session, and I don't care because it doesn't count toward my overall score."

Worst of all, I am sometimes required to leave my session to complete another assignment or to present it to a different teacher who teaches math, science, English, or Arabic.

This subject is not deemed significant enough for the school to instruct kids in certain dances in preparation for a party or celebration.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subject?

2 sessions per week, and it is insufficient; they need additional time; several students were unable to complete a single assignment during a session.

Q10. Are you Teaching ICT subject in Class or Lab?

Based on availability.

Q11. Do you find all the resources you need available to teach the students programming

properly?

The PCs at the computer lab are outdated, and it often takes too long to launch a specific program.

Q12. What do you want to see more in computer lab?

Refresh the lab and buy new computers.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, the parents will not support.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

No, I believe that focusing on programming more and incorporating it into other subjects is adequate.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I think that if the inspection followed this subject, all schools would renew the lab and provide more resources for it. We have some labs that don't have internet access! They don't care because the inspection only attends to other subjects and never attends to ICT teachers.

Teacher 10:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, and it can be understood easily by block-based programming and robotics, and they can relate it to their real-life experience.

Q2. Are you in favour or opposed to teach programming to primary students?

yes

Q3. Is programming helping students do better in science and math?

Yes, there are common concepts between them.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

From grade one, they learn how computers work and apply simple block-based programming via small robotics, and from grade two, they start learning Scratch.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

Not really. It should be updated, especially for the higher grades – and the resources like robots should be increased because it is not enough for all students.

Q6. Is the goal of learning programming clear to the students in your school?

If it is applied properly, they will perceive its usefulness. But sometimes the school doesn't provide the tools to help them do so, because without practice they will feel it is useless, but if they work on their own, they will understand and think about how they could use and relate programming to the real world. As you can see, the robot is not far for them, and the students in the UAE are lucky because they can touch the technology in many places, for example in malls, exhibitions, and so on.

Q7. What is the students' attitude towards programming class?

They always feel excited.

Q8. How do school leaders deal with ICT subject?

The school leaders deal with this subject as a subsidiary subject, and it doesn't affect the whole grade because it is categorised as category B and it is from the ministry of education, not the school. That's why the school leaders deal with it this way. The Ministry of Education equalizes the ICT subject with PE and Art. Therefore, many students say I don't want to work on this session, and I don't care because this subject is not counted in the total grade. The worst thing is that sometimes the school asks me to leave my session to do another task or to give it to another teacher who teaches math, science, English, or Arabic.

The school doesn't feel the importance of this subject to the extent that they take the students within the class to train them on specific dances to prepare them for a specific party or celebration.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subjects?

2 sessions per week, and that is not enough, they need more time, many of the students could not even finish one project in the session.

Q10. Are you Teaching ICT subject in Class or Lab?

Based on availability, we only have one lab from grade 1 to 12.

Q11. Do you find all the resources you need available to teach the students programming

properly?

The PCs in the computer lab are old, and it sometimes takes too long for me to start a specific program on the PC.

Q12. What do you want to see more in computer lab?

Renew the lab and buy new computers.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, the parents and students will not care.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

No, I believe that paying more attention to programming and integrating it with other subjects is sufficient.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I think that if this was part of the inspection, all schools would fix up their labs and give them more resources. Some of our labs don't have access to the internet! They don't care because ICT teachers are never looked at during inspections. Only teachers of other subjects are looked at.

Teacher 11:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Sure, all students should learn it because technology is booming everywhere around us.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, in favour.

Q3. Is programming helping students do better in science and math?

Yes, sure. Programming is very related to these subjects, especially math. Programming affects the students' performance in math and vice versa.

For example, the programming refreshes students' information about many concepts in math; moreover, it reduces their calculation mistake rates.

Second theme: The teachers' opinions of the programming curriculum used at their

school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

From grade 1, they learn the basics and start block-based programming from grade 3.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

Yes, the curriculum is always up-to-date and updated to reflect the new changes and implementation.

Q6. Is the goal of learning programming clear to the students in your school?

Yes, for the majority of boys, they know that everything related to coding, websites, networking, AI, IOT, and even business. They know that in their company, if they need a basic thing like a website, they will require coding, so they know it is really linked to real life. But for girls, I don't feel they perceive the goal of programming. From my point of view, it is because of parents' influence. Parents here only think the programming, IT, and cybersecurity fields are for boys. Boys only want to be gamers and in cybersecurity fields and earn money from it. That's why most of the boys perceive programming's usefulness. In my school, I see girls prefer other fields like math and science to be engineers or doctors. Most of them feel interested. Even if they don't understand, they work around and try to understand and ask for more explanation.

Q7. What is the students' attitude towards programming class?

Yes, for the majority of boys, they know that everything related to coding, websites, networking, AI, IOT, and even business. They know that in their company, if they need a basic thing like a website, they will require coding, so they know it is really linked to real life. But for girls, I don't feel they perceive the goal of programming. From my point of view, it is because of parents' influence. Parents here only think the programming, IT, and cybersecurity fields are for boys. Boys only want to be gamers and in cybersecurity fields and earn money from it. That's why most of the boys perceive programming's usefulness. In my school, I see girls prefer other fields like math and science to be engineers or doctors. Most of them feel interested. Even if they don't understand, they work around and try to understand and ask for more explanation.

Q8. How do school leaders deal with ICT subjects?

Unfortunately, they deal with it as a subsidiary subject. Furthermore, its grade does not affect the whole grade because they have to give all students a high mark.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study D&T subjects?

Once per week.

Q10. Are you Teaching ICT subject in Class or Lab?

Both.

Q11. Do you find all the resources you need available to teach the students programming properly?

I asked the school before to add more labs because all the primary sections (1–5) share one lab, and the middle lab doesn't have one, so they share this lab also with primary.

Q12. What do you want to see more in computer lab?

The lab lacks a lot of resources. For example, the PCs are old, but the students bring their gadgets. Additionally, there is an internet issue. Moreover, they don't have a software that enables her to see all the other students' devices (it is very simple software, but we need more support).

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

Yes, we can perfectly allocate supplementary instructions to them outside the school and online. It is a good idea, and everyone should be supportive.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

I think there is no need for lower school students. I think it is better if they integrated programming with other subjects. Maybe we need to do so at the middle level.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I think that if this was part of the inspection, all schools would fix up their labs and give them more resources. Some of our labs don't have access to the internet! They don't care because ICT teachers are never looked at during inspections. Only teachers of other subjects are looked at.

Teacher 12:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Sure.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, they can, but only to simplify it and make it into steps to be able to absorb it.

Q3. Is programming helping students do better in science and math?

Yes.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

In grades 1 and 2, they start with an Hour of Code activity, and the percentage of programming is only one term from the whole curriculum; it is a self-paced activity with a total score of 20 out of 40; the other terms cover theoretical parts. They start with Scratch Junior in Grade 3.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

Yes.

Q6. Is the goal of learning programming clear to the students in your school?

There are two parts. Some students enjoy learning programming, while others see it as merely a game. They are saying to Ms. "We want to play." They don't even relate this game to real life or understand its usefulness. The teacher says the national programs conducted by some governmental institutions affect some students a lot in their perception of programming, and the teacher could see the difference between the students who attended these programs and the others. (I mean UAECODER, because we have some of them in my school).

Q7. What is the students' attitude towards programming class?

Interested.

Q8. How do school leaders deal with ICT subject?

No, they deal with it as a compulsory Like other subjects, In the past, it was like an activity subject and students did not care about it, but recently, after the school considered it as a core subject, the students, as a result, became more concerned and studied it to get a good grade because it affects their overall grade.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subject?

One session for grades 1 and 2, two sessions for grades 3 and above.

Q10. Are you Teaching D&T subject in Class or Lab?

We have tablets and labs.

Q11. Do you find all the resources you need available to teach the students programming properly?

Yes.

Q12. What do you want to see more in computer lab?

Everything is available.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

This is difficult. We should make parents and students aware of this.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Yes, better, because in ICT subjects we always miss something. For example, in grade 3, if we focused on programming, we missed the other skills of ICT and the opposite. So, if we separate it, every part will take its right amount of time and effort.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I think that if this was part of the inspection, all schools would fix up their labs and give them more resources. Some of our labs don't have access to the internet! They don't care because ICT teachers are never looked at during inspections. Only teachers of other subjects are looked at.

Teacher 13:

First Theme: Teachers' Perspectives towards the importance of programming

Q1. Do you agree that programming is a critical skill for all students?

Yes, I totally agree.

Q2. Are you in favour or opposed to teach programming to primary students?

Yes, I am in favour of teaching programming to primary students, but the issue is that they should start with simple conceptions so that the students can easily absorb them.

Unfortunately, the curriculum digs them directly into the programming tools without any introductory section.

The curriculum covers computational and logical thinking and how robots move and the theoretical logic of computing. Then in grade 3, they start from with Scratch (the opposite should happen).

So, in first and second grade, we should prepare the students with the basic skills of programming, explain the goal and usefulness of programming, and relate programming to real-life experience so that the picture is complete for the younger students. At that time, we can start exposing the kids to the basic concepts of programming and they will be able to absorb them easily.

Q3. Is programming helping students do better in science and math?

Yes, sure, it is. It positively improves their progress in these subjects, especially in science.

Second theme: The teachers' opinions of the programming curriculum used at their school and the challenges they face

Q4. From which grade do the students in your school start to learn programming?

Grade 1.

Q5. Is the programming curriculum in your school appropriate to the students' age and level of understanding?

No, the curriculum starts with teaching students the abstract concepts of programming and computational and theoretical logical thinking, which is very difficult for the students to understand. To the extent of teaching them the algorithms in grade 2, which is a complex concept for them, in grade 3 they start working on block-based programming using Scratch. In my opinion, the opposite should have happened. We should start with Scratch in the first two grades, and then in grade three, we may be able to teach them these abstract concepts and skills. One more important point: all the subjects in the school are taught in Arabic except the design and technology subjects. This makes it harder to understand these concepts before even learning how to form or pronounce a word in English.

Q6. Is the goal of learning programming clear to the students in your school?

No, not clear. In the design and technology subjects, the students learn energy and renewable energy in detail in D&T subjects that are related to science, and they are not aware of their relationship with computers. Some students asked about the relationship between what we learn and the main subject. Based on the curriculum, they are learning these concepts to know how a computer gets power! The students should learn these concepts in science, not D & T. Why confuse them and teach them these scientific concepts in D & T?

Of course, when I started teaching them programming in Grade 3, they got confused with the many concepts.

Q7. What is the students' attitude towards programming class?

They only started to enjoy it when I started teaching them Scratch programming.

Q8. How do school leaders deal with ICT subject?

They deal with it as a subsidiary subject, and this is unfortunately because it is categorised as an activity subject from group B curricula. Of course, this affects the students' attitude and interest in studying it.

It not only affects the students' attitude, it also affects the parents' attitude. For example, one time I found an outstanding student in programming. I tried to give him extra tasks to do outside the school time frame to develop his skills in computing. The student was excited and accepted to search and do extra tasks. The next day, he came back out and told me, "My mother asked me: Why did you give me extra tasks in this subject? It is not important. I'd rather spend my time studying math or science, or any other core subject, because at the end you have to give me the full mark or near on it even if I didn't answer all the questions."

Some of them may know the answers to questions in the exam. However, they refuse to answer because they know that at the end, they will get a high mark.

Third Theme: Time and Resources allocated to ICT Subject in UAE primary schools.

Q9. How many sessions per week do the students study ICT subjects?

For grades 1 and 2, there are two sessions. 3 sessions for grades 3, 4, and 5. In some terms, the whole curriculum is theoretical, meaning that the students don't learn any programming at all in these terms.

Q10. Are you Teaching ICT subject in Class or Lab?

Class.

Q11. Do you find all the resources you need available to teach the students programming properly?

No, actually the students don't go to the computer lab after COVID-19. The students bring their own tablets. And no IT support. I have to install the applications on the students' tablets when needed and make all the updates.

Q12. What do you want to see more in computer lab?

I hope to see the D&T subjects, like core subjects like math and science. For example, in English, the students learn the characters first, then words, and then sentences.

Fourth Theme: Recommendations for overcoming the short timeframe allocated to programming in UAE primary schools.

Q13. Solution 1: Do you think supplementary instructions outside the school will be helpful to overcome the short time frame of the D&T subject and cover all the needed concepts of programming?

No, parents will not support---in online during COVID, most of them didn't attend the normal classes.

Q14. I recommend creating a new extra subject with the name of Programming to cover only the programming concepts. Do you agree with me?

Sure, they will study it step by step, moreover, they will perceive its usefulness and be able to understand all the concepts when they grow up, the curriculum should be appropriate and match their age step by step so that they can absorb it and perceive its value and usefulness.

Q15. Is there anything else you want to add to this topic that I didn't ask you about?

I think that if this was part of the inspection, all schools would fix up their labs and give them more resources. Some of our labs don't have access to the internet! They don't care because ICT teachers are never looked at during inspections. Only teachers of other subjects are looked at.

5.5 Appendix B: Parents' Questionnaire

Parents' questionnaire for exploring their perceptions about programming being taught to their primary kids

You have been asked to participate in this questionnaire as part of a research paper conducted by me, Wafaa Elsawah, a student at British University in Dubai, during the final stage (dissertation) of my master's study.

The research title **is "The Importance of Computer Programming for primary students' future and academic skills: Examining the time and resources allotted for it in UAE schools".** The study is designed to reveal the importance of programming skills for primary students which are essential to cope with 21st-century requirements and investigates the ICT teachers' and parents' perceptions of programming being taught in UAE schools. You are being asked to participate in this because parents are the main factors who can be relied upon to get a clear view regarding parents' thoughts about programming, how the kids perceive programming, do they able to understand the coding logic and concepts being taught at school? And satisfaction level with the time and resources allocated to it at school. The information from the questionnaire will help in figuring out solutions to improve teaching programming in primary schools in UAE schools.

Read and answer each question carefully and ask for help if you do not understand something

or are not sure how to respond. The questionnaire is confidential and anonymous, and your answers will be combined with those of other parents. Answering this questionnaire should require you about 10 minutes.

Please write your age (As a parent):

Please write your nationality:

My kids' school curriculum:

- Male.
- Female.

My kids' school curriculum:

- British.
- American.
- Ministerial.

My kid is in grade:

- One.
- Two.
- Three.
- Four.
- Five.

(1) Programming affects students' academic achievement and will be required in future jobs.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(2) Every student in the primary stage must learn to program.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(3) The goal of programming education is not clear in my kid's school, and this affects his/her passion for learning programming.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(4) My kid can absorb the programming concepts easily in his/her curricula.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(5) As a parent, I can provide guidance and follow the supplementary instruction in programming at home for my child when required.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(6) Parents should be provided with workshops to help them support their kids in programming.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(7) Because of the importance of programming to my Kid’s academic and future development, schools should allocate more time and resources to it.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

(8) I see that including programming as a new compulsory subject is a good solution to address the programming skills of all students at an early age.

☐ Strongly Agree
☐ Agree
☐ Neutral
☐ Disagree
☐ Strongly Disagree

General comments. Is there anything else or recommendation you would like us to know?

Thank you very much for your collaboration. Your opinion and experience are really important for my study.

5.6 Appendix C: Parents' Comments

At the end of the questionnaire, the researcher added an optional open question for the participants to add their comments or recommendations, if any. Some of them shared their thoughts and recommendations as follows:

- Pay an attention to the programming material in private schools, and its content to make it appropriate for the age of students and is not distracting for them.

- Add demonstration videos and practical experiments in programming.

- Please don't rely too much on this subject and cancel burying human skills. The student in the other is a human being, and a lot of orientation and guidance on this subject will affect the thinking of generations and turn them into robots without using their awareness and skills that will be atrophied by technology.

- More work should be done on technology subjects in schools.

- Modern technology is not an ideal way to make the student learn, understand and excel in his studies and his practical and practical life. Rather, it is an entertaining and negative way rather than an educational and positive one. I am not in favour of imposing the means of technology in schools, as it is tiring and burdensome on the guardian and on the student, and it is not sufficient to present the student and raise his educational level at all.

- I do not agree to teach students programming, books are the most important means of learning, please do not abandon them.

- I hope that schools will pay attention to programming fruitfully due to its importance in the future for our children

- Introducing programming material to all schools because it is not available except in some schools

- Giving workshops to parents that support programming and make programming education is practical, not just theoretical.

- Programming should be done about the computer subject to give it more scope, as it is taught in schools in general only.

- Provide more time and resources to programming.

- Make programming as a core subject and depend on gamification on teaching it.

- Spread awareness about the importance of programming.

- My son school start teaching programming from grade 6.

- Beginning teaching in any subject is better in childhood.

- Not all parents perceive the value of programming, because they think it is limited to engineers only.

- We do not want any of these programs for our children, such as Netflix, nor inform them about the romantic relationships that children can watch with the teacher and the teacher. Please keep teachers bound.

- Increasing the ability of teachers to deal with programming and to be sufficient to provide technological information in a smooth and lasting way for a long time, and not only in a way of memorization.

- Teaching the concepts of programming since childhood so that the student becomes accustomed to it and does not find it difficult with the development of his academic stages and always raise awareness of the importance of programming

- Programming is an elective at my daughters' school. So, they take French instead.

- It is a skill that only suits kids with deep interest in computer field so I am not quite sure if it should be taught as core subject but what I suggest is to encourage it as extra curricula and to be taken in more serious in this aspect with more rewarding system from the school

- I don't know much about this, so I don't have a strong opinion on it. I still think soft skills and critical thinking skills are more important than technical skills.

- Parents must be rehabilitated in parallel with the child to reach the desired goal of programming without that there will be an imbalance.

- Programming has become an integral part of learning.

- Programming is a requirement for future work, so please include it in the scientific curricula as a basic subject.

- Motivating students to participate in programming competitions and support them.

- I suggest that if there is an education in programming, it should be from the sixth grade so that the child is fully aware and able to comprehend this from my point of view. Thank you very much.

- It is necessary to provide a trained teaching staff capable of providing such workshops and classes. Or at least intensive training for the staff to be qualified. thank you so much.

- Intensifying programming courses and developing the skills of future children to create a generation capable of keeping pace with future developments

- I hope to teach parents programming

- I hope that technology and its concepts began to be learned in schools from primary and by specialized teachers to make it easier for students to understand and skill

- Parents must be rehabilitated in parallel with the child to reach the desired goal of programming without that there will be an imbalance.

- Education must be according to the student’s passion. Does he really like programming and technologies in general or not? I help him to develop effectively and gradually develop his skills according to his abilities and capabilities and the amount he will absorb.

- My experience as a mother and software specialist: No matter how simple what is required of children, I find a large percentage of mothers' grumble about computer-related duties... especially in the case of software or the like, even if they are simple... knowing that most of our children are able to carry out the duty on their own..."