

# Development in Computer Curriculum in Saudi Arabia: Systematic Review

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## Abstract

This paper seeks to provide an overview of publications in Saudi Arabia in the field of computer curriculum in K-12. We applied a systematic review methodology to analyze publications through 2021. Out of 225 publications initially identified, 110 were included based on the inclusion and exclusion criteria. The findings show that the number of publications in the field of computer curriculum in K-12 increased until 2018 but started to decrease in 2019. In addition, computer curriculum research trends focused on the high school stage, followed by the intermediate stage, and most participants were teachers and students. Moreover, the qualitative approach was frequently used in empirical studies, while most methodologies were surveys and semi-experimental. The results show that most of the papers' suggestions involved training teachers and developing the curriculum. Finally, the study presents some recommendations for computer curriculum research. It suggests developing a research center in the education ministry to encourage researching the curriculum and presents other suggestions in detail.

**Keywords:** computer curriculum, K-12 education, Saudi Arabia education, ICT curriculum, computer research

## 1. Introduction

Computers have become popular in recent decades, and using computers, as Alhazmai (1995) mentioned, has become the fourth most-necessary skill after reading and writing and math literacy. In addition, computers have become one of the most important aspects of life, including in education. The Ministry of Education (MoE) in the Kingdom of Saudi Arabia has realized the importance of computers in the lives of its students and has thus made it imperative to amend objectives, programs, and curricula to add new materials in the various educational stages that deal with computers (devices and materials) and their programming and usage (Alageely, 2002). The MoE has been concerned with spreading information culture since the middle of the last decade (Aldayel, 2005).

Computer as a curriculum was established in 1985 within the Developed High School Program (Almohesin, 1997; Fodah, 2002, 2003; Hakami, Hussin, and Dahlan, 2013). This was achieved through five mandatory hours divided as follows: computer introduction curriculum (two hours), introduction of programming with BASIC (three hours), and programming and information systems (three hours specified for administration and humanity science) (Almohesin, 1997). However, this was only a pilot program (Hakami et al., 2013). This included the creation of three courses, two of which were compulsory and the third being compulsory for students who were administrative and human sciences majors but optional for the rest of the students (Abdulaziz, 2004). By 1989, the actual study of the computer course had begun in all schools in Saudi Arabia (Aljondi, 2002).

The Developed High School Program was discontinued in 1990 and replaced with the previously used yearly program, and the three courses declared in the Developed High School Program were transferred to the first, second, and third years in their various departments (Almohesin, 1997; Fodah, 2002, 2003; Aldayel, 2005). Hakami et al. (2013) stated, that in 1991 a Computer Studies transformed to a compulsory subject into all secondary school's curriculum. In 1993, another major was added to the high school program under the Science and Technology Department, with four curricula (computer and information systems, logical design, introduction to mini processors, and computer and communications networks), but this major was only applied to specific schools and was discontinued a long time ago (Almohesin, 1997). In 1995, the computer curriculum content was updated to fit the changes that had occurred, but this update focused on the theoretical parts more than the practical ones, and a decision was issued in 1996 for the introduction of practical training as a side-by-side prerequisite with the theoretical part (Fodah, 2002). The computer plan was increased from one hour to two hours weekly for all

high school grades (Almohezin, 1997; Aldayel, 2005). After the practical parts were applied, the content of the curricula for high school was as follows (Aldayel, 2005):

First grade: history of computers and their components, and training on drawing and word editing programs.

- 1) Second grade: using electronic tables and databases.
- 2) Third grade: programming using Quick Basic language.

In the same year 1996, the MoE signed an agreement with a private company, Future Kids, to teach computers to students and train teachers in some elementary and intermediate schools as a trial phase (Fodah, 2002).

All previous attempts were concerned with educating boys. For girls' education, (the General Presidency for Girls' Education began introducing computer curriculum in high school in 1996 as two classes per week for Grades 2 and 3 in selected schools (Tatweer Company for Educational Services, 2013), and 29 schools were selected for teaching computer curriculum in Riyadh, Jeddah, Makkah, and the Eastern Province (Fodah, 2002).

In 1997, the MoE launched an initiative of cooperation with private sectors in computer and information technology education for teachers and students in all stages (levels). This included introducing a computer curriculum into intermediate and primary schools. Many companies have participated in developing the computer curriculum within the curriculum syllabus (plan), as decided by the MoE (Fodah, 2003).

In 2000, Prince Abdullah bin Abdulaziz and his sons initiated a student project for computers (the Watani Project) aiming, as Alhazani (2009) mentioned, to enable educational institutions to use computers and informatics (information and communication technology [ICT]) and to employ their technologies in enhancing the educational process (Alghamdi, 2004).

In 2002, a project with the aim of spreading computer literacy and introducing computers into primary and intermediate schools was approved through the integrated curriculum project (Abdulaziz, 2004; Tatweer Company for Educational Services, n.d.). In the first year of this program, illiteracy was eradicated for students and teachers, and computers were integrated into other subjects over the following years.

To meet Saudi Arabia's social and economic needs in the 21st century and to contribute to building a knowledge society, the Tatweer Project (1429–2008), which is affiliated with the King Abdullah Project for the Development of Public Education, aimed to reform the system of education and enhance the quality of learning and teaching, particularly in state schools, through the development of an integrated strategic plan for the curricula (Zalah, 2016). In 2013, the Tatweer Project commissioned a team to prepare a curriculum document for high school computer education that would be applied during the following years (Tatweer, 2013).

The Tatweer Project turned into an educational holding company owned by the Public Investment Fund in Saudi Arabia, and its work was not limited to creating computer curriculum documents, as it began developing computer curricula and changed its name to the ICT Curriculum Development Program, which tackles designing and developing ICT curriculum and developing national curriculum standards. The outcomes of the newly named program were a new curriculum for ICT for Grades 7–12 and the provision of an ICT curriculum that incorporates the latest up-to-date technology. In 2021, the ICT curriculum was transformed into digital technology from the first intermediate grade to the third secondary grade, and digital skills were added to the curriculum for the fifth and sixth grades of primary school (MoE, 2022). The development of the computer curriculum is summarized in Table 1.

Table 1. Historical development of computer curriculum in K-12 over time

Date	Major Changes	Curriculum
1985	Computer curriculum is established within Developed High School Program.	5 mandatory hours.
1990	Developed High School Program is replaced with a yearly program.	The 3 curricula declared in the Developed High School Program are transferred to the first, second, and third years in its various departments.
1991	"Computer Studies" as a compulsory subject is added into all secondary schools' curricula by the MoE.	

		4 curricula: computer and information systems logical design introduction to mini processors computer and communications networks This major is applied only in specific schools and has been discontinued.
1993	Another major is added to the high school program under the Science and Technology Department.	
1996	The computer curriculum plan is increased from 1 hour to 2 hours weekly for all high school grades.	
	The General Presidency for Girls' Education is introduced into computer curriculum for high schools.	Two classes per week are added for the 2nd and 3rd grades in selected schools.
1997-1998	Curricula are updated.	Focus is placed on practical classes. New books contain both theoretical and practical classes. The curriculum includes five units, and in each year, students should study part of each unit: computer science, computer technology, computer applications, information systems, and the information age.
	Cooperation with private sectors in computer and information technology education for teachers and students Introducing computer curriculum into the intermediate and primary private schools.	
2000-2001	Ta'aheel Project	Project to rehabilitate high school graduates in information technology within two years and five tracks; this project is with (or in cooperation with) the Saudi Computer Society.
2002	Computer curriculum is added in primary and intermediate schools (public schools).	Used as an extracurricular activity.
2005	ICT is used in education (using computers in teaching and learning).	The development of school libraries into learning resources centers, the establishment of 1500 computer labs, and establishment of digital technical centers.
2008	King Abdullah Project for the Development of Public Education Tatweer Project is established.	Integrated strategic plan is developed for the curricula, including computer curriculum in secondary education.
2013	Curriculum document is prepared for high school computer education by the Tatweer Project.	E-book and training activities are established.
2014	Duroos streaming live lessons are produced. ICT development program is established.	National curriculum standards are developed New curriculum for ICT for Grades 7–12 is developed.
2015	E-School	
2016	iEN portal is produced.	Portal contains more than 720 books and 12,000 activities.
2017-2019	Future Gate is produced.	Learning management system (LMS) for distance learning.
2020-2021	Transformation to digital skills and digital technology. Covid-19 pandemic hits, and there is a move to distance learning.	Madrasti platform and Microsoft Teams are established.

The aim of this study is to understand the impact of and relation between the literature and computer curriculum development in general education in order to answer the following questions:

- 1) How have publications on the computer curriculum developed over time.
- 2) What is the distribution of articles published on computer education in K-12 over the years? What subjects did most of the publications cover?
- 3) What are the suggestions to improve the development of the computer curriculum in general education based on existing publications? Which factors support or constrain the development of the curriculum?

4) What is the relation between computer curriculum in K-12 over the years and publications in this field?

## 2. Method

To answer these research questions, we carried out a systematic review with the help of the methods proposed by Tawfik et al. (2019). After identifying the research questions and the inclusion and exclusion criteria, we performed a replicable search strategy. The selection of studies was based on eligibility criteria for included or excluded studies. Data were then coded and extracted from the included studies. Figure 1 shows the study selection process.

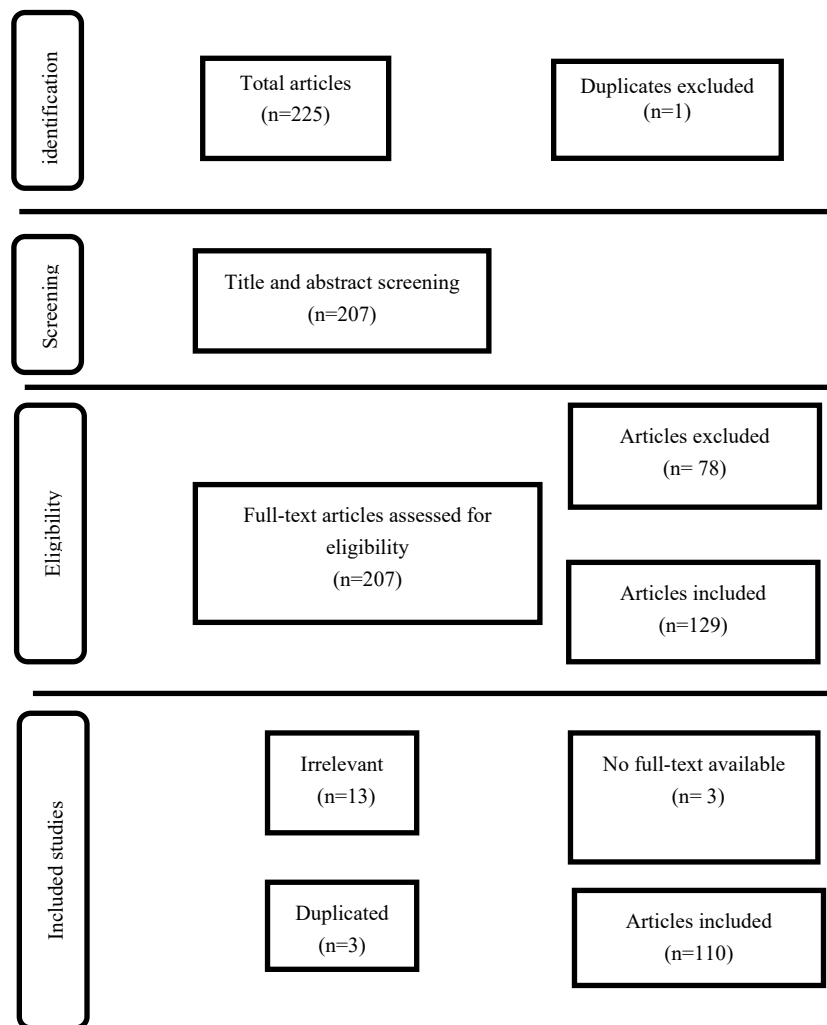


Figure 1. Flow diagram of study selection

### 2.1 Information Sources and Search Strategy

To answer the research questions, we carried out an electronic search of many databases for related papers. Our search was carried out in Google Scholar, the Directory of Open Access Journals (DOAJ), Dar AlMandumah, AlManhal, and EBSCO using the following search terms in Arabic and English with no lower date limit: computer, education, Saudi Arabia, computer teacher, computer course, and ICT (see Table 2). In addition, we manually searched the references of the included studies that could not be retrieved from the electronic search. The search dates were June 2020 through March 2021 and included 225 initial studies. The search strategies are provided in Table 2.

Table 2. Search strategies

Databases (providers)	Search terms
Google Scholar	Computer education Saudi Arabia
DOAJ	Computer education Computer teacher Saudi Arabia
Dar AlMandumah	Computer education Computer curriculum Computer teacher ICT teacher Saudi Arabia
AlManhal	Computer education Computer curriculum Computer teacher Computer lab Computer teaching methods Saudi Arabia
EBSCO	Computer education Saudi Arabia

### 2.2 Eligibility Criteria

Studies that fulfilled the eligibility criteria based on the research questions were included if they met the following inclusion criteria: studies conducted in Saudi Arabia and in the computer curriculum field for K-12. Reasons for exclusion were (a) studies unrelated to the inclusion criteria (e.g., ICT in other subjects, ICT use in school, or for undergraduates), (b) the full text was not available (e.g., abstract only), or (c) duplication (see Table 3).

Table 3. Final inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
related to ICT subject in K-12 school	Unrelated subject
	full text was not available (abstract only)
	Duplication

### 2.3 Study Selection

As Figure 1 shows, we first removed any duplicate publications. Then, based on the eligibility criteria, a preliminary screening was performed. On the basis of a title and abstract screening, papers that were not directly related to the computer curriculum were excluded (e.g., studies focusing on teaching computers in higher education or using computer technology in teaching other K-12 courses). We included studies that appeared to be related to our search focus on the curriculum of computers in general education that satisfied the inclusion criteria above. We then scanned the full texts for the remaining studies using the same inclusion criteria, and more papers that did not answer the research questions were excluded. The final number of studies reviewed was 110. All steps above were conducted manually by the research team, with each member reviewing the articles individually. A meeting was then set to discuss any disagreement in included/excluded publications.

### 2.4 Coding, Data Extraction, and Analysis

We then read the full text using the same inclusion criteria stated above. We also excluded papers that did not provide an answer to any of the research questions. The final number of studies reviewed was 110, of which 109 were quantitative studies and one was qualitative (see Figure 1).

To code and extract the data, all articles were exported to an Excel spreadsheet, and a coding system was developed. Codes included study information (year of publication), study design and interventions (methodology, participants and/or focus of study, stage), and study outcome (challenges, benefits, and recommendations).

The researchers independently reviewed the full papers to include/exclude the papers. If there was a difference, they then discussed their decision. After that, each member coded the data based on the research questions. Next,

the team members met to discuss the differences, if found, until they reached an agreement. Finally, the results were summarized and categorized.

### 3. Results

With the help of Microsoft Excel, we started analyzing the data based on the following research questions:

- 1) How have publications on the computer curriculum developed over time?
- 2) What is the distribution of the articles published on computer education in K-12 over the years? What subjects did most of the publications cover?
- 3) What are the suggestions to improve the development of the computer curriculum in general education based on existing publications? Which factors support or constrain the development of the curriculum?
- 4) What is the relation between computer curriculum in K-12 over the years and publications in this field?

#### 3.1 How Have Publications on the Computer Curriculum Developed Over Time?

To determine the development of research in the computer curriculum, we entered the data into Table 1. It was clear that computer curriculum research increased rapidly, coinciding with the King Abdullah Project for the Development of Public Education's Tatweer Project was established in 2008, reaching its highest at 2018. Then, in 2019, the number of research papers started to drop, as Figure 1 illustrates. This drop in the number of computer curriculum studies could have been caused by the spread of COVID-19 and the resulting crisis in education, as most researchers searched for how it affected education and how education institutions could deal with this new situation. A gap in the research was found between 2005 and 2007. The reasons for this could be that there was no change in the education policy regarding the computer curriculum or that there were limited researchers in this area (see Table 4 and Figure 2).

Table 4. Number of research papers per year

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
No. Papers	3	2	1	0	0	0	1	1	2
Years	2011	2012	2013	2014	2015	2016	2017	2018	2019
No. Papers	1	2	4	5	6	10	11	28	26
Years	2020	2021							
No. Papers	8	2							

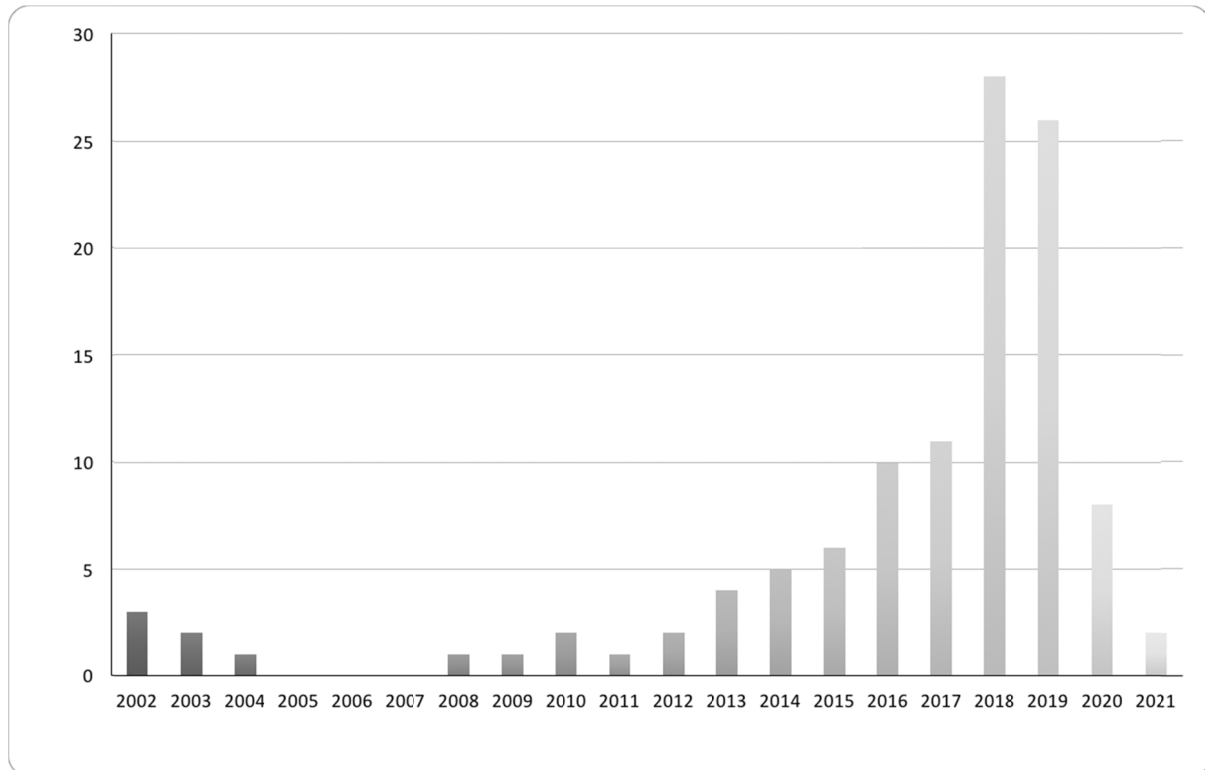


Figure 2. Number of research papers per year

### 3.2 What Is the Distribution of the Articles Published on Computer Education in K-12 Over The Years? What Subjects did Most of the Publications Cover?

To answer this question, the data were analyzed based on three categories:

- 1) The stage under study (intermediate, high school, other).
- 2) The participants and/or focus of study (students, teachers, books, other).
- 3) Research approaches (semi-experimental, survey, content analysis, etc.).

Based on the first category, most studies researched the high school stage (Aljondi, 2002; Almatrafi, 2010; Alghamdi & Aladeel, 2019; Alotaibi, 2016), followed by intermediate (Alenezi, 2011; Tohari & Alzahrani, 2020; Alatwey & Almassad, 2018). As the computer curriculum was introduced in high school in 1985, followed by the intermediate stage in 1991, 21 research papers examined the computer curriculum in general in K-12 (Alresheedi & Alibrahim, 2019; Alsaadani & Alriyashi, 2018; Almatrodi, 2016) (see Figure 3 and Table 5).

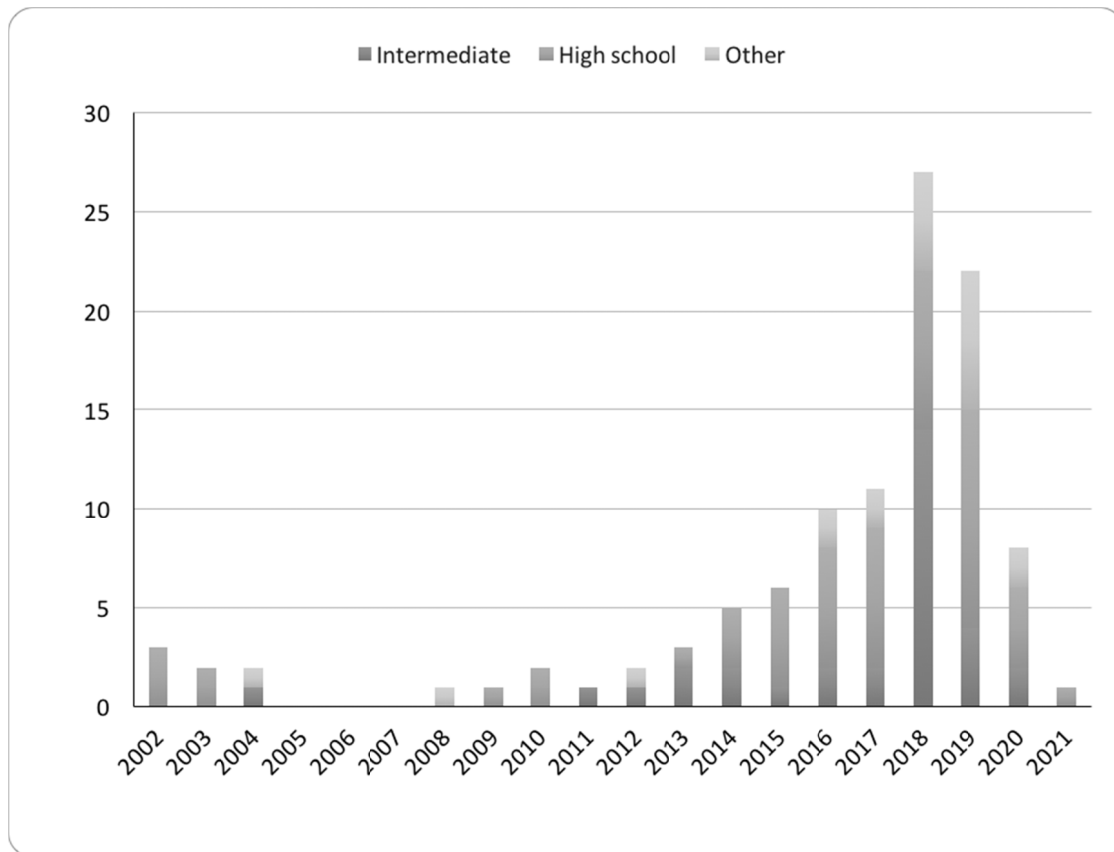


Figure 3. Number of research papers per year based on stage

Most of the participants and/or focus of study in the research papers were teachers and students (e.g., Tohari & Alzahrani, 2020; Alrobai & Azmy, 2018; Alhossaini, 2014; Alafraj, 2012). It is clear that other participants (e.g., leadership, head teachers) took part at an earlier stage of developing the computer curriculum in schools (Abdulaziz, 2004; Alzahrani & Alzahrani, 2020; Almenie, 2016). Books have received little attention in the research (Alibrahim & Almahaiza, 2019; Almohammed, 2016; Alsaqri, 2015) and have only become the subject of research since 2015 (see Table 5 and Figure 4).

Table 5. Number of research papers per year based on the stage and the participants

Years	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Intermediate	0	0	1	0	0	0	0	0	0	1	1
High school	3	2	0	0	0	0	0	1	2	0	0
Other	0	0	1	0	0	0	1	0	0	0	1
Students	1	0	0	0	0	0	0	1	2	0	1
Teachers	1	0	0	0	0	0	1	0	1	0	1
Books	0	0	0	0	0	0	0	0	0	0	0
Other	2	2	1	0	0	0	1	0	0	1	1
Years	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	
Intermediate	2	2	1	2	2	14	4	2	0	32	
High school	1	3	5	6	7	8	11	4	1	54	
Other	0	0	0	2	2	5	7	2	0	21	
Students	1	2	5	4	2	17	14	2	0	52	
Teachers	3	3	0	4	8	10	11	5	2	50	
Books	0	0	1	1	1	1	1	0	0	5	
Other	0	1	0	1	0	0	2	1	0	13	



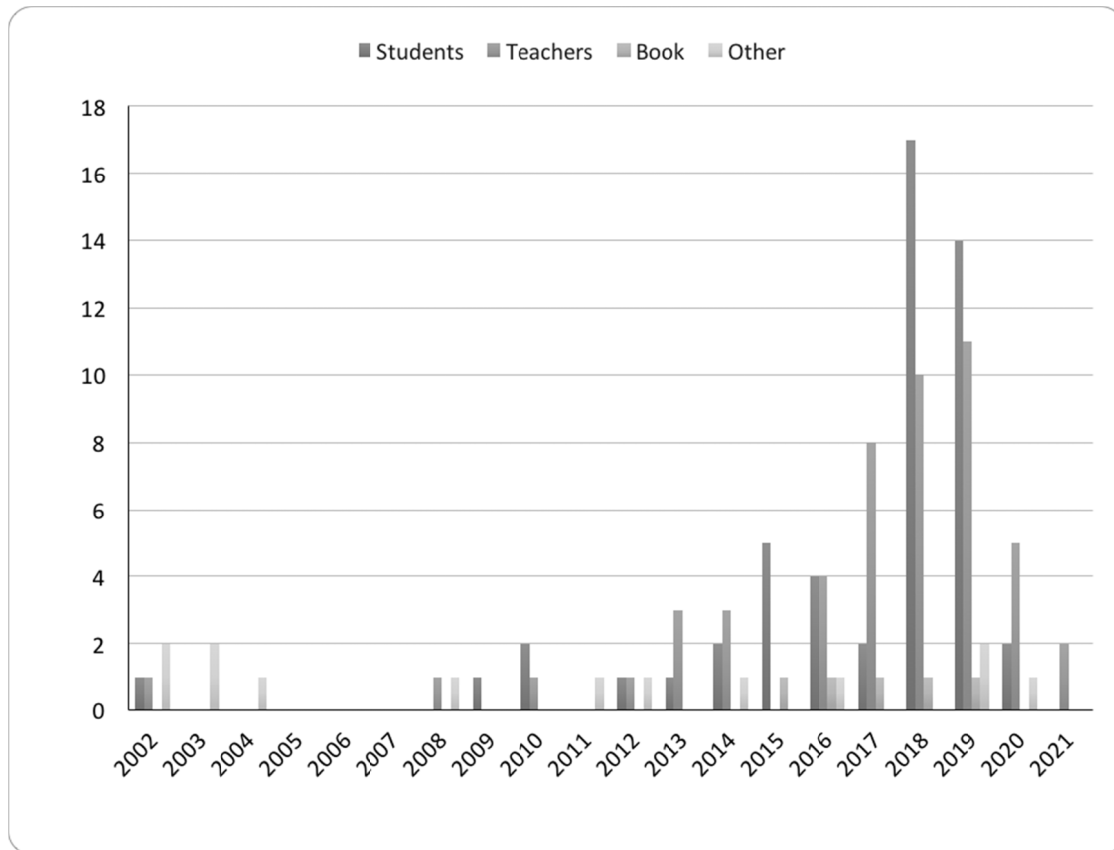


Figure 4. Number of research papers per year based on the participants and/or focus of study

It is worth noting that all of the research papers adopted a quantitative approach, one of which was a mixed-methods study that also applied a qualitative approach (Alkhaledi & Alturki, 2018). Furthermore, content analysis was rarely used, and only for studying computer books (Alenezi & Aleqaab, 2019; Alharbi & Almohammed, 2018; Alghamlas, 2017). Common approaches were survey and semi-experimental, as they were used nearly equivalently. Survey methodologies were used in early years (Almatrafi, 2010; Almotairi, 2013; Fodah, 2002), while semi-experimental methods were used after 2009, mostly in 2018 (18) and 2019 (16). The research was mostly about teaching strategies and their impact.

Table 6. Number of research papers per year based on research approaches

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Semi-experimental	0	0	0	0	0	0	0	1	1	1	1
Survey	3	2	1	0	0	0	1	0	1	0	1
Content analysis	0	0	0	0	0	0	0	0	0	0	0
Qualitative approach	0	0	0	0	0	0	0	0	0	0	0
	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total	
Semi-experimental	0	2	5	4	3	18	16	2	1	55	
Survey	3	3	0	5	7	8	7	6	1	49	
Content analysis	0	0	1	1	1	0	2	0	0	5	
Qualitative approach	0	0	0	0	0	1	0	0	0	1	

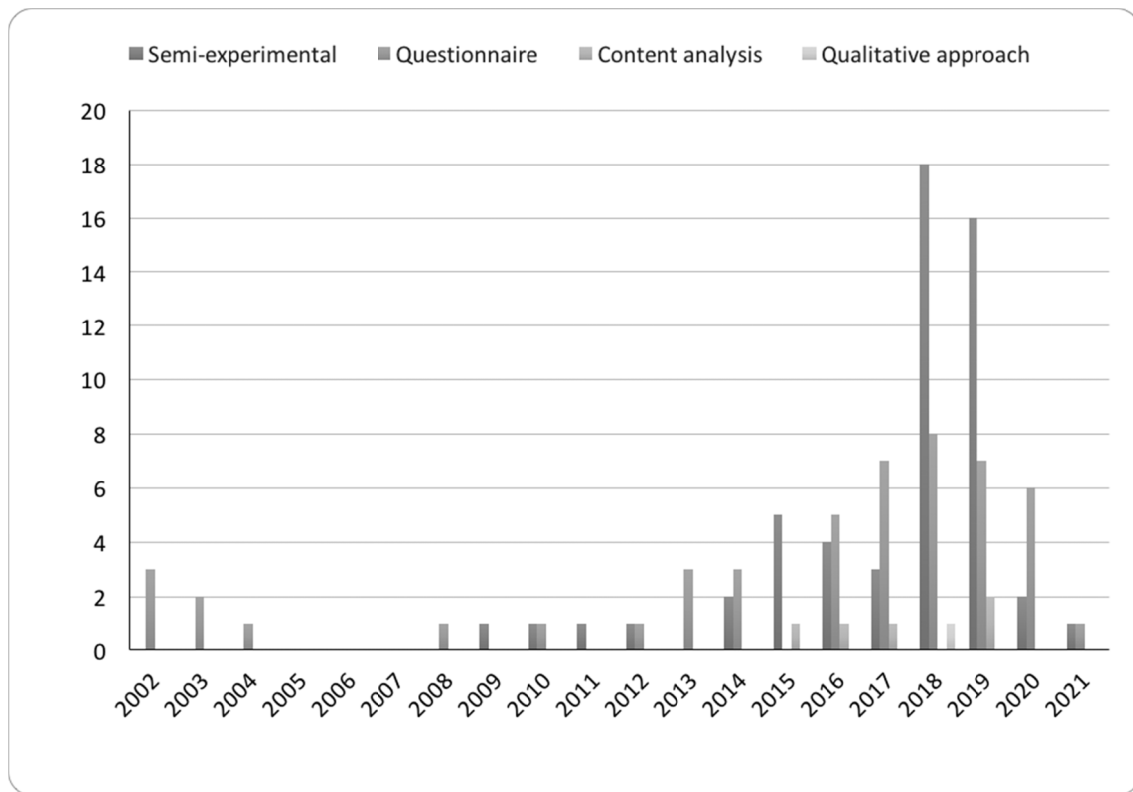


Figure 5. Number of research papers per year based on researches approaches

### 3.3 What Are the Suggestions for Improving the Development of the Computer Curriculum in General Education Based on Existing Research? Which Factors Support or Constrain the Development of the Curriculum?

We noted early in the data collection process that the vast majority of studies employed quantitative research methods and were published after 2002. Most research papers recommended the following: teachers' preparation programs, workshops, and in-service training, curriculum development, and infrastructure development and maintenance.

From 2002 to 2008, all of the research papers recommended introducing a computer curriculum as a subject in all stages and developing a plan for that. They also recommended training teachers to teach the curriculum. While the ICT curriculum was introduced in schools in Saudi Arabia in 1985, it was taught in some high schools at an earlier stage and gradually introduced to all K-12 schools. Almoheesin (1997) recommended a vision for a national plan for teaching ICT in schools in the Kingdom and a plan for preparing teachers to teach this curriculum. Later, the papers began to focus on strategies in computer education, activating e-learning, and teacher development and growth.

We noticed that, from 2009, the papers' recommendations began to focus on five areas, with most recommendations promoting teachers' professional growth by training them to use new technologies (Alrobai & Azmy, 2018; Alotaibi, 2016; Alzamil & Alhojailan, 2016; Alrashed, 2015) and new strategies (Alghamdi & Ali, 2018; Alshardi & Aladeel, 2018; Almubarak & Almassad, 2016) in their practice. In addition, most of the studies recommended the use of e-learning in teaching ICT curriculum, for example, Web 2.0 applications (Alzahrani & Allam, 2018; Alhojailan, 2015; Alatwey & Almassad, 2018), blended learning (Alebaikan & Alhenaki, 2016), cloud applications (Alshaik, 2019; Albanian & Alarabi, 2019), and LMS (Alresheedi & Alibrahim, 2019; Alghamdi & Haroon, 2019; Alkhaledi & Alturki, 2018). Some researchers also recommended updating the school infrastructure to include new technologies (Alshammari, 2020) and updating the books and curriculum (Alibrahim & Almuhaiza, 2019). One interesting recommendation included designing a curriculum in a way that teachers could develop its content (Alafraj, 2012).

Regarding the factors constraining the development of the curriculum, papers from 2002 to 2012 highlighted the following obstacles: the lack of equipment and inefficiency of devices (Alafraj, 2012; Alageely, 2002) and the inappropriateness of the curriculum to the needs of the learner (Almoheesin, 1997). Earlier research (Fodah, 2003) found resistance from learners, as they do not accept the ICT subject. During the same interval, a lack of

experience of teachers was found (Abdulaziz, 2004). After 2012, more research papers emphasized the main areas that needed to be developed, including teacher training (Alatwey & Almassad, 2018) and curriculum content (Alshammari, 2020).

### 3.4 What Is the Relation Between Computer Curriculum in K-12 over the Years and Publications in This Field?

When comparing the publication papers with the development of the curriculum as shown in Table 6, the publication studies started in 2002, whereas computer curriculum have been introduced in schools since 1985, we acknowledge the limited studies published electronically since 1985. During 1997-1998, there were no studies about curriculum and textbooks developments, until 2008 the studies focus was on describing the acceptance of computer course in schools. Where the curriculum was updated already. It can be notice that at 2008 Tatweer project is established, in 2009 a study evaluating the using of LMS was published (Al-Harbi, 2009). As one of Tatweer project aims is to introduce LMS in schools.

Starting from 2010 until 2014 the studies focus on teaching strategies, and training teachers; where it is concurred with Duroos streaming live lessons are produced and ICT development program is established. At 2015 the studies continuing focus on teaching strategies and their effects, it could be argued that it is a result of Duroos streaming. While at 2015 E-School is introduced, there was no studies about E-learning found until 2016 we found some studies about E-evaluations (Alzamil & Alhojailan, 2016; Alotaibi, 2016) which corresponds with iEN portal production. Also, some studies dealt with ethical aspect of computer use such as (Almenie, 2016; Almohammadi, 2016). At 2017 only two studies about E-learning published (Aljoni, 2017; Al-Amery, 2017) and the rest of studies found in this research about teaching strategies and teachers' skills on using some strategies.

From 2018 to 2019 most studies concentrated on teachers' developments and training which concurred with development of future gate project 2017-2019 such as (Harrab & Alameer, 2018; Alasmari & Shareefi, 2018; Alobaikan & Bin-dokhi, 2019; Alsuhaim & Alibrahim, 2019). Introducing E-learning required different teachers' skills that need to be investigated, while most of publications where explored teaching strategies and some on E-evaluation (Al-Salman, & Al-Hujailan, 2018).

At 2020-2021 Madrasti platform was established, there were no studies about Madrasti platform, the most publications were about teachers' skills of using technologies and teaching strategies.

Finally, the development of curriculum and textbooks don't follow and are not supported by studies, as all publication on textbooks evaluation-as mentioned in the Table 7 based on point of view (Almatrafi, 2010; Alhazzani, 2013; Alsaqri, 2015; Alharbi & Almohammadi, 2018), or analyzed based on specific criteria for example (Alghamdi, 2018). There was no comprehensive study on which the curriculum updated based on at the publications studies reviewed, that evaluates the needs for development and/or the limitations of the curriculum.

Table 7. The relation between computer curriculum development and research papers

Date	Curriculum development	Studies	
		No. of publications	Subject
1985	Start computer in school		
1990-1996	Introduce computer course to high schools		
1997-1998	Curricula are updated.		
	Introducing computer curriculum into the intermediate and primary private schools.		
2000-2001	Ta'aheel Project		
2002	Computer curriculum is added in primary and intermediate schools (public schools).	3	acceptance of computer course
2003		2	acceptance of computer course
2004		1	acceptance of computer course
2005	ICT is used in education	0	
2006		0	
2007		0	
2008	Tatweer Project is established.	1	acceptance of computer course.
2009		1	Evaluation the use of LMS.
2010		2	Study strategies, evaluate book, point of view

2011		1	Design a course
2012		2	study Strategies, evaluate teachers satisfaction
2013	Curriculum document is prepared for high school computer education by the Tatweer Project.	4	Point of view-books, teachers' skills, social media.
2014	Duroos streaming live lessons are produced. ICT development program is established.	5	Study strategies, training teachers
2015	E-School	6	Study strategies, Books evaluation.
2016	iEN portal is produced.	10	Study strategies, E-evaluation, Computer ethics
2017	Future Gate is produced.	11	Study strategies, teachers' attitude and knowledge, E-learning, book evaluation.
2018		28	Study strategies, Teachers' skills, E-evaluation, books evaluation
2019		26	Teachers use of technologies, Study strategies, books evaluation.
2020	Madrasti platform and Microsoft Teams are established.	8	Study strategies, Teachers use of technologies
2021		2	Teachers training and difficulty

#### 4. Discussion

In this paper, we reviewed research about computer curriculum in K-12 schools published until 2021. We noticed that published research on the ICT curriculum started in 2002, revealing a delay in research since the beginning of introducing the computer curriculum in schools in 1985. Intermediate schools started teaching computer subjects in 1991, but research on this did not begin until 2004 (Abdulaziz, 2004). Moreover, most papers were published in 2018 and 2019. As the systematic review shows that the studies about computer curriculum was conducted later and delayed for decade, as a result the development and improvement of curriculum were not based on findings of studies.

Most research papers recruited teachers and/or students as participants. In addition, almost all of the studies applied the quantitative research approach; we found only one study out of 110 papers that applied the qualitative method. Moreover, most research used semi-experimental and survey methodologies. Most of the papers in the earlier years focused on the introduction of computers in general in schools and applied surveys (questionnaires) as the main research tools, with no in-depth study of the development of the curriculum. Whereas computer curriculum already applied at schools, and the curriculum were developed several times. We noticed that research was rarely funded by the MoE or received no support from the MoE for research.

Most research suggestions and recommendations involved training and preparing teachers and developing the curriculum, followed by updating infrastructure. Because ICT is an emerging and rapidly developing field, we recommend designing a highly flexible curriculum that allows teachers to add additional subjects as needed and that is open to external partnership and encourages communities of practice, as this help reduce the cost and effort.

We found qualitative research to be rare. One reason for this is that the qualitative approach is not taught in educational research programs. We recommend that there is a need to encourage researchers to use qualitative approaches to provide a deep understanding and a clear vision. In addition, more diversity in methodologies and in-depth research is needed. There is a lack of diversity in the research, mostly regarding the effects of strategies. We highly recommend a research center in the MoE to support scientific research. There are a number of projects carried out by the MoE, but we did not find any studies on them.

As described above, it rarely shows that the publication studies support or evaluate the curriculum developments. Also, it is found that the publications studies considered a specific subject in the field without deep-focus, one explanation is that it could be as the researchers is not supported from any education organizations.

Finally, as a result, we suggest some implementations based on research finding as shown in figure 6 to make sure that studies are supporting and evaluate the curriculum developments.

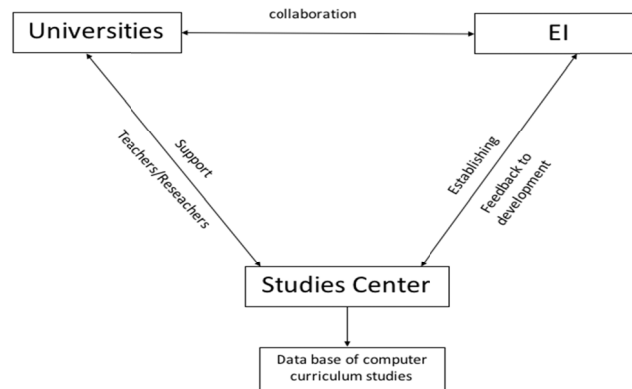


Figure 6. Suggested implementation to support computer curriculum development

As shown in Figure 6, we suggest establishing a studies center collaborating between educational institutions (EI) and universities. The University support and enhance researchers on conducting good researches whilst EI provide the needed development or evaluation to a field, in addition to funding some projects.

## 5. Conclusion

From the results, it can be concluded that the publication studies have rarely supported or followed the development of the computer curriculum in K-12. In earlier years, the research emphasized how to integrate the computer curriculum and suggested a plan to introduce it into all stages of K-12. In addition, studies have searched for successful procedures to apply computer curriculum in schools. In later years, research focused on how to apply new strategies for teaching and their effect on students and their learning. Due to the rapid development in the computer field, most suggestions have focused on training teachers and developing the curriculum.

Moreover, the impact of research on the K-12 computer curriculum is not clear, as the development of the curriculum has not followed the research. Researchers have suggested improving the curriculum after developing the curriculum, and researchers have evaluated the new inventions in the curriculum. It is worth noting that the MoE did not provide any support research, nor did we find any research funded by it.

We acknowledge some limitations in this study, one of which is narrow research on e-published studies, and on papers published on selected databases as stated above, we also admit that writing and publishing a study consume time.

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### Authors contributions

Dr. Amal was responsible for study design. Dr. Amal and Mrs. Abeer were responsible for data collection and analysis. Dr. Amal and Mrs. Abeer drafted the manuscript and revised it. Both authors read and approved the final manuscript.

### Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.



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