



## A Comparative Study of Goals & Content of Technology Education Curriculum in Higher Secondary Schools of Australia, Finland, Malaysia and USA

Marzban AdibManesh<sup>1</sup>(Corresponding author)

Javad Jahan<sup>2</sup>

ARTICLE INFO	ABSTRACT
Received: 29 July 2024 Revised: 24 October 2024 Accepted: 27 February 2025 Online: 02 July 2025	The main goal of this study was to identify and compare technology education curriculum of in the higher secondary education system of Australia, Finland, Malaysia, and USA. The strategy of "different social systems, different educational outputs" was used to select countries. The findings reveal that all selected countries emphasize the development of 21st century skills such as critical thinking, creativity, and problem solving in TEC. In Finland, the curriculum pays special attention to digital skills and media literacy, and teachers use modern educational tools such as programming and distance learning. Australia also emphasizes hands-on learning and effective content management. In the USA, curricula integrate technology and engineering education with STEM education, emphasizing development of technological literacy and problem-solving skills. Despite similarities in educational goals, differences in approaches and curriculum content are also observed between the selected countries. For example, the USA emphasizes environmental issues but Malaysia emphasizes more on ethical & social concepts in technology. This study highlighted that attention to the experiences of successful countries in the field of technology education can help improve curricula in developing countries such as Iran.
<b>KEYWORDS</b> Curriculum Goals of TEC Secondary Education Technology Education	

<sup>1</sup> Assistant Professor, Department of Educational Sciences, Farhangian University, Tehran, Iran, Email: marzbanadib@cfu.ac.ir

<sup>2</sup> Assistant Professor, Department of Educational Sciences, Farhangian University, Tehran, Iran, Email: Email: JavadJahan@cfu.ac.ir

## **1. Introduction**

In recent decades, the world has witnessed fundamental changes in various fields of science & technology. The results of the introduction of information and communication technology in life include the emergence of concepts such as: information society, information age, and knowledge-based economy (Sadr & Rast, 2022). The adoption of digital technology in education in developed countries is also progressing at an accelerated pace, although this issue does not occur at the same speed in different countries (Landri, 2018). For this reason, attention to the curriculum of technology education has attracted curriculum experts and educational planners (Zoufan, 2017). In this situation, teachers no longer play a central role, and the goal of the class is to develop cognitive skills of learners (Eadie, 2001). In this regard, extensive research has examined and implemented technology curricula in various educational systems, some of the findings of which are mentioned: Estigoy (2021) examined the readiness of ICT and its integration into the teaching & learning process in private higher secondary schools of Philippines and concluded that there was a significant relationship between teachers' readiness to use ICT and the extent to which it was used in the classroom teaching process. Sun et al. (2024) found that the use of ICT on scientific higher-order thinking skills (S-HOTS) in schools depends on the way in which ICT is used and its integration into the learning process. Rezaei et al. (2022) conducted a comparative study of integrated STEM curricula (STEM is an acronym for the four scientific disciplines of Science, Technology, Engineering and Mathematics ) in Finland, Singapore, and USA and concluded that all three countries have set the goal of STEM education as achieving 21st century skills and preparing a skilled workforce. The most important difference between Finland and the two selected countries is lack of special STEM schools, emphasis on collaborative learning, deep attention to issue of integrating science and training professional teachers in all disciplines. Ajit et al. (2022) studied the situation of secondary schools in Malaysia and concluded that the impact of challenges such as insufficient teachers' knowledge & skills, students' lack of understanding of abstract subjects, and inadequate facilities, equipment & resources cannot be ignored. Niiranen et al. (2022) studied technology education in Finland and emphasized that the role and place of the technology education curriculum in this country is unclear and there is a need for a clear re-definition for it at the national curriculum level. Saarinen et al. (2021) believe that although some students have ICT skills, they may not have a specific goal and understanding of the impact of personal use of digital technologies - which can enhance their learning. Kaarakainen & Saikkonen (2021) found that before the COVID-19 pandemic, Finnish teachers used digital devices in their teaching on average at

least once a week, and that changes in teachers' use of technology occurred mainly at the individual level. Hardy et al. (2019) examine the challenges and prospects of a robotics course to complement the Australian digital technology curriculum, arguing that challenges arise when complementary programs are not aligned with the indigenous curriculum. Starkey and Finger (2018), examining ICT in Australia and New Zealand education policies found that a key challenge for both countries is providing equitable access to opportunities for teachers & students to effectively integrate digital technologies into teaching and learning process. Abrahamson et al. (2016) found that the results of using technology in Australian curricula were very effective and increased student participation in activities, increased awareness of complex and difficult topics, interest and motivation to learn, and teachers' awareness of students' learning difficulties. Similar research has also been conducted in Iran in recent years. For example, Kian (2019), through a comparative study of ICT programs in the education systems of Australia, Finland, and Iran, found that addressing challenges such as weakness in attracting private sector participation, lack of long-term financial investment, lack of pre-service teacher training, and lack of a coherent assessment strategy could be a great step towards developing ICT programs in the Iranian general education system. Abolhasani and Dehghani (2020) by analyzing the pathology of the vocational & technology curriculum in middle secondary school indicated that the implementation of this curriculum faces numerous problems and disadvantages such as lack of facilities and sufficient budget to provide equipment. Despite the fact that previous studies have to some extent identified the dimensions, components, and challenges of the ICT curriculum, it seems that- in a comparative perspective - the need to attention to the experiences of successful countries still can contain instructive lessons for planners in developing countries such as Iran. Based on this thought, the overall goal of the present study is to determine the similarities and differences of ICT education curriculum in higher secondary schools of selected countries.

## **2. Research Method**

The present research method is qualitatively comparative and George Z.F. Bereday's approach was used for data analysis. The strategy for selecting countries was "different social systems, different educational outputs" and the data collection method was documentary through keyword searches in international information databases such as Google Scholar, EBSCO, ERIC finding primary sources (documents about objectives, content, teaching methods and evaluation of ICT education curriculum in secondary school of selected countries) and secondary sources (books and

articles). To judge the validity of documents, attention was paid to external and internal criticism of sources. In external criticism, the authenticity of the document (by examining and comparing documents) and in internal criticism, the importance and accuracy of the content of documents were considered.

### **3. Findings**

According to the Bereday's regional approach, the research results are presented in four stages: of description, interpretation, juxtaposition and comparison.

#### *Stage 1) Description*

According to the regional approach, this section describes the ICT curriculum in the selected countries:

##### *Australia*

Since the 1980s, Technology education has been a recognised and compulsory subject area in Australia. This shift has reflected the increasing importance of technology in the Australian educational system with students, teachers and therefore schools now having access to a wide range of digital technologies (Williams et al, 2019). Secondary schools also use a high level of educational technology in the classroom (Jones, 2016). The technology curriculum includes two main areas: 'Design & Technology' – which emphasises design thinking – and 'Digital Technology' – which focuses on computational thinking. These two areas help students to engage in the design process and generate innovative solutions (Australian Curriculum, Assessment & Reporting Authority "ACARA", 2015).

*Educational Objectives:* The overall goal of technology education in Australian secondary schools is to produce technologically literate individuals. Through the ICT curriculum, secondary school students are expected to become creative, knowledgeable, skilled and risk-takers (Rasinen et al, 2009). The curriculum strives to develop informed and active citizens who are able to analyse impacts of technology on society and environment. The technology curriculum clearly emphasises social, economic & environmental needs. For example, students are encouraged to consider the impacts of their designs on users (ACARA, 2018). The technology curriculum is responsive to students' needs & interests and attempts to connect the content to real-life experiences of students. This has been highlighted in feedback collected from teachers and stakeholders (Blannin et al.,

2022). According to the ACARA final report on the technology curriculum, the key objectives of the program are: To provide opportunities for students to develop key skills in the fields of design & digital technology. These skills include critical thinking, problem solving and ability to work with new technologies (ACARA, 2021). Rather than using key ideas, the curriculum emphasizes the fundamental concepts that form infrastructure of the two subjects of “Design & Technology” and “Digital Technology”. This reform was made to improve students’ understanding of the main concepts and connections between them (ACARA, 2021:15). The technology curriculum also emphasizes recognition and inclusion of Indigenous Australian histories and cultures in the curriculum. This is done to promote awareness and respect for cultural & social diversity in this country. Another key goal is to reduce the amount of curriculum content and improve the manageability of it in the early years. To this end, the number of technology platforms has been reduced and repetitive content has been removed (ACARA, 2021:20). Improving the curriculum content and reducing its amount as a goal helps teachers to easily implement that content in their classrooms. This is clearly evident in the feedback from teachers and stakeholders (Blannin et al., 2022). The curriculum emphasizes the development of design thinking & practical skills. This goal includes students’ ability to create and evaluate innovative solutions to real-world problems and helps them strengthen their digital capabilities and become familiar with concepts related to privacy and security in the digital world (ACARA, 2021:35). The technology curriculum also helps students develop problem-solving, critical thinking, and creativity skills in various technological fields (Blannin et al., 2022).

*Educational Content* : The Australian education system seeks to create a dynamic and effective learning environment in the field of technology by emphasizing practical learning, effective management of curriculum content, attention to student needs, development of critical thinking & creativity, and teacher training (ACARA, 2021). Teachers are allowed to adjust lessons to suit the interests and needs of students. In this way, curriculum content is selected and developed according to the individual characteristics and needs of students, and teachers use electronic & digital resources. In the e-learning process, course materials are provided to students in a flexible and manipulable way. Students also combine data in visual, audio, symbolic and electronic formats by examining existing data and creating new information. In addition, learners compile format and publish information in the form of text, models, simulations and diagrams, and transfer them to others. In this process, students learn production, design, and systems thinking skills & creative solutions to solve problems and needs of individual and social life (Williams et al., 2019).

### *Finland*

In the 2010s, Finnish school curricula underwent significant reforms with the aim of digitalization (Kaarakainen & Saikkonen, 2021). In Finland need to accelerate the digitalization of education has attracted considerable public attention. For example, the digitalization of education was prominently featured in the Finnish government's 2015 strategic plan, which predicted that digital learning environments and innovative educational approaches would help strengthen future skills, increase lifelong learning, reduce dropout rates, and create opportunities for innovation in Finnish society (Kaarakainen & Saikkonen, 2021:954). In Finland, the 21st century has seen a particular focus on social media such as mobiles. Digital devices and games along with social networks, have quickly become a more vital skill. In 2023, the Finnish education system once again ranked first in terms of media literacy compared to 47 European and OECD countries (Finland Ministry of Education and Culture, 2024). The increased use of ICT in the Finnish education system has followed government measures, such that programming and computational thinking have become a mandatory part of the curriculum (Bocconi, et al , 2016). However, these concepts are usually taught as sub-topics in mathematics and similar subjects, rather than as independent subjects. These reforms have increased the need for appropriate hardware and software for students and teachers. Teachers have also been required to learn the principles of computational thinking and programming, which has increased their digital literacy (Yadav et al., 2017). According to Salokangas et al. (2019), the autonomy of teachers' profession is a prominent feature of the Finnish education system, ranging from planning, teaching, and assessment to the development of individual professional skills. This autonomy allows teachers to make their own decisions about the digital and non-digital environments they want to use in their teaching.

*Educational Goals:* In order to develop technology in the Finnish school curriculum, a project entitled " ICTs in School's Everyday Life" was implemented. The goal of this project was to create a national educational technology plan to provide schools with access to practical models and innovative teaching methods. The project also aims to generate new knowledge about the latest developments in ICT (Niiranen at al,2021). The process of revising the Finnish core curriculum for basic education began in 2012 and the final documents were published at the end of 2014. The new curriculum emphasizes 21st century skills such as critical & creative thinking skills and collaborative learning methods (Vahtivuori-Hänninen, et al,2016). Health and environmental protection, etiquette, problem solving using digital tools, solving common problems, innovation & creative use of technology , identifying digital competence gaps, and acquiring skills (including

ability to solve technical problems, meet needs and technological responses) are other major goals of the technology curriculum in Finland (Siddiq et al, 2016). The overall goal of technology education in Finland is to increase students' self-esteem through the development of attractive functional skills and activities. Teachers should encourage a sense of independence in students and facilitate the growth of their creative skills through problem-based learning and development of technical literacy (Autio et al, 2019). In fact, the use of new technologies in the country's education system helps students become familiar with new techniques & tools and learn the skills necessary to face challenges of digital age (Bennett & Maton, 2010; Lehto & Neittaanmäki, 2023).

*Educational Content:* In Finnish primary and secondary schools, ICT is seen as a general tool to help learn other subjects or as a main for teaching (European Schoolnet and University of Liège, 2012). The Finnish curriculum refers to basic computer skills (hardware & software). Comprehensive school curricula are designed to provide basic ICT skills to all students. Although there is no specific subject in this field, its teaching integrated into all subjects to provide better and more effective learning. It should be noted that this also depends on the curriculum of each educational district. Some districts may offer ICT as a separate subject. In this case, the content includes the following: Word processing, use of office software, multimedia applications & communications. Optional ICT courses may also be offered to students to acquire computer skills. Teachers in Finland are teaching programming as a new part of the curriculum. Curriculum objectives for programming include supporting students' skills in programming basics, familiarity with programming environments, creating simple programs and using programming to build innovative artifacts (Korhonen et al, 2023). According to the World Bank, during the 2020 school closures in Finland, students were taught through alternative digital methods, such as distance learning, digital learning environments, and guidance for independent learning. Also, during this time, digital teaching tools for distance learning, especially online conferencing tools, were widely used, allowing students to complete projects and assignments individually and participate in classes online (World Bank, 2020). In addition, communication between home and school is routinely done through online platforms. These online tools are used to provide teacher feedback, assignments to students, and send student's scores & progress reports to parents and school administrators (Karakainen & Saikkonen, 2021). The content of the technological curriculum focuses on content creation, safety, problem solving and operational technical skills in the information dimension - including browsing, searching, filtering, evaluating information, storing and retrieving information. Teaching interaction through digital technologies, sharing information

& content, participating in online citizenship & collaboration through digital technologies, computer programming, and protecting personal digital data are also part of the technology curriculum in schools (Siddiq et al, 2016). The Finnish curriculum also focuses on teaching concepts such as computer science, calculations, programming, computational thinking, and digital literacy (Heintz et al., 2016 as cited in Korhonen et al, 2023). Lander reports on the content of the technology curriculum in Finnish schools: “The main focus of teacher and students was on the digital screen, not on the blackboard. After the class was over, teacher allowed all visitors to walk around the classroom and take pictures freely. During the visit, I noticed that the teacher’s desk contained items such as a main hardware unit, a computer connected to the screen, a digital projector with a camera connected to the screen, and an iPad. It later became clear that these facilities are available in all classrooms of country” (Lander, 2019: 35).

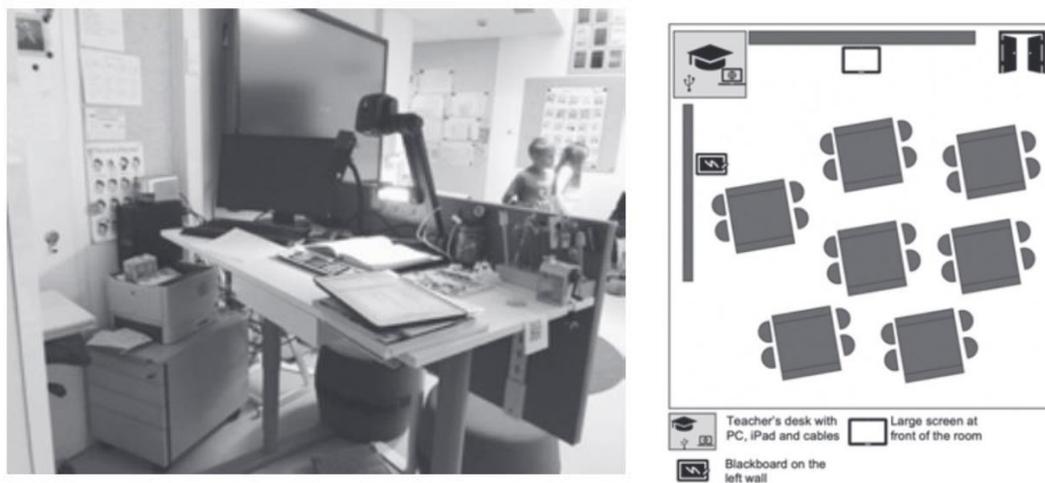


Figure 1 & 2: Educational technology in a Finnish school classroom (Source : Lander, 2019)

Another influential component of this classroom observation was the use of iPads by students. In two cases and during class, the teacher taught pupils how to use the iPad. The first involved reviewing vocabulary introduced in the previous week’s class using a tool namely “Quizlet”. Students received an iPad from the teacher and diligently set up their devices. They also worked on an assignment in pairs – reviewing vocabulary with Quizlet. The second involved listening to audio files related to a section of the textbook. Pupils accessed this again via a Bookmark Saved and worked on the material in pairs for five minutes (Lander, 2019: 35). Thus, modern technologies such as Learning Management Systems (LMS) and online educational tools

are widely used in the Finnish curriculum. These tools help teachers to present educational content in engaging and interactive ways (Rafiq et al., 2024). In this regard, the Finnish Cybersecurity Development Plan emphasizes that in basic education, young people should be given sufficient skills to work in the digital environment and that they should recognize cybersecurity threats and know how to protect themselves against them (Digital Watch, 2024). A study conducted on cybersecurity education in Finland in 2021-2022 showed that there is a need to take steps to make cybersecurity a central aspect of educational planning and teaching (Lehto & Neittaanmäki, 2023 )

### *Malaysia*

The world's first smart school was established in Malaysia, and in fact, the country should be considered the originator of this project. Following its Vision 2020, the Malaysian government tried to prepare the country for Age of Information through the Multimedia Super Corridor (MSC) and e-City projects. The Smart School Project was one of the seven major MSC projects. The Malaysian Government's 1997 Document stated: "Malaysia needs a serious transformation to move from an industrialized country to a leading country in the information age. Malaysia must become a country with deep technological literacy, a workforce that is capable of working in the global economy and has acquired the skills to use the tools of the information age. To achieve this goal, the education system must undergo a maximum transformation (Bajunid, 2008 as cited in Attaran, 2019). The technology curriculum in Malaysian schools is designed to promote science, technology, engineering, and mathematics (STEM) skills. The program seeks to increase students' interest & ability in STEM fields, which is recognized as a national priority in education (Ajit et al., 2021).

*Educational Objectives:* One of the main goals of the technology curriculum in Malaysian secondary schools is to enhance students' critical thinking & problem-solving skills. Through using new technologies such as augmented reality (AR), students can experience complex scientific concepts visually and interactively. This helps them to gain deeper understanding and improve their analytical abilities (Ajit et al., 2021). This is especially important in STEM (Science, Technology, Engineering, and Mathematics) fields (Hayes & Kraemer, 2017). Technology can help increase students' motivation and engagement in the learning process. For example, the use of augmented reality (AR) in classrooms can make learning more engaging and interactive (Garzón & Acevedo, 2019). Technology helps students better understand abstract concepts and visualize them visually. This is especially useful in scientific fields that require spatial visualization (Cai et al., 2014). The use of technology can also enhance students' collaboration and teamwork skills which

are essential for success in future workplaces (Kamarainen et al., 2013). One of the key objectives of technology curriculum is to train teachers and develop their skills in using new technologies. This training helps teachers to effectively use technology in their teaching process and stay up-to-date (Ali & Bakar, 2019). Other goal is to promote ICT skills among teachers and students. These skills include familiarity with hardware, software, and network systems (Raman, Othman, & Affandi, 2019). Given the rapid changes in the job market and the need for technology skills, the technology curriculum helps students prepare for future careers. By focusing on STEM skills, the program prepares students for entry into technical and vocational fields as well as IT-related careers (Ajit et al., 2021). Other main objective is to equip students with ICT skills to be successful in today's digital world. This objective is specifically aimed at improving the quality of education and increasing students' interest in learning (Awang, 2020). Another main objective is to reduce the educational gap between urban and rural students. The Malaysian Ministry of Education (MOE) aims to develop technology skills and enhance learning in students by providing appropriate facilities and services for teaching/learning in rural areas (Hasin & Nasir, 2021).

*Educational Content:* In the content section, the following can be mentioned: Creating & strengthening challenging thinking and motivated learning in students, network-based training and electronic course materials, interactive storybooks, games & simulation software, self-learning platforms, problem solving platforms, artificial intelligence, videos, online library, News bulletins, and Search engine (Bin, 2021). Technology-based curriculum allows teachers to create and utilize a variety of educational resources for their teaching (Ambikapathy, Halili, & Ramasamy, 2020). Technology-based educational content not only helps to improve students' understanding, but also enables teachers to adopt more creative methods for assessment and teaching (Murugan & Husnin, 2024: 1492). The use of new technologies in education, especially Augmented Reality, helps to increase students' motivation & interest in learning. Research has shown that integrating AR into the learning process can lead to increased student participation and engagement. This technology allows students to actively participate in the learning process and better understand concepts through practical experiences. This helps teachers identify students' strengths and weaknesses and tailor educational programs based on their needs (Ajit et al., 2021, ; Shah, 2020). Also, theoretical training on the history of technology and its impacts on society is included in content (Hasin & Nasir, 2021). The educational content is designed based on the Technological Pedagogical Content Knowledge (TPACK) model, which helps teachers understand the relationship between technology,

content, and teaching methods. The educational content also includes practical activities that enable teachers to directly use technology in teaching (Shah, 2020).

## USA

After the launch of the Soviet Union's Sputnik spacecraft into space in 1957, the United States embarked on a massive and unprecedented drive to accelerate scientific development and regain its leading position in science & technology. This led to the establishment of numerous curriculum development centers and implementation of centralized measures at the level of goals, exams and standards. The goal of these centers was to develop curricula that would have a long life and that were expected to best meet the goals and objectives of government officials (Winoto, 2022). Thus, the primary mission of the Department of Education was to promote student success and prepare them for global competition by promoting educational excellence and equal access. Currently, schools in the United States are using innovative methods of technology-based assessment. Schools emphasize project-based learning, and the technology curriculum seeks to strengthen students' problem-solving & critical thinking skills. Also, this program seeks to develop communication skills and collaboration in technology-based environments among learners. Also, familiarity with design and engineering approaches as a creative and innovative process is one of the goals of this program. Finally, understanding complex scientific and mathematical concepts through the use of simulations & applied software is another goal of the curriculum (US.Department of Education, Office of Educational Technology, 2010).

*Educational Objectives:* The main objectives of technology curriculum in secondary education include: familiarizing students with basic concepts and applications of artificial intelligence (AI) - such as machine learning & neural networks and focusing curricula on practical applications of artificial intelligence in everyday life -, creating readiness and a positive attitude towards learning through AI, increasing self-confidence and readiness to learn AI, creating a positive understanding and connection of AI with life, strengthening internal motivation to learn AI, creating interest and curiosity about topics related to AI, developing practical and interactive skills with AI technologies, strengthening interactive skills with tools and technologies related to AI, attention to ethical & social issues related to AI, and understanding the effects of AI on individual and social life (Christopoulos & Sprangers, 2021).

*Educational Content:* In the United States, new curricula and standards are being developed to respond to technological, educational, and social changes (Moye et al., 2019). The Standards for Technological Literacy, published by the International Technology and Engineering Education Association (ITEEA), is used as the primary guide for developing technology educational content in American curricula (ITEEA, 2007: 208). The ITEEA's approach to developing Integrative STEM Education (Integrative STEM Education) designs educational content with the goal of integrating technology and engineering with science and mathematics education (LaPorte & Sanders, 1995:29; Sanders, 2009:20-26). The technology and engineering educational content in these programs focuses on preparing students for future careers that require technological & engineering literacy (STEM, 2018). The development of standards for technology education in the United States has a long history, dating back to the 1920s (Reed, 2019: 236). These early standards were highly detailed and specific skill statements based on industry practices of the time. In the 1980s, the "A Nation at Risk" report focused on the need to increase educational rigor in the United States in order to make the workforce competitive in the global economy. This led to the creation of standards & assessments in many disciplines, including technology education (Reed, 2019: 235). The International Technology Education Association (ITEA) – now known as the International Technology & Engineering Education Association (ITEEA) – has played a key role in the development of several versions of technology education standards in the United States (Reed, 2019, p. 244). ITEA/ITEEA has published important documents, including: Technology Literacy Standards: The Content of Technology Learning (ITEA/ITEEA, 2000, 2007), which outlines 20 standards and 286 key points for technology education (Reed, 2019, p. 239-244). Advancing Excellence in Technology Literacy: Student Assessment, Professional Development & Program Standards (ITEA/ITEEA, 2003), which provides standards for assessment, professional development & technology education programs (Reed, 2019, p. 243). These standards have evolved over time, moving from very specific skill statements to broad concepts & ideas related to technology literacy (Reed, 2019, p. 235-246). In addition, curriculum content in other disciplines, such as science, mathematics, social studies, and educational technology, has developed standards that explicitly include technology components (Reed, 2019, p. 244-246). In sum, the development of technology education standards in the United States has been an ongoing process, driven by professional organizations as well as educational reform efforts such as increasing academic rigor and preparing students for the global economy (Reed, 2019, p. 235-246).

### *Second Stage : Interpretation*

This section examines the social context and historical development of ICT curriculum development in selected countries.

#### *Australia*

To date, four national strategic plans have been considered in Australia for the technology education curriculum: the National Education Action Plan, Technical & Vocational Education Sector Action Plan, Higher Education Sector Action Plan, and School Education & Online Learning Sector Action Plan (Kian, 2019). In 2001, the National Education Performance Monitoring Task Force (NEPMT) reported on the characteristics of the information & communication systems required to access, collect, manipulate and present information. The most important actions of the latter group, which were reported in 2002, included the development of a framework for measuring key performance indicators based on progress towards national goals in schools and development of a framework for reporting on these activities. The report is produced annually and reflects effective actions to improve the performance of programs and factors involved (Eadie, 2001). The ICT curriculum in Australia has been developed under the Teaching Teachers for the Future (TTF) project, which aims to strengthen the ICT teaching capacity of the next generation of Australian teachers. The project focuses specifically on education of pre-service teachers and trainers, and seeks to effectively integrate technology into teaching & learning (Romeo, Lloyd & Downes, 2012: 950). Funded by the Australian Government and in partnership with 39 higher education institutions, the TTF project seeks to bring about fundamental changes in ICT training in pre-service teacher education. The project consists of three main components:

- Develop national professional standards for teachers and integrate them into curricula (AITSL, 2011).
- Produce high-quality digital resources for teachers and students that are specifically linked to the Australian Curriculum (Romeo et al., 2012).
- Build sustainable professional networks and share experiences & resources between institutions (Romeo et al., 2012:951).

The TTF project is seen as a unique opportunity to create lasting change in ICT education in Australia. It seeks to develop a shared and integrated view of the use of technology in the classroom (Romeo et al., 2012). The TTF project is based on the TPACK (Technological Pedagogical Content Knowledge) framework, which emphasises the interaction between content and pedagogical & technological knowledge. This framework helps teachers to integrate technology effectively into their teaching (Mishra & Koehler, 2006). The TTF project is being continuously evaluated and initial

results indicate that pre-service teachers have increased their confidence in using technology and improved understanding of the applications of technology in learning process (Romeo et al., 2012). The project is seen as a catalyst for wider change in Australian education, helping to create a digital learning culture in schools. The ICT curriculum in Australia, through the TTF project, seeks to create sustainable and effective changes in teacher education. The project is recognized as a successful model in technology education globally, with an emphasis on integrating technology into the curriculum and developing national standards (Romeo et al., 2012).

### *Finland*

Digitalization has been on the school agenda for many years, and one of the main goals of the Finnish government between 2015 and 2019 was to increase the use of technology in learning process. In the meantime, the public discussion about new teaching and learning technologies has mainly focused on the needs of future working life or training of digital skills for teachers (Nikula, 2020). In addition, there have been criticisms about the negative effects of using technological devices, such as increased screen time and reduced ability to concentrate (Nikula, Järvinen, & Laiho, 2020). Some have claimed that today's youth are so accustomed to technology that they are "born with a chip" and suffer from culture shock if the learning environment is devoid of technology (Berg, 2009: 3). In Finland, technology is strongly emphasized in learning, and curricula are designed to strengthen students' problem-solving and critical thinking skills (Finnish National Agency for Education, 2020). Teachers encourage students from an early age to use ICT, a path they will continue as citizens of the "Digital Society" in adulthood. While this approach is common in many schools and teachers, it should be noted that teachers' attitudes towards the use of ICT vary. Most teachers are enthusiastic about using new innovations such as virtual reality (VR) and augmented reality (AR) in their teaching, but at the same time there are those who are reluctant to use it in their teaching (Toivonen et al., 2020). Technology topics are included in only a few school subjects in the Finnish national basic education curriculum (Metsärinne et al., 2024). The focus on technology in science lessons are mostly focused on information and communication technology and media skills. In addition, production and evaluation technology are particularly important in the subject of "Handicrafts" (Leinonen & Salonen, 2024; Niiranen et al., 2022). Therefore, to properly understand technology education, it is necessary to consider it within the context of the handicrafts lesson (Niiranen et al., 2021; Niiranen et al., 2022). This subject area should take the main responsibility for ensuring that all students in the Finnish basic education system learn technology systematically (Rasinen et al., 2011). Technology education is actually considered

equivalent to “technical handicrafts” (Kananoja, 2009), and its integration with Sloyd Education – which is called handicraft education in the Nordic countries – is considered as a possible approach in Finnish handicraft education (Peltonen, 2009).

### *Malaysia*

Malaysia is the first developing Islamic country to successfully establish an ICT-based framework within its educational system in 1996. The Malaysian Smart School System pursues five main objectives, which include ensuring the overall development of individual, providing opportunities to enhance individual strengths & abilities, developing a thoughtful workforce, delivering education in a democratic process, and increasing stakeholder participation in the education process. In general, in Malaysia, the government aims to invest in ICT-led education in schools and maintain support for this movement and equip all schools with this system by 2030 (UNESCO, 2019). The long-term vision of the Malaysian Technology Plan for 2030 provides a good representation of the theoretical underpinnings for the development of a technology education curriculum in education (Belawati, et al, 2018). The Malaysian Ministry of Education sees the use of technology in curricula as a tool to transform learning and produce more technical programs, improve teaching methods, and empower learners. This orientation indicates that the technology education curriculum is being transformed to produce a new generation that is adaptable to technology and capable of the information explosion (Harris & Kington, 2002). In addition, the technology curriculum, especially in rural schools, aims to reduce the educational gap and provide equal educational opportunities. These initiatives demonstrate Malaysia’s comprehensive approach to implementing technology in education, which simultaneously improves the quality of learning and expands educational equity across the country.

### *USA*

In United States schools, ICT curricula seek to promote programming-oriented thinking in students rather than training them to be programmers. The core of ICT education is “computational thinking” . Computational thinking refers to a way of solving problems, designing systems, and understanding human behavior that draws on a variety of concepts. The technology curriculum in American secondary schools is significantly influenced by the integration of information and communication technology (ICT), which is recognized as a key element for improving the quality of education (Goldhaber et al., 2021). ICT integration helps teachers replace traditional teaching methods with technology-based educational tools, which leads to increased student engagement &

knowledge retention (Goldhaber et al., 2021). The educational goals of this program include enabling learners to analyze and evaluate media, understand its social & cultural impacts, and develop the skills necessary for content production (Fedorov, 2001). In general, the technology curriculum is recognized as a key tool for preparing students for life in the modern digital world.

*Stage 3: Juxtaposition*

Australia: in particular has a strong focus on developing information & communication technology (ICT) skills, and considers the use of advanced digital tools and blended learning as part of its education strategies

Finland: focuses on expansion of education, but differs from other countries in terms of its traditional structure and emphasis on new technologies (such as augmented reality).

Malaysia : compared to other countries, Malaysia is trying to reduce educational gaps by focusing on improving access to technology in rural areas. The country specifically emphasizes the use of technology to enhance capabilities of teachers & students.

United States: has a very diverse and innovative education program in the field of technology, with a significant focus on advanced digital tools and distance learning.

Table 1. Description of ICT curriculum in selected educational systems

Country	Components	Elements
Finland	Educational Goals	<ul style="list-style-type: none"> <li>• National ICT Project</li> <li>• Focus on developing 21st century skills</li> <li>• Develop general citizenship competencies</li> <li>• Develop technological skills</li> <li>• Strengthen students' self-confidence</li> <li>• Facilitate problem-based learning</li> <li>• Teaching responsible and safe use of technology,</li> </ul>
	Educational Content	<ul style="list-style-type: none"> <li>▪ Integrate technological skills with general citizenship skills.</li> <li>▪ Use ICT as a general tool for teaching</li> <li>▪ Teach basic ICT skills to all students</li> <li>▪ Teach programming as part of the new curriculum</li> <li>▪ Distance learning using digital tools and online conferencing</li> <li>▪ Online communication between home and school for feedback and assignments</li> <li>▪ Teach cybersecurity and protection against digital threats</li> <li>▪ Use camera-pen pedagogy for visual thinking &amp; collaborative learning</li> <li>▪ Emphasize multiliteracy in the educational process</li> <li>▪ Focus on content production, digital safety &amp; online collaboration</li> </ul>
Australia	Educational Goals	<ul style="list-style-type: none"> <li>○ Develop students' skills in searching, collecting and storing appropriate information</li> <li>○ Develop technologically literate and creative, knowledgeable and skilled individuals</li> <li>○ Provide learning opportunities to develop technology-related</li> </ul>

		<p>skills</p> <ul style="list-style-type: none"> <li>○ Emphasize the impacts of designs on users and the environment</li> <li>○ Provide opportunities to develop key skills such as critical thinking and problem solving.</li> <li>○ Reduce content load and improve the ability to manage educational content.</li> <li>○ Strengthen digital capabilities and familiarize with privacy and security</li> </ul>
	Educational Content	<ul style="list-style-type: none"> <li>● Select and develop content tailored to students' needs &amp; interests.</li> <li>● Teachers are allowed to adjust content.</li> <li>● Emphasize design thinking and computational thinking.</li> <li>● Emphasize learning digital skills.</li> <li>● Incorporate Australian Indigenous histories and cultures into educational content.</li> </ul>
<b>USA</b>	Educational Goals	<ul style="list-style-type: none"> <li>▪ Strengthening students' critical thinking &amp; problem-solving abilities</li> <li>▪ Strengthening communication &amp; collaboration skills in technology-based environments</li> <li>▪ Familiarizing students with design and engineering approaches</li> <li>▪ Familiarizing students with the basic concepts and applications of artificial intelligence (AI)</li> <li>▪ Developing technological literacy and integrating technology and engineering education with science and mathematics education as part of STEM education.</li> <li>▪ prepares students for careers that require technological &amp; engineering literacy.</li> <li>▪ Promoting student success &amp; readiness for global competition by strengthening educational excellence and equal access.</li> <li>▪ Emphasize importance of developing critical thinking &amp; problem-solving skills</li> </ul>
	Educational Content	<ul style="list-style-type: none"> <li>○ Each state has specific program content for technology education in secondary school.</li> <li>○ Designing technology literacy standards</li> <li>○ Using technology literacy standards</li> <li>○ Educational content based on standards</li> <li>○ Focusing on preparing students for careers that require technological and engineering literacy.</li> <li>○ Emphasizing the connection between the nature and essence of knowledge</li> <li>○ Ongoing process of developing technology education standards influenced by professional organizations and educational reforms</li> <li>○ Evolution of standards from detailed skill statements to broad concepts of technology literacy.</li> <li>○ Inclusion of technology components in standards across disciplines such as science, mathematics, and social studies.</li> </ul>
<b>Malaysia</b>	Educational Goals	<ul style="list-style-type: none"> <li>▪ Strengthening critical thinking and problem-solving skills</li> <li>▪ Increasing teachers' information literacy.</li> </ul>

		<ul style="list-style-type: none"> <li>▪ Increasing skills and understanding of using technology for efficient teaching in schools.</li> <li>▪ Introducing teachers to new educational strategies and approaches.</li> <li>▪ Training teachers to effectively use all traditional and new educational facilities.</li> <li>▪ Strengthening critical thinking and problem-solving skills in STEM fields.</li> <li>▪ Using augmented reality (AR) for more engaging and interactive learning.</li> <li>▪ Strengthening cooperation and teamwork skills in students.</li> <li>▪ Reduce the educational gap between urban and rural students</li> </ul>
	Educational Content	<ul style="list-style-type: none"> <li>○ Network-based training and electronic course materials, interactive storybooks, games and simulation software, self-learning platforms, computer games, problem-solving AI platforms, videos, online libraries, and search engine newsletters.</li> <li>○ Using new technologies, especially augmented reality</li> <li>○ Incorporating practical and theoretical lessons in (ICT)</li> <li>○ Designing educational content based on the Technological Pedagogical Content Knowledge (TPACK) model</li> <li>○ Practical activities that enable teachers to use technology directly in their teaching.</li> </ul>

At the juxtaposition level, there are significant similarities between the four countries, given that all countries are using educational technologies. In particular, they emphasize digital skills training & advanced technologies (such as AR and Simulation Software). However, there are also differences in how these programs are implemented. For example, while Malaysia emphasizes technology development in rural areas and bridging the digital divide, Finland emphasizes personalized and project-based education. Australia and the United States also specifically use online and blended learning methods, while Malaysia focuses more on the use of new software systems and equipment for teaching. These similarities and differences specifically affect how students in the four countries are taught and learned. At this stage, the analysis of the situation in different countries shows that each of them has adopted different approaches to technology education in secondary schools, according to their specific circumstances and based on society's needs and available technology.

Table 2: Juxtaposition of ICT curriculum elements in selected countries

Curriculum element	Finland	Australia	USA	Malaysia
<b>Goals</b>	<ul style="list-style-type: none"> <li>▪ Fostering 21st century skills such as critical thinking, problem solving, and innovation.</li> <li>▪ Emphasis on learning technology skills for future life.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Strengthening STEM skills and critical thinking through digital education.</li> <li>▪ Preparing students for the digital economy</li> </ul>	<ul style="list-style-type: none"> <li>○ Develop technology skills through hands-on projects and online learning.</li> <li>○ Enhance communication and collaboration skills.</li> </ul>	<ul style="list-style-type: none"> <li>○ Expanding access to technology in schools and developing digital skills in students.</li> <li>○ Preparing for a digital future.</li> </ul>
<b>Content</b>	Combining theoretical & experiential training, with an emphasis on digitalization, programming, and algorithmic thinking.	STEM-based content that includes programming, robotics, and designing digital projects.	Flexible content that includes technology-based projects, data science, augmented reality, and online learning	Comprehensive training in information technology, programming, and simulation systems in schools.

#### Stage Four: Comparison

This section discusses the similarities and differences in the ICT curriculum in the countries studied.

Table 3: Similarities and differences in ICT curriculum in the selected countries

Curriculum element	Components	Finland	Australia	USA	Malaysia
<b>Goals</b>	Learning based on practical & applied skills (information technology, programming, cybersecurity)	✓	✓	✓	✓
	Ability to solve complex problems and think critically in the fields of technology and computer science	✓	✓	✓	✓
	Fostering creativity and innovation in technological sciences, with an emphasis on practical & independent projects.	✓	✓	✓	✓
	Teamwork and social skills in project collaborations	✓	✓	✓	✓
	Preparing for the future world of work - more focus on training in new technologies such as IoT and artificial intelligence	✓			

	More emphasis on teaching ethical issues in technology - focusing on the impacts of technology on society and ethics in use of technology				✓
<b>Content</b>	Information technology, programming, and cybersecurity education	✓	✓	✓	✓
	Teaching technical and engineering concepts such as algorithms, object-oriented programming, and data analysis	✓	✓	✓	✓
	Up-to-date training in new technologies (artificial intelligence, IoT, machine learning) in selected countries with differences in the level of accuracy and depth of teaching	✓	✓	✓	✓
	Teaching ethical and social concepts regarding new technologies				✓
	Greater emphasis on environmental issues and social responsibility in technology - including applications of technology towards environmental issues			✓	

*Similarities and differences:*

❖ Educational objectives

Similarities: All countries emphasize practical and applied skills, critical thinking, and fostering creativity in the field of technology.

Differences: a) Finland places a particular emphasis on preparing for the future world of work, while other countries have less emphasis on this ; and b) Malaysia focuses more on ethical issues in technology.

❖ Educational content

Similarities: Teaching IT concepts, programming, and cybersecurity is common among selected countries. Also, teaching technical and engineering concepts (algorithms & programming) and new IOT technologies (artificial intelligence) is present in all countries.

Differences: a) The USA places more emphasis on the applications of technology in the field of environmental issues , and b) Malaysia focuses more on ethical and social concepts in technology.

In overall there are similarities in seven components among the selected countries such as an emphasis on practical and project-based learning, training in new technologies, and continuous assessment and there are clear differences between countries in four components. These differences are mainly evident in the degree of emphasis on specific issues such as ethics in technology, training in social skills, and use of standardized exams.

#### **4. Conclusion**

According to the main findings of research all countries emphasize the development of digital skills, computational thinking, and technological literacy. While Finland and Australia emphasize the integration of technology with other subjects, the United States focuses more on the application of technology in STEM. Malaysia's approach also focuses on bridging the digital divide and using new technologies to enhance learning. The findings of present research are in significant agreement with the findings of previous studies. Similar to what was observed in the selected educational systems, Estigoy (2021) confirms that the extent of technology use in education depends on the readiness of teachers. Sun et al. (2024) also emphasize the importance of the way technology is used in developing high-level scientific thinking skills, which has also been emphasized in the Finnish and Australian educational systems. Also, Rezaei et al. (2022) showed that the goal of STEM programs in advanced countries is to prepare a skilled workforce for the 21st century. The findings of the present study on the United States and Australia also confirm this issue. In addition, Niiranen et al. (2022) have pointed out the need to redefine the position of the technology curriculum in Finland, which is consistent with the findings of this study on the lack of coherence of some approaches in this country. Ajit et al. (2022) also raised challenges related to facilities, teacher knowledge and student perceptions in Malaysia, which are in line with the findings of the present study. Hardy et al. (2019) pointed out the challenges of integrating extracurricular programs with local digital technology programs in Australia, which are in line with the findings of the present study. Starkey and Finger (2018) emphasized the challenges of equitable access to digital technologies for teachers & students, which in the findings of this study is particularly true for Malaysia. Based on the findings, it can be concluded that each country has a different approach to technology education depending on the level of economic development, labor market needs, and educational policies. Finland, with its emphasis on collaborative learning and digital competencies, has a more flexible model that allows for the integration of technology into different subjects. Australia, with its focus on engineering and programming skills, tries to cultivate

students' computational thinking. The United States prepares students for the jobs of the future by emphasizing the relevance of technology education to the labor market and STEM fields, and Malaysia strives to achieve educational equity in technology by reducing the digital divide. Based on the research findings, the following suggestions are made:

- ❖ Other countries can benefit from the Finnish and Australian approach to integrating technology with creative thinking skills
- ❖ Using tools such as augmented reality, machine learning, and the Internet of Things in curricula can improve the quality of technology education
- ❖ Professional training of teachers is essential for the effective use of technology in teaching.
- ❖ Curricula should be designed to suit the rapid technological developments.
- ❖ Providing technology infrastructure in underserved areas can help with educational equity.

## References

- Abolhasani, Z. and Deghani, M. (2020). Pathology of Technology Curriculum in secondary School: Qualitative Study. *Technology of Education Journal (TEJ)*, 14(2), 261-272. doi: 10.22061/jte.2018.4216.2027. [ in Persian].
- Abrahmson, w. ,& , Rsochelle , J. (2016). *Networked classroom educational leadership*- NewYork: Routledge. Australia online available at <http://www.educ.utas.edu.au>-
- ACARA. (2015, May). Digital Technologies: Sequence of content F-10. *Australian Curriculum*, [http://docs.acara.edu.au/resources/Digital\\_Technologies\\_Sequence\\_of\\_content.pdf](http://docs.acara.edu.au/resources/Digital_Technologies_Sequence_of_content.pdf).
- ACARA. (2018). Technologies: Introduction. *Australian Curriculum*: <https://www.australiancurriculum.edu.au/f-10-curriculum/technologies/introduction/>
- ACARA. (2021). *Final Report - Technologies. Australian Curriculum, Assessment and Reporting Authority*. Retrieved from ACARA. <https://www.acara.edu.au/docs/defaultsource/curriculum/australian-curriculum-review/technologies-final-report-australian-curriculum-review.pdf>.
- Australian Institute for Teaching and School Leadership (AITSL). (2011). *Australian Professional Standards for Teachers*. Canberra, Australian Government.
- Ajit, G., Lucas, T. and Kanyan, R. (2022) "Design and Technology in Malaysian Secondary Schools: A Perspective on Challenges", *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 7(1), 335 - 351. doi: 10.47405/mjssh.v7i1.1219.
- Ajit, G., Lucas, T., & Kanyan, R. (2021). A Systematic Review of Augmented Reality in STEM Education. *Studies of Applied Economics*, 38(3), 1-20. DOI: 10.25115/eea.v38i3%20(2).4280

- Ali, R., & Bakar, A. (2019). The probability to memorize and understand textbook information: Socioeconomic class as the predictor for cognitive processing strategies in Pakistani education system. *Pakistan Journal of Social Sciences (PJSS)*, 39(1), 253–270.
- Ambikapathy A., Halili S. H., and Ramasamy, M. D. (2020). Kemahiran TMK dalam kalangan guru-guru bahasa Tamil sekolah menengah [ICT skills among secondary school Tamil language teachers]. *Muallim Journal of Social Sciences and Humanities*, 4(3): 99-114. <https://doi.org/10.33306/mjssh/85>
- Ansari, S., Seraji, F., & Yousefzadeh, M. R. (2021). Designing and validating the curriculum model of media literacy education in the primary course. *Teaching and Learning Research*, 17(2), 61-72. doi: 10.22070/tlr.2021.10455.0. [in Persian].
- Attaran, M. (2019). Technological foundations of curriculum. *Persian Encyclopedia of Iranian Curriculum*. Tehran: Iranian Curriculum Studies Association. (in Persian).
- Autio, O., Jamsek, J., Soobik, M., & Olafsson, B. (2019). Technology education in Finland, Slovenia, Estonia and Iceland: The structure of students' attitudes towards technology. *International Journal of Technology in Education and Science (IJTES)*, 3(2), 95-106. <https://doi.org/10.1111/jcal.12534>
- Awang, R. (2020). Pedagogical And Social Issues Of Technology In Teaching And Learning; A Review. *Journal of Physics: Conference Series*. 1529. 042058. 10.1088/1742-6596/1529/4/042058
- Bahri, S., Salut Muhidin, Warta, W., Rahman, M. A., & Hayaturrohman, H. (2024). Comparative Study of Levels and Curriculum in Education Systems of Indonesia and Australia. *Journal of Instructional and Development Researches*, 4(6), 455-466. <https://journals.indexcopernicus.com/search/article?articleId=4157674>
- Belawati, T. (2018). *Malaysia ICT use in education (meta-survey on use of technologies in Asia and the pacific (2003-2004))*, Banglols: UNESCO.
- Bennett, S., & Maton, K. (2010). Beyond the 'digital natives' debate: Towards a more nuanced understanding of students' technology experiences. *Journal of Computer Assisted Learning*, 26(5), 321-331. DOI:10.1111/j.1365-2729.2010.00360.x
- Berg, R. A. (2009). Teaching strategies for the net generation. *Transformative Dialogues: Teaching & Learning Journal*, 3(2), 1–24.
- Bin, H. M. (2021). *Information and communication technology: the role of teacher education division*, Malaysia: Koalalampur, Ministry of Education.
- Blannin, J., Redmond, P., McLeod, A., & Mayne, F. (2021). Positioning the technologies curriculum: A snapshot of Australian initial teacher education programs. *The Australian Educational Researcher*, 49(5), 979–999. <https://doi.org/10.1007/s13384-021-00473-5>

- Bocconi, S., Chiocciariello, A., Dettori, G., Ferrari, A., Engelhardt, K., Kampylis, P., & Punie, Y. (2016). *Developing computational thinking in compulsory education*. European Commission, JRC Science for Policy Report.
- Cai, S., Wang, X., & Chiang, F. K. (2014). A case study of augmented reality simulation system application in a chemistry course. *Computers in Human Behavior*, 37, 31–40.
- Christopoulos, A., & Sprangers, P. (2021). Integration of educational technology during the Covid-19 pandemic: An analysis of teacher and student receptions. *Cogent Education*, 8(1). <https://doi.org/10.1080/2331186X.2021.1964690>
- Cilliers, E. J. (2017). The challenge of teaching generation Z. *PEOPLE: International Journal of Social Sciences*, 3(1), 188–198.
- Dawson, V. (2008). Use of information communication technology by early career science teachers in Western Australia. *International Journal of Science Education*, 30(2), 203-219.
- Digital Watch, (2024). *Finland's Cyber Security Strategy 2024–2035*, available at : <https://dig.watch/resource/finlands-cyber-security-strategy-2024-2035#:~:text=Finland's%20Cyber%20Security%20Strategy%202024%E2%80%932035%20focuses%20on%20a%20comprehensive,a%20framework%20for%20their%20implementation.>
- Eadie, M.,G. (2001).*The impact of ICT on school .Classroom Design and Curriculum Delivery*. Winston Churchill Millennium Fellow.
- Emam-Jome Kashan, T., & Mollaenezhad, A. (2007). A comparative investigation for ICT integration in some countries in order to present a model for Iran. *Educational Innovations*, 6(1), 31-72. [ in Persian].
- Estigoy, E . (2021). *Information and Communication Technology (ICT) Readiness and its Integration to Teaching and Learning Process among Private High Schools*, ResearchGate, 10.31124/advance.13669814.v1
- European Schoolnet and University of Liège (2012). *Survey Of Schools: Ict In Education Country Profile: Finland*. Contractor: European Schoolnet and University of Liège under contract SMART 2010/0039.
- Fedorov, A. V. (2001). *Media Education: A New Approach to the Education in the XXI Century*. Moscow: Russian Academy of Education.
- Goldhaber, D. D., Neumark, D., & Perova, E. (2021). The Impact of Technology Integration on Student Learning: A Review of the Evidence. *Educational Policy Analysis Archives*, 29(12), 50-70.
- Finland Ministry of Education and Culture, (2024). *Media Literacy and Education in Finland*. Finland Ministry of Education Publication, available at:

<https://okm.fi/documents/1410845/204781055/Media+Literacy+in+Finland.pdf/a6b4760b-d36e-e218-bf95-6b8b8c40eea3/Media+Literacy+in+Finland.pdf?t=1709717603636>

Finnish National Agency for Education. (2020). *National Core Curriculum for Basic Education*. Retrieved from <https://www.oph.fi/en/statistics-and-publications/publications/national-curriculum-basic-education>

Garzón, J., & Acevedo, J. (2019). Meta-analysis of the impact of augmented reality on students' learning gains. *Educational Research Review*, 27, 244–260.

Halili S. H. and Suguneswary R. (2016). Teachers' acceptance on using information communication and technology (ICT) in teaching Tamil language. *The Online Journal of New Horizons in Education*, 6(2): 101-111.

Hardy, L., Castles, M., Yeom, S., & Kang, B. H. (2019). Challenges and prospects of a robotics course to supplement Australia's digital technology curriculum. *IEEE 19th International Conference on Advanced Learning Technologies (ICALT)*, Maceio, Brazil, 224–226. <https://doi.org/10.1109/ICALT.2019.00074>

Harris, S. Kington, A. (2002). *Innovative classroom practices using ICT in England, Implications for schools*, York, UK: National foundation for Educational Research (infer), available at : [https://www.researchgate.net/publication/281449657\\_Innovative\\_Classroom\\_Practices\\_Using\\_ICT\\_in\\_England](https://www.researchgate.net/publication/281449657_Innovative_Classroom_Practices_Using_ICT_in_England)

Hasin, I., & Nasir, M. K. M. (2021). The Effectiveness of the Use of Information and Communication Technology (ICT) in Rural Secondary Schools in Malaysia. *Journal of Education and e-Learning Research*, 8(1), 59-64.

Hayes, J. C., & Kraemer, D. J. M. (2017). Grounded understanding of abstract concepts: The case of STEM learning. *Cognitive Research: Principles and Implications*, 2(7). <http://www.education.gov.uk/schools/teachingandlearning/curriculum>—<http://www.edu.uk.go>.

ITEEA. (2007). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

LaPorte, J. & Sanders, M. (1995). Technology, science, mathematics integration. In E. Martin (Ed.), *Foundations of technology education*, Council on Technology Teacher Education. Peoria, IL: Glencoe /McGraw-Hill.

Jones, A. (2016). *If Only: Changing Classroom Learning Teaching with ICT*. Australian Association for Research in Education.

Kaarakainen M-T, Saikkonen L.(2021) Multilevel analysis of the educational use of technology: Quantity and versatility of digital technology usage in Finnish basic education schools. *Journal of Computer Assisted Learning*. 37: 953–965. <https://doi.org/10.1111/jcal.12534>.

- Kamarainen, A. M., Metcalf, S., Grotzer, T., Browne, A., Mazzuca, D., Tutwiler, M. S., & Dede, C. (2013). EcoMOBILE: Integrating augmented reality and probeware with environmental education field trips. *Computers and Education*, 68, 545–556.
- Kananoja, T. (2009). Technology education in general education in Finland. In A. Jones & M. de Vries (Eds.), *International handbook of research and development in technology education* (pp. 41–50). Rotterdam, The Netherlands: Sense.
- Kian, M.(2019). A comparative study of information and communication technology programs in the general education period of the educational system of Australia, Finland and Iran. *Iranian Journal of Comparative Education* ,2(3), 383-406 .  
<https://doi.org/10.22034/ijce.2020.103834> [ in Persian ]
- Korhonen, T., Salo, L., Laakso, N., Seitamaa, A., Sormunen, K., Kukkonen, M., & Forsström, H. (2023). Finnish teachers as adopters of educational innovation: Perceptions of programming as a new part of the curriculum. *Computer Science Education*, 33(1), 94–116.  
<https://doi.org/10.1080/08993408.2022.2095595>
- Kusaka, S. (2021). Systematizing ICT Education Curriculum for Developing Computational Thinking: Case Studies of Curricula in the United States, Australia, and the United Kingdom. *Journal of Education and Learning*, 10(5), 76-83.  
[https://www.researchgate.net/publication/354246947\\_Systematizing\\_ICT\\_Education\\_Curriculum\\_for\\_Developing\\_Computational\\_Thinking\\_Case\\_Studies\\_of\\_Curricula\\_in\\_the\\_United\\_States\\_Australia\\_and\\_the\\_United\\_Kingdom](https://www.researchgate.net/publication/354246947_Systematizing_ICT_Education_Curriculum_for_Developing_Computational_Thinking_Case_Studies_of_Curricula_in_the_United_States_Australia_and_the_United_Kingdom)
- Lander, B. (2019). Technology in education :What can we learn from Finland ? *MagazineMatsuyama University Review*, 31( 2 ), 26-49. [https://matsuyama-u-r.repo.nii.ac.jp/?action=repository\\_uri&item\\_id=2764&file\\_id=22&file\\_no=1](https://matsuyama-u-r.repo.nii.ac.jp/?action=repository_uri&item_id=2764&file_id=22&file_no=1)
- Landri, P. (2018). *Digital governance of education. Technology, standards and Europeanization of education*. London, England: Bloomsbury Academic.
- Lehto, M ., Neittaanmäki, P. (2023). Cyber Security Training in Finnish Basic and General Upper Secondary Education. *Proceedings of the 18th International Conference on Cyber Warfare and Security*, Vol. 18 No.,199-208. <https://doi.org/10.34190/iccws.18.1.984>
- Leinonen, R., & Salonen, A. (2024). Pre-service teachers of physics, craft, and chemistry students' perceptions of interdisciplinary teaching and technology education. *LUMAT: International Journal on Math, Science and Technology Education*, 11(4), 25–58.  
<https://doi.org/10.31129/LUMAT.11.4.2030>
- Lyotar, F. (2018). *The Postmodern Condition: A Report on Knowledge*, translator Hussein Ali Nozari, Tehran: Gameno pPublication,[ in Persian]
- Marmoah, S., Roslan, R., Chaeroh, M., Elita, M. D., & Fauziah, M. (2021). The Comparison of Education System in Australia and Indonesia. *JPI (Jurnal Pendidikan Indonesia)*, 10(4), 784–796. <https://doi.org/10.23887/jpi-undiksha.v10i4.33661>

- Metsärinne, M & Salonen, A& Kallio, M & Virta, K & Hilmola, A. (2024). Outlining technical craft as technology and engineering education in Finnish school craft. *International Journal of Technology and Design Education*. 1-29. 10.1007/s10798-024-09950-1.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017-1054.
- Moye, J. J., Reed, P. A., Barbato, S., & Fujita, S. (2019). Technology education in the United States. *Journal of the Japan Society of Technology Education*, 61(4), 89-97.
- Murugan, P., & Husnin, H. (2024). Advantages of using Technology in Classroom Assessment to Improve Teaching Professionalism and Challenges among Tamil National Type School Teachers (SJKT). *International Journal of Academic Research in Business and Social Sciences*, 14(8), 1490-1496. <https://doi.org/10.6007/IJARBS/v14-i8/22521>
- Nikula, E., Järvinen, T., & Laiho, A. (2020). The Contradictory Role of Technology in Finnish Young People's Images of Future Schools. *YOUNG*, 28(5), 465-484. <https://doi.org/10.1177/1103308819894806> (Original work published 2020)
- Niiranen, S., Rasinen, A., Rissanen, T., & Ikonen, P. (2021). Identifying Past and Current Trends in Technology Education in Finland. *Methods and Agendas in Technology Education*, 28(2), 17-24. <https://journals.oslomet.no/index.php/techneA/article/view/4265>
- Niiranen, S., Ikonen, P., Rissanen, T., & Rasinen, A. (2022). Current and future trends and issues facing technology education in Finland : Taking part in an international Delphi study. *Australasian Journal of Technology Education*, 8. <https://doi.org/10.15663/ajte.v8i.88>.
- Nikula, E., Järvinen, T., & Laiho, A. (2020). The Contradictory Role of Technology in Finnish Young People's Images of Future Schools. *YOUNG*, 28(5), 465-484. <https://doi.org/10.1177/1103308819894806>
- NSTC, (2018). *Charting a course for success: America's strategy for STEM education*. Washington, DC: Office of Science and Technology Policy.
- Peltonen, J. (2009). The technology as the value construction and its implication to the Sloyd/Technology Education. In M. Metsarinne (Ed.), *Käsityökasvatus tieteenalana 20v—Sloyd Education 20 years as discipline*. *Techne Series A:15* (pp. 17–24). NordFo. Nordic Forum for Research and Development in Craft and Design.
- Priporas, C.-V., Stylos, N., & Fotiadis, A. K. (2017). Generation Z consumers' expectations of interactions in smart retailing: A future agenda. *Computers in Human Behavior*, 77, 374–381.
- Rafiq, S., Iqbal, S., & Afzal, A. (2024). The Impact of Digital Tools and Online Learning Platforms on Higher Education Learning Outcomes. *Al-Mahdi Research Journal*, 5(4), 359-369. <https://ojs.mrj.com.pk/index.php/MRJ/article/view/342>

- Raman, K., Othman, N., & Affandi, H. M. (2019). Information communication and technology (ICT) usage gaps between urban and rural schools. *Malaysian Journal of Education*, 44(1SI), 109-119.
- Rasinen, Aki & Niiranen, Sonja & Endepohls-Ulpe, Martina & Ikonen, Pasi & Ebach, Judith & Zabern, Janine. (2009). Technology education for children in primary schools in Finland and Germany: Different school systems, similar problems and how to overcome them. *International Journal of Technology and Design Education*. 19(4), 367-379. <http://dx.doi.org/10.1007/s10798-009-9097-5>
- Rasinen, A., Ikonen, P., & Rissanen, T. (2011). Technology education in finnish comprehensive schools. In C. Benson & J. Lunt (Eds.), *International handbook of primary technology education; Reviewing the past twenty years* (pp. 97–105). Sense Publishers.
- Rezaei, M. , Emamjomeh, S. M. R. , Ahmadi, G. A. , Assareh, A. and Niknam, Z. (2022). A Comparative Study of Integrated STEM Curriculum in Finland, Singapore and the United States to Provide Recommendations for Iranian Curriculum Planners. *Iranian Journal of Comparative Education*, 5(1), 1765-1788. <https://doi.org/10.22034/ijce.2022.251947.1227>[ in Persian].
- Rizal, F., Jalinus, N., Zaus, M. A., Wulansari, R. E., & Nabawi, R. A. (2019). Comparison of ICT using in learning between Indonesia and Malaysia. *Journal of Physics* (Vol. 1387, No. 1, p. 012133). IOP Publishing, Doi:10.1088/1742-6596/1387/1/012133
- Romeo, G., Lloyd, M., & Downes, T. (2012). Teaching Teachers for the Future (TTF): Building the ICT in education capacity of the next generation of teachers in Australia. In C. P. Lim & C. S. Chai (Eds), Building the ICT capacity of the next generation of teachers in Asia. *Australasian Journal of Educational Technology*, 28(Special issue, 6), 949-964.
- Saarinen, A. I., Lipsanen, J., Hintsanen, M., Huotilainen, M., & Keltikangas-Jarvinen, L. (2021). The use of digital technologies at school and cognitive learning outcomes: A population-based study in Finland. *International Journal of Educational Psychology*, 10(1), 1-26.
- Sadr.A Rast. M(2022). A Comparative study of technology education curriculum in teacher training of Australia, England, Malaysia and Iran in order to provide a model of ICT education curriculum in Farhangian University. *The third international conference on comparative education*, Babolsar: Imam Ali Educational and Research Center, Farhangian University. [ in Persian ].
- Salokangas, M., Wermke, W., & Harvey, G. (2019). Teachers' autonomy deconstructed: Irish and Finnish teachers' perceptions of decisionmaking and control. *European Educational Research Journal*, 19(4), 329–350. <https://doi.org/10.1177/1474904119868378>.
- Samadi, P., & Ramezani, M. (2014). A comparative study of technology education curriculum in Japan, England, Australia and America in order to provide a model for information

- technology training program in Iran, *Journal of Curriculum Studies*, 89 (31), 107-124. [ in Persian].
- Sanders, M. E. (2009). Integrative STEM education: A primer. *The Technology Teacher*, 68(4), 20-26.
- Shah, G. (2020). Training for 'ICT in Education' via Blended Learning Mode: Educators' Experiences and Perceptions. *i-manager's Journal of Educational Technology*, 16(4), 43-54. <https://doi.org/10.26634/jet.16.4.16551>
- Siddiq, F & Hatlevik, O & Olsen, R & Throndsen, I & Scherer, R. (2016). Taking a future perspective by learning from the past - A systematic review of assessment instruments that aim to measure primary and secondary school students' ICT literacy. *Educational Research Review*. 19. 58-84. <https://www.learntechlib.org/p/197420/>
- Starkey, L., Finger, F. (2018). *Information and Communication Technology in Educational Policies in Australia and New Zealand*. Springer, Cham. DOI: 10.1007/978-3-319-53803-7\_87-1.
- STEM (2018). *STEM4: The power of collaboration for change*. Reston, VA: Advance CTE, Association of State Supervisors of Math (ASSM), Council of State Science Supervisors (CSSS), and International Technology and Engineering Educators Association (ITEEA).
- Sun, H., Xie, Y., & Lavonen, J. (2024). Effects of the use of ICT in schools on students' science higher-order thinking skills: comparative study of China and Finland. *Research in Science & Technological Education*, 42(2), 276-293.
- UNESCO, (2018). *Positioning ICT in education to achieve the Education 2030 Agenda in Asia and the Pacific: recommendations for a regional strategy*, UNESCO Office Bangkok and Regional Bureau for Education in Asia and the Pacific, available at : <https://unesdoc.unesco.org/ark:/48223/pf0000261661>
- United States Office Of Educational Technology. (2010) *Transforming American education: learning powered by technology: National Education Technology Plan*. Washington, D.C.: U.S. Dept. of Education, Office of Educational Technology. [Pdf] Retrieved from the Library of Congress, <https://www.loc.gov/item/2023692186/>.
- Toivonen, T., Oyelere, S., Suhonen, J. (2020). The role of ICT and its pedagogical contributions in Finnish education: Advances in educational innovation for inclusion and technological literacy from the perspective of stakeholders. In *ICT and education in the perspective of experts from business, government, academia and NGOs*. DOI:10.33324/memorias.vi1.492
- Williams, P. J., Ellis, D., Pagram, J., MacGregor, D., Seemann, K., & Fujita, S. (2019). A Critical Perspective on Technology Education in Australia. *Journal of the Japan Society for Technology Education*, 61(2), 163-186. DOI: 10.1007/s10798-011-9168-2

World Bank , (2020). *How countries are using edtech (including online learning, radio, television, texting) to support access to remote learning during the COVID-19 pandemic*. Washington, DC: The World Bank. Retrieved from <https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learningduring-the-covid-19-pandemic>.

Zoufan, S. H. (2017). *The application of new technologies in education*, Tehran: samt publishin.[in Persian].