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Embedding Fourth Industrial Revolution Skills in Science Curricula

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Abstract:
The study aimed to identify the skills of the Fourth Industrial Revolution that must be available in the science curriculum (Cambridge) in the Sultanate of Oman and to show the extent to which these skills are included in the science curricula through the opinion of the sample included in the study. To achieve this, the study adopted a descriptive approach to data collection and analysis to explore the availability of the Fourth Industrial Revolution skills in science curricula. The researchers prepared a list of Fourth Industrial Revolution skills built through previous studies considering four areas: digital skills, learning and creativity skills, soft skills, and job skills. The results of the study showed four areas under which the skills of the Fourth Industrial Revolution fall and the previous areas that must be available in science curricula. The results showed that the availability of these skills in science curricula is low in the four areas, the least of which was digital skills. Based on the results, the study will be useful to the Sultanate of Oman by reconsidering the extent to which science curricula include the skills of the Fourth Industrial Revolution, and paying more attention to the compatibility between science curricula and the characteristics of the current era and the requirements of the future in light of the skills of the Fourth Industrial Revolution. The novelty of this study lies in linking the skills of the Fourth Industrial Revolution with the science curricula (Cambridge) in the Sultanate, which are the developed curricula adopted by the Sultanate, and highlighting the importance of their availability in these curricula to provide students with skills that prepare them for the future in the era of the Fourth Industrial Revolution.

Keywords: Fourth Industrial Revolution skills, Cambridge Science Curriculum, science education, curriculum studies.

将第四次工业革命技能融入科学课程

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摘要：
该研究旨在确定阿曼苏丹国科学课程（剑桥）中必须具备的第四次工业革命技能，并通过样本的意见显示这些技能在多大程度上被包含在科学课程中 在研究中。为实现这一目标，该研究采用描述性方法进行数据收集和分析，以探索第四次工业革命技能在科学课程中的可用性。研究人员准备了一份第四次工业革命技能清单，这些技能是通过之前的研究建立起来的，考虑了四个领域：数字技能、学习和创造力技能、软技能和工作技能。该研究的结果显示了第四次工业革命技能的四个领域以及科学课程中必须提供的先前领域。结果表明，在这四个领域中，科学课程中这些技能的可用性较低，其中最少的是数字技能。根据研究结果，该研究将有助于阿曼苏丹国重新考虑科学课程在多大程度上包含第四次工业革命的技能，并更加关注科学课程与当前时代特征的兼容性以及 根据第四次工业革命的技能来满足未来的要求。这项研究的新颖之处在于将第四次工业革命的技能与苏丹国采用的已开发课程的科学课程（剑桥）联系起来，并强调它们在这些课程中的重要性，以便为学生提供 为第四次工业革命时代的未来做好准备的技能。

关键词：第四次工业革命技能、剑桥科学课程、科学教育、课程研究。

1. Introduction

The Fourth Industrial Revolution has penetrated into various areas of life and brought about many changes in it, and the education system has had a large share of these changes in its various elements, which requires those concerned in the field of education to develop the educational system in line with the requirements of the Fourth Industrial Revolution and develop curricula in line with the developments of the Fourth Industrial Revolution (Raharja et al., 2019). This is what the current study will examine, which identified the skills of the Fourth Industrial Revolution that must be available in science curricula, and the extent to which science curricula in the Sultanate include the skills of the Fourth Industrial Revolution. The Fourth Industrial Revolution, which we are witnessing its transformations today, is characterized by a set of skills that require individuals to be able to live with modern changes and face the future with its various challenges. Creativity in the education process is the most important aspect on which the education process is based considering the skill areas of the Fourth Industrial Revolution, so that the learner can achieve this creativity and acquire it through flexible and continuous learning at any time. For this to happen in education, the learner must possess certain skills required by the revolution brought about by the technology of the Fourth Industrial Revolution, including digital skills, learning skills, creativity, soft skills, and functional skills (Maghauri, 2020). The current study is expected to determine the availability of previous skills in the curriculum and highlight the need to include them in the curricula in line with the developments in the current era.

1.1. Study Problem

The problem of the study stems from the importance of the educational system in all its elements on the one hand and the clear changes brought about by the Fourth Industrial Revolution in the education system, emphasizing the need for education to keep pace with its requirements, on the other hand. Because education is the main axis for the rehabilitation of generations and the development of their skills, it was necessary to consider the current curricula in the Sultanate and identify the extent to which they include the skills of the Fourth Industrial Revolution necessary to prepare learners for the future and for life, which has provided them with a number of necessary skills through the curriculum. Because the current curricula have been applied since 2017 in the Sultanate, any modern curriculum must be based on knowing its strengths and priorities for development considering different aspects, and the Fourth Industrial Revolution represents one of these aspects, the current study will evaluate the curriculum considering the skills of the Industrial Revolution.

Accordingly, the problem of the study will be identified in two basic questions:

1) What skills of the Fourth Industrial Revolution should be available in current science curricula?

2) To what extent are the skills of the Fourth Industrial Revolution embedded in the current science curricula?

1.2. Objectives of the Study

As the current study seeks to include the skills of the Fourth Industrial Revolution in science curricula, it is from this viewpoint that it aims to:

1) Identify the skills of the Fourth Industrial Revolution that must be available in current science curricula.

2) Reveal the extent to which the Fourth Industrial Revolution skills are included in the current science curricula.

1.3. The Importance of the Study

The importance of the current study is as follows:

- The results of the current study may contribute to the development of curricula in the future by including the skills of the four industrial revolutions.
- Current study proposals may contribute to the

establishment of studies and research in other similar aspects or approaches.

- The current study may provide interested researchers and educators with a well-judged Fourth Industrial Revolution skills list.

1.4. Study Terminology

The Fourth Industrial Revolution skills are the experiences required by the Fourth Industrial Revolution that the learner must gain to be in line with the developments of the times and ready for the future and are represented in digital skills, learning skills, creativity, personal skills, and job skills.

Cambridge Science Curriculum is one of the science curriculum series launched by the Cambridge International University, through which it seeks to prepare the learners for life and represents in this study the science series translated in cooperation with the Cambridge Foundation and applied in the Sultanate since 2017.

2. Theoretical Framework

2.1. The Fourth Industrial Revolution

The concept of the Fourth Industrial Revolution has been strongly linked to technology, digital skills, and the integration of various technologies, so that human intervention is reduced to become dependent on the scrutiny and observation of certain events. The Fourth Industrial Revolution of the present era requires the availability of highly experienced scientific capabilities, many skills, extensive experience, and practice that societies must strive to acquire for their members. There is no doubt that the Fourth Industrial Revolution has impacted various societies and systems and in several fields, especially the educational system, which is one of the most important systems that work to prepare individuals in societies (Elayyan, 2021).

The Sultanate is one of the countries doing its best to keep pace with the requirements of the Fourth Industrial Revolution across various fields of education, medicine, science, and engineering. The Sultanate has provided the necessary infrastructure and has strived toward the development of the technology industry in information and communications. It sought to develop the members of the community and provide them with a number of skills that qualify them to keep pace with the future considering the Fourth Industrial Revolution, based on the axes of the national strategy to work on making a digital society in Oman. Oman's Vision 2040 affirmed that the interest in the education sector is the greatest proof of this, as the vision stressed the need for education to be inclusive on the one hand, of high quality, and to lead to a digital knowledge society on the other. The Sultanate's efforts in this regard have come through attention to the teacher, the development of his abilities, and through the development of curricula in various disciplines, and the diversity of teaching methods and strategies. The educational portal has been launched as a digital system to work in the system Education, and many e-learning technologies have been launched with the aim of moving toward a digital Omani society (Belushi & Mahamari, 2020).

2.2. Fourth Industrial Revolution Skills

Empowering students with the concepts of the Fourth Industrial Revolution is one of its most important requirements as came the study of Al-Mayahi et al. (2020) to identify the impact of a training program to enable students to understand the concepts of the Fourth Industrial Revolution, by identifying the Fourth Industrial Revolution and its requirements and the changes expected to occur for students after learning about the concepts of the Fourth Industrial Revolution, and the extent to which this contributes to preparing students to acquire the experiences and skills of the Fourth Industrial Revolution, and keep pace with the orientation towards it, and the study mentioned the importance of working to find appropriate solutions to bridge the gap between the requirements of the Fourth Industrial Revolution and the capabilities of current outputs.

Several studies have mentioned the skills of the Fourth Industrial Revolution that it deems necessary to be available in the curriculum, including the study of Al-Hujaili and Tunisian (2021), which limited it to three areas: learning skills, creativity, digital skills, life skills, work and life, and the list included 27 skills. The study of Al-Sweikit et al. (2021) presented skills more comprehensively, showcasing the skills of the Fourth Industrial Revolution in six areas, represented in digital skills, learning and creativity skills, moral thinking skills, global citizenship skills, life and career skills, and interpersonal skills. Dahshan and Farghli (2021) identified skills in digital culture skills, work and life skills, and creativity skills, which corresponded in the skills they studied with the study of Al-Hujaili and Tunisian (2021).

Reaves (2019) presented a number of skills: creativity, innovation, flexibility, adaptation, observation, empathy, and the ability to learn. Kemp's (2018) study showcased a number of Fourth Industrial Revolution skills, which were represented in creativity skills, critical thinking, problem solving, emotional intelligence skills, people management, negotiation, decision-making, dealing with others, flexibility, and guidance of individuals. Farisi's (2016) study identified ten skills represented by creativity, innovation, problem solving, critical thinking, communication, leadership, responsibility, technical employment, teamwork, and dealing with others that correspond largely to the skills presented by Kemp (2018) and Reaves (2019). The list of skills in the current study has been built through the literature and previous studies, and these skills are:

Digital skills: These include technical skills in life that are employed through the employment of applications of the Fourth Industrial Revolution, as well as the skill of collecting data accurately and quickly, the skill of investigation and research in various digital sources, the skill of solving digital and technical

problems.

Learning and creativity skills: Critical thinking skills, the skill of inventing new ideas, new processes, and others in the same field.

Personal skills: Self-confidence when dealing with the requirements of the Fourth Industrial Revolution, the use of associated technologies, leadership skills, and the formation of a team in digital environments.

Career skills: The ability to apply new projects, the skill of working in entrepreneurship and innovating different ways to do so, the skill of working in virtual environments, and the skill of endurance.

3. Research Methods

The current study depends in achieving its goal on the descriptive approach, where this approach is based on the study of reality and its description of the accurate description and expresses that description qualitatively and quantitatively by clarifying the magnitude of this phenomenon or the degree of its presence or its association with other phenomena. Therefore, this study will build a list of skills of the Fourth Industrial Revolution to be available in the science curricula in the fourth basic grade of the previous literature and present them to the specialists in the curricula to ensure the need for their availability in the curricula, and then describe the extent to which they are included in the science curricula in the Sultanate quantitatively and qualitatively. This is performed by collecting, classifying, comparing, analyzing, and extracting data from the selected sample (Sulaitani, 2019).

3.1. Population and Sampling

The study population consists of the first supervisors and teachers in the Sultanate of Oman who supervise and teach the science curriculum in the first cycle classes in the Sultanate, which represent grades (1-4) and the number of supervisors (100) in the Ministry of Education according to the statistics of the Ministry of Education for the academic year (2021-2022). It represents 227 first female teachers (as there are no first male teachers in the first to fourth grades) affiliated with the Ministry of Education during the academic year (2021-2022) (Ministry of Education, 2021).

A random sample of the community of 11 governorates was selected in a random class manner, and the sample of supervisors consisted of 20 supervisors and supervisors supervising science teachers in the first cycle (1-4) grades in the educational directorates of the Ministry of Education in the academic year (2021-2022) and constituted 20% of the study population according to Taima (2004). As for the sample of the first female teachers, the community of the first teachers consists of 227 first teachers who teach science (1-4) in the educational directorates of the Ministry of Education in the semester of the academic year (2021-2022), and six sample forms 10% of the study population according to Taima (2004).

3.2. Instrument

Since the main objective of the study is to identify the extent to which the skills of the Fourth Industrial Revolution are included in the science curricula through the identification of the skills of the Fourth Industrial Revolution, which was prepared after the preparation of a list containing the skills of the Fourth Industrial Revolution obtained through the review of studies and literature, which were presented to the arbitrators specialized in the curricula in general and the science curricula in particular, in order to know the availability of these skills in the science curriculum for the fourth grade to be then adopted and used as a questionnaire To collect data from the sample of the first supervisors and teachers to achieve the objectives of the study. The study tool consisted of four areas, each area containing several skills with a total of 45 skills for the four areas, distributed as follows:

- The field of digital skills, which included 10 skills.
- The field of learning and creativity skills, which included 13 skills.
- The field of interpersonal skills includes nine skills.
- The field of functional life skills included 13 skills.

4. Findings

The results of the study indicate that:

- There are four areas of the Fourth Industrial Revolution skills that are essential in science curricula, and specialists agree that they are important considering the requirements of the Fourth Industrial Revolution;
- Learning, creativity, and digital skills ranked first in the importance of their availability according to experts;
- Functional and soft skills are important within the Fourth Industrial Revolution skill areas. Digital skills are the least available at a very low rate;
- Soft and job skills were available in moderate proportions.

5. Discussion and Conclusion

When looking at the educational literature related to the variables of the study and the relevant previous studies, the results can be interpreted based on the requirements of the Fourth Industrial Revolution as follows: The results of the current study were consistent with the studies of Al-Hujaili and Tunisian (2021), Al-Sweikit et al. (2021), as these studies confirmed that the Fourth Industrial Revolution has a significant and clear impact on various societies, and that students' acquisition of the skills of the Fourth Industrial Revolution has become critical and must be available in different curricula. The current study proved that there is an urgent need to develop students' digital skills and prepare them to use high technologies in line with learning and creativity skills, which are among the most important skills of the Fourth Industrial Revolution. This was confirmed by the World Economic Forum's report on the Fourth Industrial Revolution, where it said

that innovation has become an important factor and a key driver of growth and value creation in the era of the Fourth Industrial Revolution, which requires developing students' skills at an early age and in the early basic stages of education, and transforming ideas into applicable products by using active learning methods and strategies. The results of the study found that digital skills, learning skills, and creativity based on soft and job skills contribute to the formation of a base for learners through which they can build their future. Dahshan and Farghli (2021) stressed that they are necessary skills that students must acquire.

Based on the results, the researchers recommended:

- Reconsidering the way to include the skills of the Fourth Industrial Revolution in its various fields in the science curricula to achieve a balance between different aspects and fields;
- Including all the skills of the Fourth Industrial Revolution in the science curricula, proposing strategies and teaching methods to enable students to do so, and paying more attention to the alignment of science curricula with the characteristics of the current era and the requirements of the future.
- Conducting further educational studies considering the requirements of the Fourth Industrial Revolution to achieve the development of the skills presented by the study.

6. Limitations and Further Study

Because the inclusion of the skills of the Fourth Industrial Revolution in science curricula is not easy, and because the availability of the skills of the Fourth Industrial Revolution was identified through the opinion of the target sample, who are supervisors and early teachers, the study plans in its future to analyze the science curriculum to ensure the extent of inclusion of these skills more and more accurately.

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Authors' Contributions

All the authors were involved in conducting this research by doing literature review, designing the research, collecting, and analyzing data, and reviewing the paper as one research team.

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