Int. j. adv. multidisc. res. stud. 2023; 3(4):590-594

Received: 11-06-2023
Accepted: 21-07-2023

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Transferring Digital Knowledge in Computer Science Education: The Role of Smart Farms

Adel Mosfer Alshehri
Kingdom of Saudi Arabia, Saudi Arabia

Corresponding Author: **Adel Mosfer Alshehri**

Abstract
The current objective is to identify the knowledge transfer of Computing and Society as a cross-cutting task of computer science teaching to students through the theme of smart farms, how the theme of smart farms can be integrated into computer science teaching to understand and the benefits of smart farms for society and the environment learn how to deal with it in their future, examine best practices for integrating smart farms in school curricula, and shed light on the Internet of Things in smart farms.

Keywords: Computer Science, Society, Computer Science Education, Smart Farms, Sustainability

1. Introduction

Computer science plays an important role in modern society. It has become a major economic sector and impacts many areas of daily life, including communication, education, entertainment, healthcare, and transportation. Computer science enables people to access information, communicate and collaborate quickly and easily. It has helped to simplify and connect the world and thus has the potential to improve the quality of life [Co04] [3].

But IT also poses risks and challenges. It can lead to addiction and affect people's privacy. There are also concerns about the security of IT systems and the possibility of cyber-attacks. To meet these challenges, it is important to use IT responsibly and to minimize the risks [PH20] [15].

"Computer Science & Society is also an important area of computer science education that deals with the interaction between computer science and society. This can include topics such as ethics, privacy, social responsibility, and sustainability [Sc13] [16].

One example of sustainability that could be covered in a computer science class is "smart farms." These are farmers who use information technologies such as sensors, drones, and machine learning to use resources more efficiently and increase yields. For example, sensors can be used to monitor soil moisture to make sure crops are getting enough water without wasting it. Drones can also be used to monitor crops for pests or diseases without the need for manual inspections. By using machine learning algorithms, farmers can also optimize their operations and improve crop yields. The use of information technology in agriculture can therefore help to conserve resources and increase the sustainability of agriculture. In computer science classes, students could learn how smart farms work and consider the potential implications for society [Pe20] [14].

2. Research Question

What digital knowledge can smart farms teach students in computer science classes?

3. Theoretical Literature

3.1 Computing and Society in Computer Science Lessons

"Computer science education" is education that teaches students the fundamentals and applications of information technology and computer science. This may take the form of courses in schools or in adult education. Computer science education usually involves the teaching of computer-based computation, algorithms, data structures and programming. It may also include the use of computer applications such as word processing, spreadsheets and databases [HNR07] [6].

Computer science classes are also an integral part of the curriculum in many schools and can be offered at a variety of levels, from introductory courses for beginners to advanced courses for students interested in a career in computer science. Computer science education is important because it provides students with the skills to use computer technology safely and effectively and prepares them for the demands of the modern job market. Therefore, computer science education should always take into

account the social aspects of computer science. This can be done, for example, by addressing ethical issues related to the use of technology, such as data protection, privacy, and sustainability [BFFKPRS08].

Another important aspect is the consideration of different perspectives and the promotion of inclusion and diversity in computing education. This means that teaching should address the needs and interests of all students, not just those of a particular group. In addition, computing education can also address the impact of technology on society. All in all, computer science education should not only teach technical skills, but also encourage critical thinking about the role of computer science in society. It is important that students learn to use computing ethically and responsibly to meet the challenges and opportunities of a rapidly changing world. This includes learning how to use computing to solve societal problems and make a positive difference in the world [Hu07] [8].

3.2 Sustainability

"Sustainability is an approach to meeting the needs of the present without compromising the ability of future generations to meet their own needs. It is about using resources in a way that makes them available for the present and the future. Sustainability affects all aspects of human life, including the economy, society, and the environment [Iv06] [9].

There are different approaches to sustainability that focus on different aspects of human life. One approach that focuses on the environment is environmental sustainability, which focuses on preserving biodiversity and preventing pollution and damage. Another approach that focuses on the economy is economic sustainability, which focuses on promoting growth and prosperity without overexploiting resources or damaging the environment. A third approach that focuses on society is social sustainability, which focuses on promoting equity, justice and solidarity. To be sustainable, we must recognize that all areas of human life are interdependent and that changes in one area can affect others. We must also learn to use our resources more efficiently and responsibly, and ensure that all people have access to the resources they need to meet their needs [Ma20] [12].

It is important to integrate sustainability into computer science education because computer science plays an important role in shaping the digital world. As a result, students can learn to use technology responsibly and consider the impact of their work on society and the environment [SMDKBMK21] [17].

3.3 Computing and Society and its Relationship to Sustainability

The information society is a type of society in which information and communication technologies (ICT) play a central role. In the information society, there is widespread use of digital media and a high dependence on ICT in all areas of daily life and the economy. Sustainability refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. It means using the earth's resources in a way that does not exceed their capacity to renew themselves and minimizing negative impacts on the environment [SR13] [18].

The information society has both positive and negative impacts on sustainability. On the positive side, ICT can help conserve resources and improve the efficiency of processes, which can help reduce waste and emissions. However, a high dependence on ICT can also lead to an increased demand for raw materials for the production of electronics and increased energy consumption. It is therefore important that the information society is geared towards sustainable practices and that negative impacts are minimized. Computer science, the science of information processing, can play an important role in achieving sustainability. This can be done in a variety of ways, for example by developing technologies and applications that conserve resources and reduce environmental impact, or by using information technology to improve processes and systems in different areas, such as agriculture, energy supply, or transportation infrastructure [Lü17] [11].

Information technology can also contribute to the dissemination and promotion of sustainability goals in society, for example by being used for education and information campaigns or by helping to increase the transparency of decision-making processes. However, the spread and use of information technology can also have negative impacts, such as the high energy consumption of data centers or the potential health effects of electrosmog. It is therefore important to consider these aspects in the development and use of IT solutions and to develop more sustainable alternatives [Ho21] [7].

Some possible focuses for a computer science course on IT and sustainability could be [Pe20] [14]:

1. Introduction to the concepts of sustainability and environmental impact in the context of IT and digital technologies.
2. Analyze the impact of IT systems and services on the environment and society.
3. Learn techniques to save energy and reduce CO2 emissions in IT.
4. Learn the concepts of Green IT and Green Computing.
5. Learn best practices for sustainable IT use, such as reducing waste and taking advantage of recycling opportunities.
6. Understand the concepts of privacy and data security in the context of sustainable IT.
7. Smart farms.

There are many ways to design a computer science lesson on IT and sustainability. An important aspect is that students have the opportunity to apply and test the concepts and technologies in concrete projects. This can be achieved, for example, by designing student projects or giving them the opportunity to participate in competitions.

From what has been said about sustainability and its relationship to the Computing and Society, students of all grades can identify interactions between IT systems and their social embedding [BFFKPRS08] through the following competencies that can be acquired:

Students of all grades:

1. Identify and analyze complex problems and develop sustainable solutions.
2. Evaluate information to draw logical conclusions and make sustainable decisions.
3. present sustainable solutions and their implications clearly and effectively, both orally and in writing.
4. Work as part of a team to achieve a sustainable goal.
5. understand technology and information systems, how to use them, and how to make them sustainable.
6. Understand and evaluate the environmental, social, and

economic impacts of technologies and information systems.

3.4 Computing and Society as a Cross-Cutting Task of Computer Science Education through Smart Farms

Computer science and society is an important part of computer science education because it provides an opportunity to explore the impact of information technology on society and to consider the responsibilities of computer scientists in dealing with technology. This can be seen as a cross-cutting issue as it cuts across different areas of computing education and develops students' skills in different areas such as communication, critical thinking, and ethical behavior [GS20] [4].

Computer science education can help students understand the impact of information technology on society and their role as active citizens in a digital world. For example, students can learn how information technology can improve the quality of life, but also recognize the implications for privacy and security online. Computer science education can also provide an opportunity to discuss the ethical and social implications of information technology and how it can be used responsibly. And it is important that students' computer science education also addresses the societal impact of information and communication technology (ICT). One of the topics where this is particularly relevant is smart farms. Smart farms are farming methods that use information and communication technology to increase productivity and conserve resources. For example, sensors can be used to monitor soil conditions, weather, and crop growth to automatically adjust irrigation and fertilization. Through the use of ICT, smart farms can also optimize animal husbandry, for example by using automatic feeding systems [O'O'17] [13].

Therefore, computer science classes can teach students about the opportunities and challenges of smart farms and encourage them to consider societal issues such as sustainability, animal welfare, and the impact of technology on agriculture. It might also be interesting to encourage students to consider ethical issues related to smart farms.

3.5 Smart Farms

"Smart farms is a term used to describe farms that use modern technologies and methods to produce more efficiently and sustainably. For example, using sensors and other technologies to monitor crop growth and use resources effectively. The use of organic pesticides and crop rotation can also help make the farm more sustainable. Smart farms may also sell their products directly to consumers to minimize value loss along the supply chain. Smart farms are therefore one of the central elements of the sustainability and information society, where the use of resources and the development of technologies are increasingly geared towards sustainability and efficiency. Through the use of technologies such as sensors and data analytics, smart farms can help reduce the impact of agriculture on the environment while improving farm productivity and profitability. They are therefore an important part of the sustainability and information society and can help address the challenges of agriculture in a rapidly changing world [Br22] [2].

Using sensors and other technologies to monitor crop growth can help use resources more efficiently and optimize crop production. For example, sensors can be used to measure humidity, temperature, and soil moisture. This information can then be used to manage irrigation and fertilization of crops to ensure they have optimal growing conditions. Other technologies that can be used in agriculture include drones and satellite imagery, which can be used to monitor crop growth from the air and detect pests and diseases at an early stage. The use of artificial intelligence and machine learning can also help improve crop production by enabling the analysis of large amounts of data and helping farmers make better decisions [Br22] [2].

The use of organic pesticides and crop rotation is a more sustainable alternative to synthetic pesticides and can help make the farm more sustainable. Organic pesticides are substances derived from natural resources that are typically less harmful to humans and the environment than synthetic pesticides. They can be made from plant oils, herbal extracts or strains of bacteria, for example, and act against pests by attacking their natural defenses or inhibiting their reproduction. Crop rotation is a farming system in which different types of crops are grown in a fixed rotation to protect and improve the soil and reduce pest infestation. Crop rotation fertilizes the soil and returns important nutrients that are absorbed by plants. In this way, crop rotation can help reduce dependence on synthetic fertilizers and pesticides and make the farm more sustainable [Ke20] [10].

Yes, another feature of smart farms can be that they sell their produce directly to consumers to minimize value loss along the supply chain. This can help farmers make more profit while providing consumers with fresh, high-quality food. Direct marketing can be done in many ways, such as selling at markets, in grocery stores, or through online platforms. There are also different models of direct marketing, such as seasonal subscriptions for fruits and vegetables, Community Supported Agriculture (CSA), where consumers pay for produce in advance in exchange for regular food deliveries, or marketing produce through cooperatives. Direct marketing can also help strengthen the relationship between farmers and consumers and create transparency about the origin and production of food. There are also opportunities to combine direct marketing with other forms of marketing, such as selling food to wholesalers or the food service industry [Br22] [2].

Therefore, smart farms can offer many opportunities that can be covered in computer science classes. Some examples are given in [Gü20] [5]:

1. Use drones to monitor and control agricultural areas: Drones can be used to monitor crop growth, irrigation, pest detection, and other tasks.
2. Using sensors to monitor environmental conditions: Sensors can be used to monitor soil moisture, humidity, temperature, and other important factors to make agriculture more efficient and sustainable.
3. Using data analytics and machine learning to predict crop outcomes: By analyzing large amounts of agricultural data, machine learning models can be developed to predict future crop results.
4. Using apps and web platforms to manage farming: Farmers can use dedicated apps and web platforms to manage their operations, from ordering seeds to selling crops.

From what has been said about smart farms, students of all grades can name interactions between IT systems and their

social embedding [BFFKPRS08], through the following competencies that can be acquired:

Students of all grades:

1. Understand the basic concepts of automation and process control in agriculture.
2. Reflect on the impact of digitalization on society and the environment.
3. Understand the transformation of information into machine-processable data using selected examples.
4. Understand the use of sensors and other technologies to monitor and control agricultural processes.
5. Use the programming of applications and systems to control intelligent farms.

It is therefore important that students also understand the interactions between IT systems and their social embedding in order to be able to assess the impact of Smart Farms on society and the environment.

3.6 Knowledge Transfer to Students on the Subject of Smart Farms

Smart farming technologies can be a great way to teach students in computer science classes and give them the opportunity to apply their skills in real-world applications. Here are some ideas for how smart farming technologies can be used in computer science education:

1. Programming Sensors and Other Technologies: Students can learn how to program and integrate sensors to measure environmental factors such as temperature, humidity, and light intensity. They can also learn how to use the collected data to optimize plant growth. This was covered in the project above.
2. Data analysis and visualization: Students can learn how to analyze and visualize large amounts of data to identify patterns and trends and optimize growing strategies.
3. Developing apps or other tools: Students can learn how to develop apps or other tools to help farmers plan and organize their work. They can also learn how to integrate sensors and other technologies into such tools.
4. Integrate smart farming technologies: Students can learn how to integrate smart farming technologies into existing farming practices and use them to improve farm productivity and efficiency.

Therefore, there are several ways to inform students about smart farms in computer science classes [Gü20] [5]:

1. One possibility is to offer lectures on smart farms, in which the basics of smart farms are explained and students learn how they work and how to use them.
2. Another possibility is to offer internships in which the students can visit smart farms themselves and familiarize themselves with how they work.
3. Another option is to let the students work on projects related to smart farms. For example, she could design a smart farm or analyze how they could be deployed in a specific region.
4. There are also many online resources related to smart farms that students can use for self-study. This includes websites, blogs, videos and podcasts.
5. Another option is to invite subject matter experts from the industry to share their knowledge and experience with the student.

4. Discussion

It turns out that computer science education is important because it gives students the skills to use technology safely and effectively and prepares them for the demands of modern work. Therefore, computer science education should consider the societal aspects of technology by addressing ethical issues related to the use of technology, such as data protection, privacy and sustainability.

The cross-cutting task of information technology education refers to the teaching of knowledge and basic skills in the use of information technologies and their application in various areas of everyday life and work. An example of this is the transfer of knowledge in the field of automation and digital control of agricultural operations in the Smart Farm. Students will learn how to use sensors and actuators to collect data and automatically control irrigation, lighting, fertilization, and pesticide application to improve performance and decision-making.

The results also showed that it is important for computer science education to focus not only on the technology itself, but also on its impact on society and the environment. This can be achieved by incorporating issues such as sustainability, where students learn to use technology responsibly and consider the impact of their work on society and the environment.

Therefore, Smart Farming can actually be a good example to impart knowledge to students in computer science classes and give them the opportunity to apply and deepen their knowledge and skills in computer science and agriculture. By imparting knowledge about the interactions between IT systems and social integration, students can better assess and understand the impact of Smart Farms on society and the environment. Smart farming technologies also allow for more efficient use of resources and increased productivity.

5. References

1. [BFFKPRS08] Brinda T, Fothe M, Friedrich S, Koerber B, Puhlmann H, Röhner G, *et al*. Grundsätze und Standards für die Informatik in der Schule-Bildungsstandards Informatik für die Sekundarstufe I, 2008.
2. [Br22] Brandstetter P. Smart Farming/eingereicht von Philipp Brandstetter, 2022.
3. [Co04] Coy W: Was ist Informatik. für die Gesellschaft, 2004.
4. [GS20] Gleißner LK, Sefraoui H. Keine Allgemeinbildung ohne Informatik? In Seminar: Infromatik und Gesellschaft. MLU-Halle-Wittenberg, 2020. URL: https://blogs. urz. uni-halle. de/informatikundgesellschaft/files/2020/09/Gleissner_und_Sefraoui. pdf
5. [Gü20] Güldenpfennig J. Landwirtschaft 4.0 im Informatikunterricht–eine Schüler-und Kontextorientierte Unterrichtseinheit zum Thema Informatik und Ökologie Digital farming in computer science education, 2020.
6. [HNR07] Hartmann W, Näf M, Reichert R. Informatikunterricht planen und durchführen. Springer-Verlag, 2007.
7. [Ho21] Hoch C. 3 Bildung für nachhaltige Entwicklung: Historischer Überblick und politische

Rahmung. UFZ Discussion Papers, 15, 2021.
8. [Hu07] Hubwieser P. Didaktik der Informatik: Grundlagen, Konzepte, Beispiele. Springer-Verlag, 2007.
9. [Iv06] Ivanišin M. Nachhaltige Entwicklung. Regionalentwicklung im Spannungsfeld von Nachhaltigkeit und Identität, 2006, 155-173.
10. [Ke20] Kellermann K. Ökologischer Landbau. In Die Zukunft der Landwirtschaft. Springer Spektrum, Wiesbaden, 2020, 125-170.
11. [Lü17] Lübberstedt N: Wie Umwelt und Gesellschaft von nachhaltiger Informationstechnologie profitieren. In CSR und Digitalisierung. Springer Gabler, Berlin, Heidelberg, 2017, 329-345.
12. [Ma20] Marquardt K: Grundlagen von nachhaltigen und verantwortungsvollen Geschäften. In Nachhaltigkeit und Digitalisierung. Springer Gabler, Wiesbaden, 2020, 15-50.
13. [O' O'17] O'Grady MJ, O'Hare GM: Modelling the smart farm. Information processing in agriculture. 2017; 4(3):179-187.
14. [Pe20] Petrenko I: Smartphones und Smart Home-Systeme als Gegenstände eines umweltorientierten Informatikunterrichtes. In Mobil mit Informatik: 9. Münsteraner Workshop zur Schulinformatik. BoD-Books on Demand, 2020, 111.
15. [PH20] Paaß G, Hecker D: KI und ihre Chancen, Herausforderungen und Risiken. In Künstliche Intelligenz. Springer Vieweg, Wiesbaden, 2020, 375-444.
16. [Sc13] Schinzel B: Schnittstellen: Zum Verhältnis von Informatik und Gesellschaft. Springer-Verlag, 2013.
17. [SMDKBMK21] Swacha J, Maskeliūnas R, Damaševičius R, Kulikajevas A, Blažauskas T, Muszyńska K, *et al*. Introducing sustainable development topics into computer science education: Design and evaluation of the eco jsity game. Sustainability. 2021; 13(8):p4244.
18. [SR13] Schirmer I, Rick D. Nachhaltiger Entscheidungen. HDI 2012-Informatik für eine nachhaltige Zukunft: 5. Fachtagung Hochschuldidaktik der Informatik; 06.–07. November 2012, Universität Hamburg. 2013; 5:160.
19. [BFFKPRS08] Brinda T, Fothe M, Friedrich S, Koerber B, Puhlmann H, Röhner G, *et al*. Grundsätze und Standards für die Informatik in der Schule-Bildungsstandards Informatik für die Sekundarstufe I, 2008.