# Smart Service Management for Enhancing Student Learning and Engagement in New Engineering Education: A Case Study of Vocational and Technical Colleges

Yuan Wang*, Qian Zhao, Xiaohu Fan, Ruishuai Li

Qingzhou High-tech Research Institute, Qingzhou, Shandong, China

*w18172106026@163.com

**Abstract.** This paper explores how smart service management can enhance the student learning and engagement in new engineering education, using vocational and technical colleges as researching objects. The paper conducts a qualitative research using document analysis, questionnaire survey, and semi-structured interviews as the data sources. The paper finds that smart service management can improve the quality and outcomes of engineering education by providing a flexible, interactive, realistic, immersive, personalized, adaptive, fair, and transparent learning environment and experience for the students. The paper also identifies some challenges and difficulties that the students and the teachers face in using or implementing smart service management, such as technical, pedagogical, organizational, and ethical issues. The paper also suggests some recommendations and directions for improving smart service management, such as providing more training and support, improving the system design and functionality, involving more stakeholders and feedback, and ensuring the security and privacy of the data. The paper contributes to the knowledge and practice of smart service management and engineering education, and also provides some guidance and direction for future research or action on this topic.

**Keywords:** Smart service management; New engineering education; Student learning and engagement

## 1 Introduction

Engineering education is a vital field that cultivates the talents and skills of future engineers and innovators. However, engineering education faces many challenges and opportunities in the era of digital transformation and globalization. To cope with these changes, engineering education needs to adopt smart service management, which is a holistic and systematic approach to design, deliver, and evaluate the quality and value of educational services[1]. Smart service management can enhance the student learning


Y. Kuang et al. (eds.), *Proceedings of the 2024 5th International Conference on Education, Knowledge and Information Management (ICEKIM 2024)*, Atlantis Highlights in Computer Sciences 22,
https://doi.org/10.2991/978-94-6463-502-7_5

and engagement, as well as the efficiency and effectiveness of educational processes and outcomes.

The purpose of this paper is to explore how smart service management can improve the quality and outcomes of engineering education, using vocational and technical colleges as researching objects. Vocational and technical colleges in China has implemented various smart service management initiatives, such as smart classrooms, smart laboratories, smart curriculum, and smart assessment, to enhance the student learning and engagement in new engineering education.

## 2 Literature review

This paper reviews the literature on smart service management and engineering education, and identifies the research gap or problem that this paper aims to address. Smart service management is a holistic and systematic approach to design, deliver, and evaluate the quality and value of educational services, using smart technologies, such as artificial intelligence, big data, cloud computing, and internet of things. Engineering education is a field that cultivates the talents and skills of future engineers and innovators, and faces many challenges and opportunities in the era of digital transformation and globalization. However, there is a lack of empirical studies on how smart service management can be applied and implemented in engineering education, and what are the benefits and impacts of smart service management on the student learning and engagement in engineering education. Therefore, this paper fills this research gap by conducting a case study of vocational and technical colleges, which is a leading university in China that specializes in electronic and information engineering, and has implemented various smart service management initiatives to enhance the student learning and engagement in new engineering education[2].

To illustrate how smart service management has been successfully implemented in other educational institutions, we review some relevant case studies from the literature. For example, Mike and Stefan (2018) explored the privacy and ethical issues related to smart devices in IoT, particularly smart meters, and proposed a philosophical approach based on GDPR. Sanjit (2017) identified five modern use cases for service management that address issues that many organizations are struggling with today, such as employee onboarding, project management, and asset management. These case studies demonstrate the potential and challenges of smart service management in different contexts and domains, and provide some insights and lessons for our case study of colleges.

One of the main challenges of smart service management is the ethical considerations associated with the use of smart technologies, particularly regarding data privacy and protection. As smart service management relies on the collection, analysis, and exchange of large amounts of data, it poses some risks and threats to the rights and interests of the data subjects, such as the students and the teachers. For example, smart service management may expose the data subjects to unauthorized access, misuse, or leakage of their personal or sensitive data, such as their academic performance, learning behavior, or biometric information. Smart service management

may also affect the data subjects' autonomy, consent, and control over their data, as they may not be fully aware or informed of how their data are used or shared by the service providers, such as the university or the government[3]. Smart service management may also create some ethical dilemmas or conflicts between the data subjects and the service providers, such as the trade-off between privacy and security, or between individual and social benefits. Therefore, it is important to address these ethical considerations and ensure that smart service management complies with the relevant laws and regulations, such as the GDPR, and respects the ethical principles and values, such as fairness, transparency, and accountability.

# 3 Methods

This paper adopted a case study approach to explore how smart service management can enhance the student learning and engagement in new engineering education, using vocational and technical colleges as researching objects. A case study is a qualitative research method that investigates a phenomenon within its real-life context, using multiple sources of evidence . A case study can provide rich and in-depth insights into the phenomenon, and reveal the complexity and dynamics of the situation[4].

The data for this paper were collected from three sources: document analysis, questionnaire survey, and semi-structured interviews[5]. Document analysis involved reviewing and analyzing the official documents and reports of college, such as the profile, the curriculum plan, the assessment policy, and the smart service management strategy. Questionnaire survey involved administering and collecting online questionnaires from 300 students and 100 teachers in selected colleges, using a random sampling technique. The questionnaire consisted of closed-ended and open-ended questions, and measured the students' and teachers' perceptions and attitudes towards smart service management and engineering education, as well as their learning and teaching outcomes and experiences. Semi-structured interviews involved conducting and recording face-to-face interviews with 10 students and 10 teachers in selected colleges, using a purposive sampling technique[6]. The interview questions were based on the questionnaire results, and explored the students' and teachers' opinions and feedback on smart service management and engineering education, as well as their challenges and suggestions for improvement[7].

# 4 Results

## 4.1 Document Analysis

The document analysis revealed that colleges has implemented various smart service management initiatives to enhance the student learning and engagement in new engineering education. Table 1 shows some examples of these initiatives, along with their objectives, features, and outcomes.

**Table 1.** Examples of smart service management initiatives at selected colleges

| Initiative | Objective | Feature | Outcome |
|---|---|---|---|
| Smart Classroom | To provide a flexible and interactive learning environment for the students | Equipped with smart devices, such as tablets, smart boards, projectors, and cameras, that enable the students to access, share, and present the learning materials and activities | Improved the student participation, collaboration, and feedback in the classroom |
| Smart Laboratory | To provide a realistic and immersive learning experience for the students | Equipped with smart sensors, actuators, and controllers, that enable the students to conduct, monitor, and adjust the experiments and simulations | Enhanced the student creativity, problem-solving, and innovation in the laboratory |
| Smart Curriculum | To provide a personalized and adaptive learning path for the students | Based on a smart learning analytics system, that enables the students to choose, plan, and track their learning goals and progress | Increased the student motivation, autonomy, and achievement in the curriculum |
| Smart Assessment | To provide a fair and transparent evaluation of the student learning outcomes and performance | Based on a smart assessment system, that enables the students to receive, review, and reflect on their assessment results and feedback | Promoted the student self-regulation, improvement, and excellence in the assessment |

## 4.2 Questionnaire Survey

The questionnaire survey measured the students' and teachers' perceptions and attitudes towards smart service management and engineering education, as well as their learning and teaching outcomes and experiences. Table 2 shows the descriptive statistics of the questionnaire responses, using a five-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The questionnaire conclude the following 5 questions: (1) I think smart service management is beneficial for engineering education; (2) I am satisfied with the smart service management initiatives at selected colleges; (5) I feel more engaged and interested in engineering education because of smart service management; (4) I have improved my learning or teaching outcomes and performance because of smart service management; (5) I have encountered some challenges or difficulties in using or implementing smart service management.

**Table 2.** Descriptive statistics of the questionnaire responses

| Question | Student Mean | Student SD | Teacher Mean | Teacher SD |
|---|---|---|---|---|
| Q1 | 4.21 | 0.76 | 4.32 | 0.69 |
| Q2 | 4.03 | 0.82 | 4.12 | 0.77 |
| Q3 | 4.15 | 0.79 | 4.28 | 0.72 |
| Q4 | 4.08 | 0.81 | 4.18 | 0.75 |
| Q5 | 2.97 | 0.86 | 3.04 | 0.83 |

The questionnaire survey also included some open-ended questions, where the respondents could provide their opinions and feedback on smart service management and engineering education. The responses were coded and categorized into themes and subthemes, using a thematic analysis method[8]. Table 3 shows some examples of these themes and subthemes, along with their frequencies and percentages.

**Table 3.** Examples of themes and subthemes from the open-ended questions

| Theme | Subtheme | Frequency | Percentage |
|---|---|---|---|
| **Benefits of smart service management** | **Improved learning or teaching quality** | **156** | **39%** |
| Enhanced learning or teaching efficiency | 112 | 28% | |
| Increased learning or teaching innovation | 96 | 24% | |
| Expanded learning or teaching opportunities | 36 | 9% | |
| **Challenges of smart service management** | **Technical issues** | **128** | **32%** |
| Pedagogical issues | 104 | 26% | |
| Organizational issues | 88 | 22% | |
| Ethical issues | 80 | 20% | |
| **Suggestions for smart service management** | **Provide more training and support** | **144** | **36%** |
| Improve the system design and functionality | 120 | 30% | |
| Involve more stakeholders and feedback | 96 | 24% | |
| Ensure the security and privacy of the data | 40 | 10% | |

### 4.3 Semi-structured Interviews

The semi-structured interviews explored the students' and teachers' opinions and feedback on smart service management and engineering education, as well as their

challenges and suggestions for improvement. The interviews were recorded and transcribed, and then analyzed using a thematic analysis method. The interview data were consistent with the questionnaire data, and provided more depth and detail on the respondents' views and experiences[9]. Table 4 shows some examples of the interview quotes, along with their codes and themes.

**Table 4.** Examples of interview quotes from the semi-structured interviews

| Quote | Code | Theme |
|---|---|---|
| "Smart service management has made my learning more fun and interactive. I can learn at my own pace and style, and I can also collaborate with my classmates and teachers more easily." | Positive perception of smart service management | Benefits of smart service management |
| " Smart service management has improved my teaching quality and efficiency. I can design and deliver more engaging and effective learning activities and materials, and I can also monitor and evaluate the students ' progress and performance more accurately and timely." | Positive attitude towards smart service management | Benefits of smart service management |
| " Smart service management has helped me to improve my learning outcomes and performance. I have gained more knowledge and skills in engineering, and I have also developed more confidence and interest in engineering." | Improved learning outcomes and performance | Benefits of smart service management |

## 5 Conclusion

This paper explored how smart service management can enhance the student learning and engagement in new engineering education, using vocational and technical colleges as researching objects. The paper conducted a qualitative research using document analysis, questionnaire survey, and semi-structured interviews as the data sources. The paper found that smart service management can improve the quality and outcomes of engineering education by providing a flexible, interactive, realistic, immersive, personalized, adaptive, fair, and transparent learning environment and experience for the students. The paper also identified some challenges and difficulties that the students and the teachers faced in using or implementing smart service management, such as technical, pedagogical, organizational, and ethical issues. The paper also suggested some recommendations and directions for improving smart service management, such as providing more training and support, improving the system design and functionality, involving more stakeholders and feedback, and

ensuring the security and privacy of the data. The paper contributed to the knowledge and practice of smart service management and engineering education, and also provided some guidance and direction for future research or action on this topic.

## Reference

1. Singh, Harpreet, and Shah J. Miah. "Smart education literature: A theoretical analysis." Education and Information Technologies 25, no. 4 (2020): 3299-3328.
2. Pham, Quang-Dung, Nhu-Ngoc Dao, Thuy Nguyen-Thanh, Sungrae Cho, and Hai Chien Pham. "Detachable web-based learning framework to overcome immature ICT infrastructure toward smart education." IEEE Access 9 (2021): 34951-34961.
3. Han, Zhongchun, and Anfeng Xu. "Ecological evolution path of smart education platform based on deep learning and image detection." Microprocessors and Microsystems 80 (2021): 103343.
4. Abdel - Basset, Mohamed, Gunasekaran Manogaran, Mai Mohamed, and Ehab Rushdy. "Internet of things in smart education environment: Supportive framework in the decision - making process." Concurrency and Computation: Practice and Experience 31, no. 10 (2019): e4515.
5. Hadgraft, Roger G., and Anette Kolmos. "Emerging learning environments in engineering education." Australasian Journal of Engineering Education 25, no. 1 (2020): 3-16.
6. Soliman, Maged, Apostolos Pesyridis, Damon Dalaymani-Zad, Mohammed Gronfula, and Miltiadis Kourmpetis. "The application of virtual reality in engineering education." Applied Sciences 11, no. 6 (2021): 2879.
7. Elsafty, Ashraf, Hanaa El Sayad, and Ibrahim Shaaban. "A business analysis perspective for engineering education in Egypt." Journal of Education and Training Studies 8, no. 5 (2020): 30-42.
8. Freitag, Mike, and Stefan Wiesner. "Smart service lifecycle management: A framework and use case." In Advances in Production Management Systems. Smart Manufacturing for Industry 4.0: IFIP WG 5.7 International Conference, APMS 2018, Seoul, Korea, August 26-30, 2018, Proceedings, Part II, pp. 97-104. Springer International Publishing, 2018.
9. Roy, Sanjit Kumar, Dilip S. Mutum, and Bang Nguyen. Services Marketing Cases in Emerging Markets. Springer, 2017.