Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Development Of Digital-Based Work Group Management Using Artificial Intelligence Education Copilot

Abdul Aman[1]*, Erni Suharini[1], Muhammad Khafid[1], Teguh Supriyanto[1]
[1]*Semarang State University, Jl. Kelud Utara III, Petompon, Gajahmungkur District, Semarang City, Central Java 50237, Indonesia*

ARTICLE INFO

Received: 30 Dec 2024

Revised: 19 Feb 2025

Accepted: 27 Feb 2025

ABSTRACT

As artificial intelligence (AI) advances, the education sector has entered a new era of more personalized and intelligent learning, offering the potential to transform the way we approach managing the learning process and developing competencies. In particular, significant challenges arise in managing effective coaching processes, where traditional methods often fail to meet the rapidly evolving needs. Therefore, developing a digital-based coaching management system powered by AI is crucial to creating a more efficient, responsive, and data-driven learning experience. This research aims to develop and introduce a digital education coaching management system, named "AI Education Copilot," which uses AI technology to support a more structured and automated approach to educational coaching management. The methodology employed in this study is the development of a web-based platform that integrates comprehensive learning data and natural language processing technology to assess the abilities and progress of learners at various stages. The research follows the 4D model, consisting of the Define, Design, Develop, and Disseminate stages. The field trials involved 85 participants, and data were analyzed using descriptive statistics, index analysis, and paired sample T-tests. The results of the Education Copilot management system development are evident from the analysis of planning, organizing, actuating, and controlling processes. The findings show high effectiveness, with planning, organizing, actuating each receiving 88% (high), and controlling each receiving 92% (high). The feasibility test revealed an effectiveness rate of 90%, efficiency at 89.2%, attractiveness at 94.3%, and satisfaction at 91.4%. Pedagogical competence showed a significant improvement, increasing from an average of 60.21 to 75.20. Based on these results, this study concludes that the Education Copilot is highly effective in improving group work management and provides a viable solution for enhancing educational practices.

Keywords: artificial intelligence, development, digital education, education copilot, group work management (gwm).

INTRODUCTION

With the rapid advancement of technology, particularly artificial intelligence (AI), the education sector has entered a new era characterized by more personalized learning, transforming how we manage the learning process and develop competencies. In this context, managing work groups in education plays a crucial role, especially in enhancing collaboration among students in completing tasks together. However, effective workgroup management has been a significant challenge, as traditional methods often fail to keep up with the rapidly evolving educational needs. The development of a digital-based workgroup management system powered by AI has become an essential solution to improve efficiency, responsiveness, and data-driven learning experiences. This research aims to develop and introduce the "AI Education Copilot," a digital workgroup management system that uses AI to optimize group work in education.

Digital-based education management systems have been introduced in recent years, but most of these systems are still limited to basic functions such as managing academic data and evaluating performance. The existing systems generally fail to provide a personalized learning experience and comprehensive data analysis. This gap highlights the need for more advanced applications of technology in education, particularly in workgroup management, which involves deeper data analysis. Therefore, it is crucial to develop a digital education platform powered by AI that not only manages student data but also provides personalized feedback and supports pedagogical development in a more structured and automated manner.

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

This study addresses this gap by developing a digital-based workgroup management system called "AI Education Copilot." The system integrates comprehensive learning data with natural language processing technology to assess students' abilities and progress at various stages. It is designed to categorize content by difficulty and provide AI-driven, personalized feedback tailored to each student's needs. Thus, this research proposes a more efficient, responsive, and data-driven approach to managing educational workgroups.

One of the main challenges in managing workgroups in education is how to optimize collaboration among students with diverse backgrounds and abilities. Inefficient management can lead to differences in the quality of group outcomes, reduced interaction among group members, and diminished learning effectiveness. Furthermore, traditional methods that rely on face-to-face interactions and manual monitoring often fail to provide quick and accurate responses to changing learning needs. Therefore, the development of a system that can monitor, analyze, and provide automatic, data-driven feedback is crucial for enhancing the effectiveness of the learning process.

Previous research has extensively explored the use of AI in education, but most studies have focused on its application in individual learning or academic data analysis. Some studies have also attempted to develop AI-based learning systems to support personalized teaching and learning. However, there is limited research addressing the use of AI-driven digital platforms for comprehensive workgroup management. Existing studies tend to focus on individual learning and competency development, while the management of workgroups involving interactions between students and instructors has often been overlooked. This indicates a significant research gap in the development of technology that can effectively manage, monitor, and provide feedback for educational workgroups.

The urgency of this research is evident given the rapid advancement of technology and the growing need for more structured and efficient learning experiences. With the increasing demand for technology-based learning and the integration of AI, the development of an advanced digital management system has become an urgent requirement. Especially in the face of massive changes in how education is delivered, with online learning and remote collaboration becoming more prevalent, an AI-powered system like the "AI Education Copilot" can provide a timely solution to these challenges.

The continuation of this research is crucial as it can change the way we approach workgroup management in education. The novelty of this study lies in the development of a digital workgroup management system powered by AI, which not only analyzes data but also provides personalized and detailed feedback for each learner. Furthermore, this platform can improve the quality of group learning by offering more precise monitoring of student interactions and each member's ability to contribute to completing the group task. This is a significant step in developing a learning system that is more adaptive and data-driven.

The impact of this research is substantial, not only for managing educational workgroups but also for enhancing overall learning quality. By leveraging AI to manage workgroups, the system can provide a more efficient, responsive, and individualized learning experience. This can lead to improved learning outcomes, reduce disparities in the quality of group work, and support more structured competency development. Additionally, this research could contribute significantly to the creation of new methods for teaching that are more data-driven, accelerating pedagogical development, and preparing students to face future challenges in an increasingly digital and interconnected world.

METHODS

This study adopts a Research and Development (R&D) approach utilizing Thiagarajan's 4D model, which consists of four stages: Define, Design, Develop, and Disseminate. Data analysis is conducted using descriptive statistics, including index analysis and paired sample T-tests. The management model is based on POAC (Planning, Organizing, Actuating, Controlling). The effectiveness of this model is assessed by measuring improvements in both pedagogic and professional competencies [22]. The design of the POAC model used in this study is illustrated in Figure 1.

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

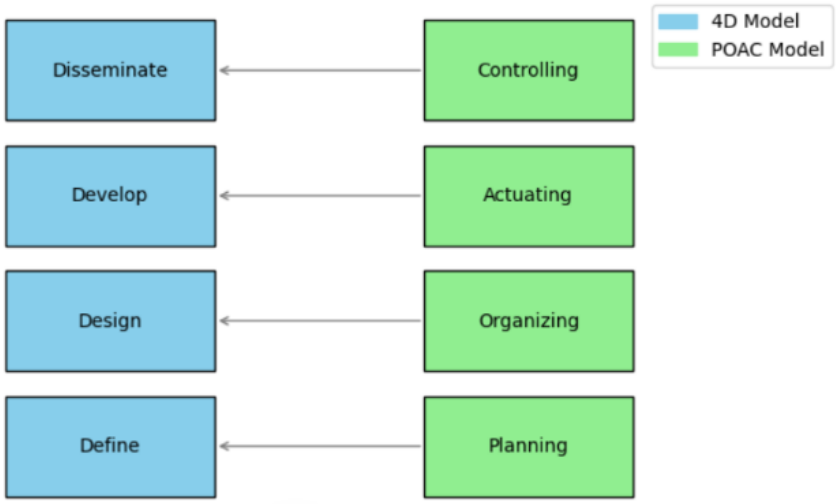

Figure 1. 4D and POAC Model

The development of the Digital-Based Work Group Management system using Artificial Intelligence Education Copilot can be carried out systematically and efficiently by integrating two main models: the 4D model (Define, Design, Develop, Disseminate) and the POAC model (Planning, Organizing, Actuating, Controlling). Below are the stages explained with the integration of both models:

1. Define-Planning: In the Define stage of the 4D model, the main focus is to identify the needs and goals of the digital-based work group management system. This includes conducting user needs analysis, gathering input from potential users such as teachers, and setting specific goals to be achieved, such as improving group work efficiency and task management. In this stage, the Planning phase of the POAC model is applied to formulate a comprehensive project plan. This plan includes creating a timeline, budget, and determining the necessary resources for system development, as well as identifying risks and developing required mitigation strategies.
2. Design-Organizing: In the Design stage, the development team designs the system architecture and user interface, making sure it is intuitive and user-friendly, while also determining how the AI Education Copilot will be integrated to support various features such as performance analysis and automated feedback. At the same time, the Organizing phase of the POAC model is applied to define the development team responsible for the project, and organize the resources and tools needed to implement the system design. This stage also includes defining the roles and responsibilities of each team member, ensuring efficient organization for system development according to the plan. See figure 2.

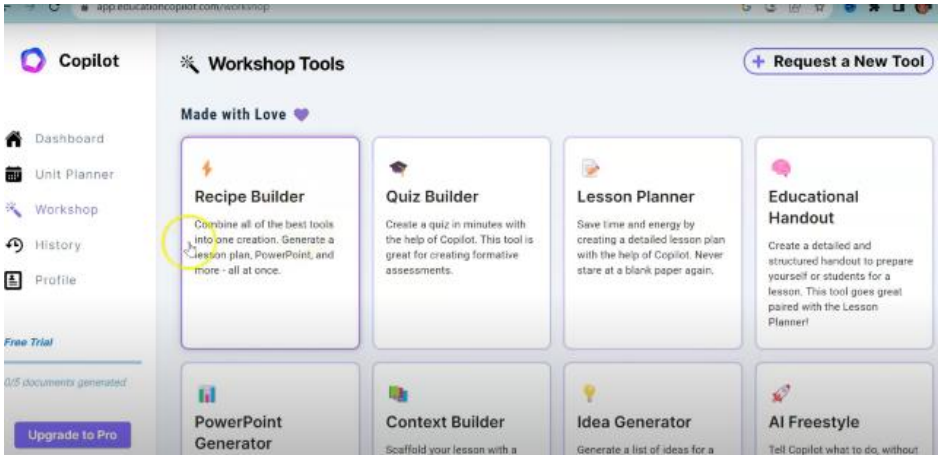

Figure 2. Education copilot platform for work group management.

3. Develop-Actuating: Once the design is finalized, the Develop stage begins, where the system is built according to the pre-established plan. This development includes creating software using the appropriate programming language and integrating AI algorithms for data analysis and recommendations. During this stage, the Actuating phase of the POAC model comes into play, which focuses on executing the development plan. The team begins

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

working according to the set timeline, motivating all members to complete tasks on time and achieve the established goals. Additionally, unit and integration testing is conducted to ensure the system functions correctly. See figure 3.

```
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;

@SpringBootApplication
public class EducationCopilotApplication {

    public static void main(String[] args) {
        SpringApplication.run(EducationCopilotApplication.class, args);
    }

    @RestController
    class HomeController {
        @GetMapping("/")
        public String home() {
            return "Selamat datang di Education Copilot";
```

Figure 3. Programming language education copilot platform

Disseminate-Controlling: The final stage in the 4D model is Disseminate, which focuses on launching the system to users and ensuring they can access and use it effectively. In this stage, user training is conducted to help them understand how to use the system optimally. At the same time, the Controlling phase of the POAC model is applied to monitor and control the project's implementation, ensuring the system is being deployed as planned. User feedback is collected for further improvements, and periodic evaluations are carried out to ensure the system meets the users' needs. If necessary, adjustments to the system will be made based on the feedback and evaluations received.

RESULTS AND DISCUSSION

In this section, the results of the development and implementation of the AI-based workgroup management system, "AI Education Copilot," will be discussed in detail. This study aims to assess the effectiveness of the system in enhancing collaboration among students and optimizing the group learning process. The results obtained from trials and evaluations of the system's usage show significant improvements in the quality of group work, interaction among members, and a deeper understanding of the material [23]. Below are the results of the analysis of the Development of Digital-Based Work Group Management using Artificial Intelligence Education Copilot presented in the form of Table 1:

Tabel 1. Program Standards Development

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	2,75	Chance (O)	2,80
Weakness (W)	2,60	Threat (T)	5,00
TOTAL SW	0,15	TOTAL OT	-2,20

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

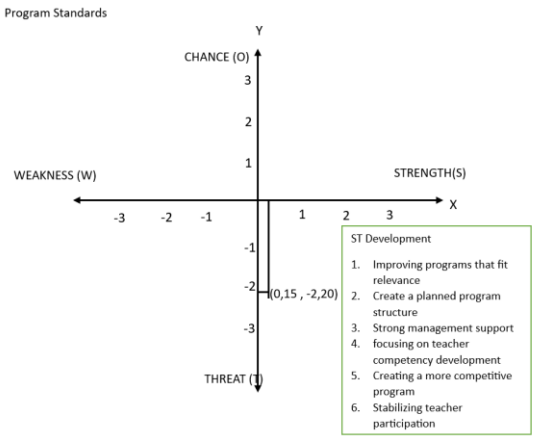

Figure 4. Program Development Strategy

The Cartesian diagram shows that the Program Standard is in quadrant IV or ST (0.15; -2.20), which means that the GWM has greater power to develop the program but has external threats that need to be circumvented so that the strategy applied is ST. Strategies 1) improve programs that suit the needs of teachers, 2) create a planned program structure 3) strong management support 4) focus on developing teacher competencies 5) make programs more competitive 6) stabilize the role and participation of teachers participating in the GWM.

Table 2. Development of Organizational Standards

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	2,75	Chance (O)	2,75
Weakness (W)	3,50	Threat (T)	1,78
TOTAL SW	-0,75	TOTAL OT	0,97

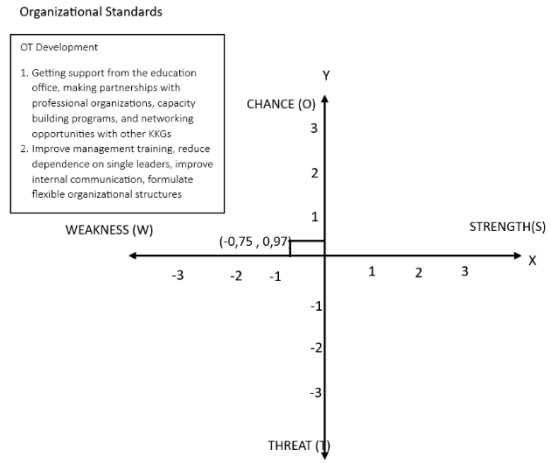

Figure 5. Organizational Development Strate

The cartesius diagram shows that the organizational standard is in quadrant III or OW (-0.75; -2.20), which means that the GWM has a greater opportunity to develop the organization but has internal weaknesses that need to be overcome, so the strategy applied is OW. Strategies: 1) get support from the education office, 2) create partnerships with professional organizations, 3) have capacity building programs, 4) have networking opportunities with other GWMs, 5) improve training for GWM administrators, 6) reduce dependence on single leaders, 6) formulate a flexible organizational structure.

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Table 3. Development of Organizational Standards

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	2,50	Chance (O)	2,25
Weakness (W)	1,75	Threat (T)	1,75
TOTAL SW	0,75	TOTAL OT	0,50

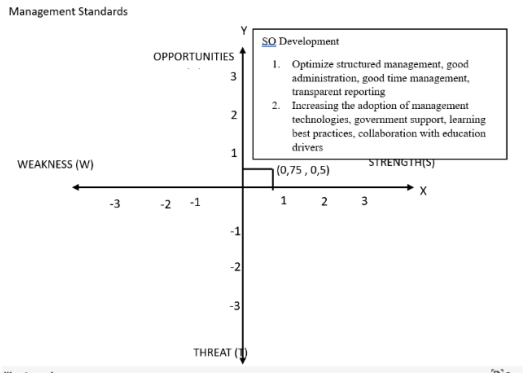

Figure 6. Management Development Strategy

The cartesius diagram shows that the management standard is in quadrant I or SO (0.75; 0.50), which means that the GWM has greater power to develop management and has great opportunities, so the strategy applied is SO. Strategies: 1) optimizing structured management, 2) good administration, 3) time management, 4) transparent reporting, 5) implementing management technology, 6) learning about best practices, 7) support from the government, 8) cooperation with the community, and education practitioners.

Table 4. Development of Sarpras Standards

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	3,00	Chance (O)	3,25
Weakness (W)	1,75	Threat (T)	1,89
TOTAL SW	1,25	TOTAL OT	1,36

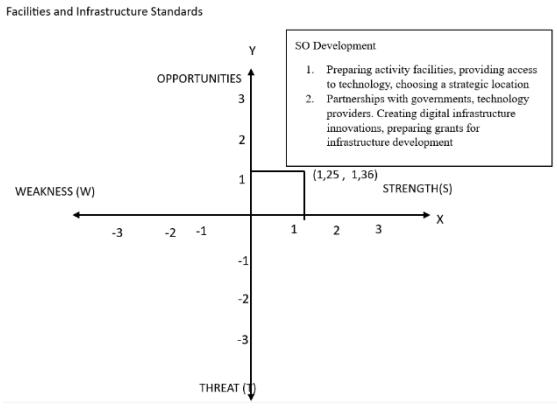

Figure 7. Facilities and Infrastructure Development Strategy

The cartesius diagram shows that the standard of facilities and infrastructure is in quadrant I or SO (1.25; 1.36), which means that the GWM has greater power to develop facilities and infrastructure and has a great opportunity to develop facilities and infrastructure, so the strategy applied is SO. Strategies 1) prepare activity facilities, provide access to technology, and have a strategic location 2) partnership with the government to provide technology, create digital facilities with the hope of grant funds for infrastructure development.

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Table 5. Development of HR Standards

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	3,25	Chance (O)	3,25
Weakness (W)	2,00	Threat (T)	2,00
TOTAL SW	1,25	TOTAL OT	1,25

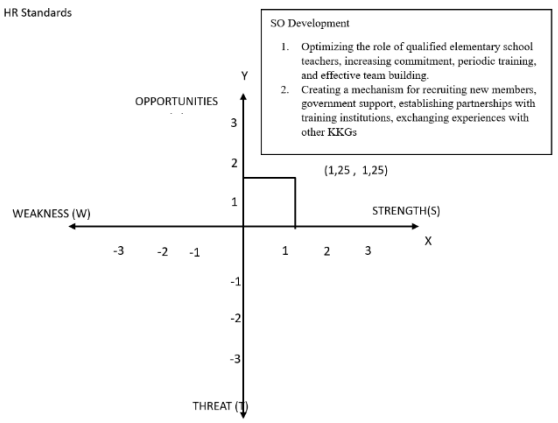

Figure 8. HR Development Strategy

The cartesius diagram shows that the HR standard is in quadrant I or SO (1.25; 1.25), which means that the GWM has greater strength and opportunities to develop human resources, so the strategy applied is SO. 1) optimizing the presence of elementary school teachers with diverse educational qualifications. Increasing teachers' commitment to participating in the GWM, carrying out periodic training, effective team formation 2) creating a mechanism for recruiting bru members, government support, establishing partnerships with training institutions, exchanging experiences with other GWM.

Table 6. Development of Financing Standards

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	3,25	Chance (O)	3,25
Weakness (W)	2,00	Threat (T)	2,00
TOTAL SW	1,25	TOTAL OT	1,25

Financing Standards

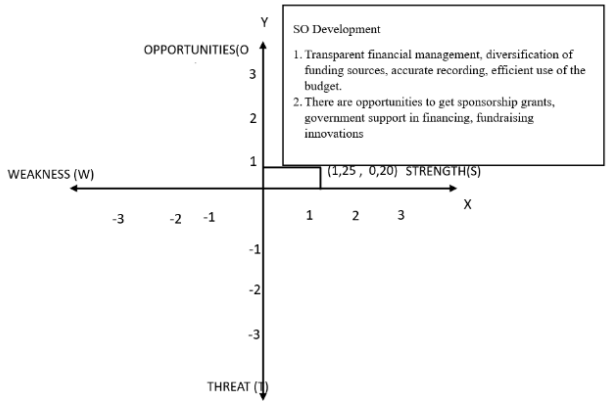

Figure 9. Financing Development Strategy

The cartesius diagram shows that the financing standard is in quadrant I or SO (1.25; 0.20), which means that the GWM has greater strength and opportunities to develop financing, so the strategy applied is SO. 1) Transparent financial management, accurate recording, efficient use of the budget 2) the opportunity to get sponsorship grants, government support in fundraising, fundraising innovations.

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Table 7. Quality Assurance Development

IFAS		EFAS	
Category	Subtotal	Category	Subtotal
Power (S)	3,55	Chance (O)	3,22
Weakness (W)	1,75	Threat (T)	1,75
TOTAL SW	1,80	TOTAL OT	1,47

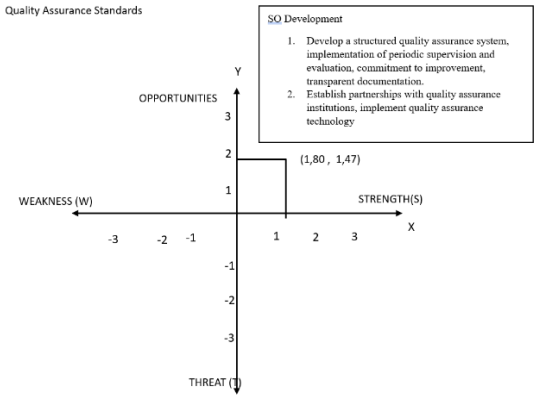

Figure 10. Quality Assurance Development Strategy

The cartesius diagram shows that the quality assurance standard in quadrant I or SO (1.80; 1.47), which means that the GWM has greater strength and opportunity to develop quality assurance, so the strategy applied is SO. 1) Develop a structured quality assurance system, implement periodic supervision and evaluation, commitment to improvement 2) establish partnerships with quality assurance institutions and implement quality assurance technology.

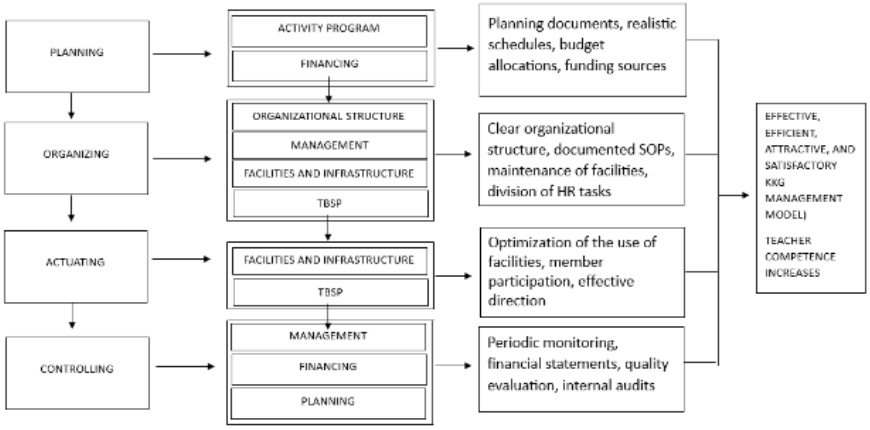

Figure 11. GWM Management Model

GWM management starts from *planning*. Planning activities plan activity programs, namely making planning documents, arranging activity schedules. The financing aspect in planning makes budget allocations and determines financing sources. The *organizing stage* includes organizational structure, management, infrastructure and human resources. In determining the organizational structure, teacher representatives are involved in deliberating in determining the GWM management [24]. Documenting SOPs is important for the organizing stage. The determination and maintenance of infrastructure facilities to support the sustainability of the GWM is also important to be prepared. After determining who actors are involved in the GWM, the management determines the division of tasks according to their respective authorities and obligations, including optimizing the potential of teachers.

Actuataing in terms of optimizing the use of facilities and infrastructure that have been prepared. Which room will be used, what equipment is needed. Inviting teachers as GWM participants is also a very important stage. Target teachers who will be invited as a form of implementing GWM to get materials for scheduled activities. *Controlling* in

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Journal of Information Systems Engineering and Management
2025, 10(33s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

this GWM activity is carried out periodically by the team that has been formed. In addition to carrying out monitoring, this team also carried out internal audits and examined financial statements. The controlling stage also plays an important role in maintaining the quality of the GWM, namely quality evaluation.

The observation of the final model applied in the main field test showed an increase in several sub-indicators that were previously still low [25]. The involvement of members with the aspect of observing on-time attendance can be seen that there are still GWM participants who arrive late, around 8 teachers out of 85 teachers who were invited. The next indicator in the aspect of observation of discussions that focus on methods and strategies shows that many participants still seem to be inactive, some even speak outside the context of learning. Regarding the willingness to reflect, the participants seemed to be still reluctant to reflect.

Table 8. Analysis of Observation Result

No	Indicators	Sum	Percentage	Category
1	Planning	22	88%	Tall
2	Organizing	22	88%	Tall
3	Implementation	22	88%	Tall
4	Supervision	23	92%	Tall

The feasibility of the model is tested from instruments that have been prepared by researchers who have been validated by experts. The instrument contains categories of model feasibility consisting of effectiveness, efficiency, attractiveness, and satisfaction. Each indicator has 3 observation aspects [26]. Expert validators consist of 4 internal experts and 4 external experts. From the eight validators, data was obtained to be analyzed and concluded about the feasibility of the model.

Table 9. Management Model Feasibility Test Instrumen

No	Indicators	Observation Aspect	Scale				
			1	2	3	4	5
1	Effectiveness	Are the main goals of the GWM achieved according to plan? Is the material presented in the GWM activities relevant to the needs of the teachers? How often are the results of GWM discussions or training applied in daily learning?					
2	Efficiency	How efficient is the time allocation for each activity? Is the budget allocated for GWM activities used properly and on target? Are resources (facilities, teaching materials, resource persons) used optimally in GWM activities?					
3	Attraction	Does the number of teachers participating in the GWM continue to increase? Are GWM activities varied and interesting for the participants, for example in the form of discussions, workshops, or seminars? Are the invited speakers able to attract the attention of the participants and deliver the material well?					
4	Satisfaction	Are the teachers who participated in the GWM satisfied with the material and the implementation of the activities? Do participants feel comfortable with the physical (place) and social (community) environment during the activity? Are GWM activities in accordance with the expectations of participants in terms of material and benefits?					

Table 10. Model Due Diligence Analysis

No	Indicators	External Validators				Internal Validators				Average
		Expert 1	Expert 2	Expert 3	Expert 4	Expert 1	Expert 2	Expert 3	Expert 4	
1	Effectiveness	93,3	86,7	100	80	86,7	93,3	86,7	93,3	90,0
2	Efficiency	86,7	80	93,3	93,3	80	93,3	93,3	93,3	89,2
3	Attraction	100	100	93,3	93,3	93,3	93,3	93,3	93,3	94,3
4	Satisfaction	86,7	80	93,3	93,3	93,3	93,3	100	86,7	91,4

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Research Article

It can be seen from the feasibility test that the GWM management model in elementary schools in terms of average effectiveness is 90% in the high effectiveness category, in terms of efficiency of 89.2% in the high efficiency category, in terms of high category attractiveness of 91.4 or occupying the highest percentage of other indicators, in terms of participant satisfaction is also in the high category of 91.4%. Pedagogic competence increased to an average of 75.20 which was previously an average of 60.21. Professional competence increased from 64.52 to 80.94. The t-test showed a considerable difference between the pretest and the post test of 6,792.

CONCLUSIONS

This study demonstrates that the integration of artificial intelligence (AI) into education, specifically through the development of the "AI Education Copilot" system, offers a promising solution to the challenges of managing group work and coaching processes in educational settings. The research highlights the significant role that AI can play in creating more personalized, data-driven, and efficient learning experiences. The development of the AI Education Copilot, a digital-based platform that combines comprehensive learning data and natural language processing technology, represents a breakthrough in automating and structuring coaching management. By assessing students' abilities and progress at various stages, the system is able to provide tailored feedback, monitor group dynamics, and foster a more collaborative and effective learning environment.

The methodology applied in this study, based on the 4D model (Define, Design, Develop, Disseminate), facilitated a systematic and thorough approach to developing the platform. Field trials with 85 participants and the use of statistical methods, including descriptive analysis, index analysis, and paired sample T-tests, produced compelling results. The findings indicate that the AI Education Copilot significantly improves the effectiveness of workgroup management processes, with high ratings for planning (88%), organizing (88%), actuating (88%), and controlling (92%). Additionally, the feasibility of the system was highly rated, with effectiveness at 90%, efficiency at 89.2%, attractiveness at 94.3%, and user satisfaction at 91.4%. Most notably, pedagogical competence saw a substantial increase, from an average of 60.21 to 75.20, demonstrating the positive impact of the system on educational outcomes.

These results confirm that the AI Education Copilot system not only enhances the management of group work but also contributes to improving the quality of education overall. By providing real-time insights, personalized feedback, and automated support for group tasks, the system addresses critical challenges in traditional educational models. The high levels of effectiveness and user satisfaction suggest that the AI Education Copilot is a valuable tool for modernizing educational practices, promoting more efficient teaching methods, and supporting student-centered learning. Given its proven success in field trials, this system represents a viable solution for advancing educational coaching management and could be a significant step toward transforming how we approach group work and competency development in education.

ACKNOWLEDGEMENT

This research was not funded by any grant.

REFRENCES

[1] H. Wang et al., “Artificial Intelligence–Powered Training Database for Clinical Thinking: App Development Study,” JMIR Form. Res., vol. 9, pp. 1–11, 2025, doi: 10.2196/58426.
[2] Y. Xue and Y. Wang, “Artificial Intelligence for Education and Teaching,” Wirel. Commun. Mob. Comput., vol. 2022, 2022, doi: 10.1155/2022/4750018.
[3] Y. J. Lee, R. O. Davis, and J. Ryu, “Korean in-Service Teachers’ Perceptions of Implementing Artificial Intelligence (AI) Education for Teaching in Schools and Their AI Teacher Training Programs,” Int. J. Inf. Educ. Technol., vol. 14, no. 2, pp. 214–219, 2024, doi: 10.18178/ijiet.2024.14.2.2042.
[4] H. Fakhar, M. Lamrabet, N. Echantoufi, K. El Khattabi, and L. Ajana, “Towards a New Artificial Intelligence-based Framework for Teachers’ Online Continuous Professional Development Programs: Systematic Review,” Int. J. Adv. Comput. Sci. Appl., vol. 15, no. 4, pp. 480–493, 2024, doi: 10.14569/IJACSA.2024.0150450.
[5] M. S. Alwazzan, “European Journal of Educational Research,” Eur. J. Educ. Res., vol. 14, no. 1, pp. 249–265, 2024, [Online]. Available:

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Research Article

https://scholar.archive.org/work/fxr3w63xnzgx3hpxvzuotnab44/access/wayback/https://pdf.eu-jer.com/EU-JER_13_2_573.pdf

[6] Fahrurrozi, Hasanah, U., Dewi, R. S., & Ratnaningsih, S. (2020). Effectiveness of Digital Teaching Materials Based on Google Classroom to Improve Digital Literacy Competencies during the COVID-19 Pandemic Period. Proceedings - 2020 6th International Conference on Education and Technology, ICET 2020. https://doi.org/10.1109/ICET51153.2020.9276590

[7] Rudasill, K. M., McGinnis, C., Cheng, S. L., Cormier, D. R., & Koziol, N. (2023). White privilege and teacher perceptions of teacher-child relationship quality. Journal of School Psychology, 98. https://doi.org/10.1016/j.jsp.2023.04.002

[8] Burte, H., Gardony, A. L., Hutton, A., & Taylor, H. A. (2020). Elementary teachers' attitudes and beliefs about spatial thinking and mathematics. Cognitive Research: Principles and Implications, 5(1). https://doi.org/10.1186/s41235-020-00221-w

[9] Simonović, N. (2021). Teachers' Key Competencies for Innovative Teaching. International Journal of Cognitive Research in Science, Engineering and Education, 9(3). https://doi.org/10.23947/2334-8496-2021-9-3-331-345

[10] Bulkani, Fatchurahman, M., Adella, H., & Andi Setiawan, M. (2022). Development of animation learning media based on local wisdom to improve student learning outcomes in elementary schools. International Journal of Instruction, 15(1). https://doi.org/10.29333/iji.2022.1514a

[11] de Carvalho, J. S., Oliveira, S., Roberto, M. S., Gonçalves, C., Bárbara, J. M., de Castro, A. F., Pereira, R., Franco, M., Cadima, J., Leal, T., Lemos, M. S., & Marques-Pinto, A. (2021). Effects of a Mindfulness-Based Intervention for Teachers: a Study on Teacher and Student Outcomes. Mindfulness, 12(7). https://doi.org/10.1007/s12671-021-01635-3

[12] Silva, J. B., Silva, I. N., & Bilessimo, S. (2020). Technological structure for technology integration in the classroom, inspired by the maker culture. Journal of Information Technology Education: Research, 19. https://doi.org/10.28945/4532

[13] Edwar, Putri, R. I. I., Zulkardi, & Darmowijoyo. (2020). MGMP optimization in developing teacher professionalism in developing HOTS problems based on RME approach. Journal of Physics: Conference Series, 1657(1). https://doi.org/10.1088/1742-6596/1657/1/012022

[14] Nurtanto, M., Pardjono, P., Widarto, W., & Ramdani, S. D. (2020). The effect of STEM-EDP in professional learning on automotive engineering competence in vocational high school. Journal for the Education of Gifted Young Scientists, 8(2). https://doi.org/10.17478/JEGYS.645047

[15] Abdurrahman, Parmin, & Muryanto, S. (2022). Evaluation on the automotive skill competency test through 'discontinuity' model and the competency test management of vocational education school in Central Java, Indonesia. Heliyon, 8(2). https://doi.org/10.1016/j.heliyon.2022.e08872

[16] Kim, J. S., Relyea, J. E., Burkhauser, M. A., Scherer, E., & Rich, P. (2021). Improving Elementary Grade Students' Science and Social Studies Vocabulary Knowledge Depth, Reading Comprehension, and Argumentative Writing: a Conceptual Replication. Educational Psychology Review, 33(4). https://doi.org/10.1007/s10648-021-09609-6

[17] Lukman, Marsigit, Istiyono, E., Kartowagiran, B., Retnawati, H., Kistoro, H. C. A., & Putranta, H. (2021). Effective teachers' personality in strengthening character education. International Journal of Evaluation and Research in Education, 10(2). https://doi.org/10.11591/ijere.v10i2.21629

[18] Davis, J. N., Pérez, A., Asigbee, F. M., Landry, M. J., Vandyousefi, S., Ghaddar, R., Hoover, A., Jeans, M., Nikah, K., Fischer, B., Pont, S. J., Richards, D., Hoelscher, D. M., & Van Den Berg, A. E. (2021). School-based gardening, cooking and nutrition intervention increased vegetable intake but did not reduce BMI: Texas sprouts - a cluster randomized controlled trial. International Journal of Behavioral Nutrition and Physical Activity, 18(1). https://doi.org/10.1186/s12966-021-01087-x

[19] Lee, L. H. J., & Tan, S. C. (2020). Teacher learning in Lesson Study: Affordances, disturbances, contradictions, and implications. Teaching and Teacher Education, 89. https://doi.org/10.1016/j.tate.2019.102986

[20] Seleznyov, S., Goei, S. L., & Ehren, M. (2024). International policy borrowing and the case of Japanese Lesson Study: culture and its impact on implementation and adaptation. Professional Development in Education, 50(1). https://doi.org/10.1080/19415257.2021.1973069

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Research Article

[21] Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. Computers and Education, 147. https://doi.org/10.1016/j.compedu.2019.103778

[22] Yang, X., König, J., & Kaiser, G. (2021). Growth of professional noticing of mathematics teachers: a comparative study of Chinese teachers noticing with different teaching experiences. ZDM - Mathematics Education, 53(1). https://doi.org/10.1007/s11858-020-01217-y

[23] Heintz, S., & Ruch, W. (2020). Character Strengths and Job Satisfaction: Differential Relationships Across Occupational Groups and Adulthood. Applied Research in Quality of Life, 15(2). https://doi.org/10.1007/s11482-018-9691-3

[24] Román-Graván, P., Hervás-Gómez, C., Martín-Padilla, A. H., & Fernández-Márquez, E. (2020). Perceptions about the use of educational robotics in the initial training of future teachers: A study on STEAM sustainability among female teachers. Sustainability (Switzerland), 12(10). https://doi.org/10.3390/su12104154

[25] Hutchison, A. (2019). Technological efficiency in the learning management system: A wicked problem with sustainability for online writing instruction. *Computers and Composition*, *54*, 102510.

[26] Mashroofa, M. M., Haleem, A., Nawaz, N., & Saldeen, M. A. (2023). E-learning adoption for sustainable higher education. *Heliyon*, *9*(6).

Copyright © 2024 by Author/s and Licensed by JISEM. This is an open access article distributed under the Creative Commons Attribution License which permitsunrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.