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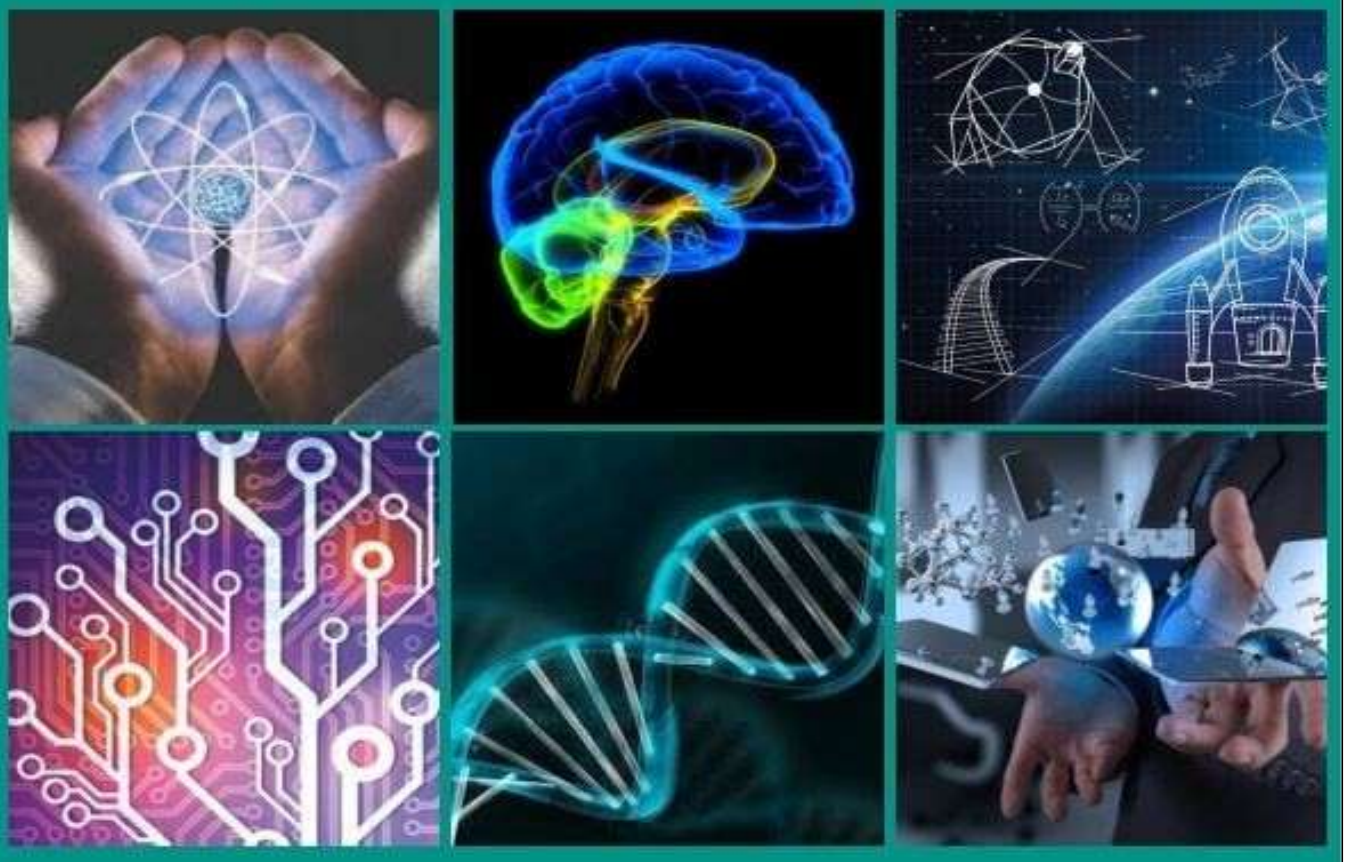

By Universitas Muhammadiyah Sidoarjo

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Self-Paced Moodle Learning Advances Teachers Digital Competence Levels: Pembelajaran Mandiri Moodle Meningkatkan Tingkat Kompetensi Digital Guru

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Abstract

General Background: Digital competence has become a fundamental requirement for effective pedagogy in technology-integrated education systems. **Specific Background:** At SMAN 1 Nagreg, teachers' use of digital tools remained limited, with most operating at the Newcomer and Explorer levels of the DigCompEdu framework and relying on conventional professional development approaches. **Knowledge Gap:** Empirical action research on self-paced e-learning models for secondary school teachers in resource-constrained settings remains limited, particularly regarding structured and iterative interventions. **Aims:** This study evaluates a Moodle-based self-paced e-learning program designed using the ADDIE framework within Classroom Action Research to improve teachers' digital competencies across six DigCompEdu domains. **Results:** Findings indicate a transition from A1/A2 levels to the Integrator (B1) level, with notable progress in legal digital resource curation and interactive digital assessment practices. Teachers reported a 79.05% positive response rate, emphasizing flexibility as a key advantage, while time management remained a primary challenge. **Novelty:** The study demonstrates the integration of CAR and ADDIE within a self-paced Moodle environment as a structured intervention model for teacher professional development. **Implications:** Institutional support, including formal policy integration and protected learning time, is essential to sustain competency development and ensure broader adoption of self-paced digital training.

Highlights:

- Transition from beginner to integrator competency stages across all DigCompEdu domains
- Strong progression in ethical resource selection and data-driven evaluation practices
- Flexible access model widely appreciated despite workload-related participation barriers

Keywords: Digital Competency; DigCompEdu Framework; Moodle Learning Platform; Self-Paced Learning; Teacher Professional Development

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Introduction

The speedy evolution of the 21st-century educational landscape has transformed digital competence from a supplementary skill into a fundamental prerequisite for effective pedagogy. As global educational systems pivot toward a technology-integrated system, the ability to foster creativity, critical thinking, and collaboration within digital environments has become one of the benchmark for teaching excellence [1]. But the successful implementation of digital transformation in schools does not rely solely on the procurement of hardware or high-speed internet. It mostly depends on the readiness and continuous development of the teachers as the primary facilitators of learning [2].

This digital mandate is written in a regulatory framework of Indonesia, especially in Law Number 14 of 2005 about Teachers and Lecturers emphasizes that educators must have professional competencies, which include the professional use of educational technology [3]. This was further solidified by the Ministry of National Education Regulation Number 16 of 2007, which explicitly requires teachers to utilize information and communication technology (ICT) to enhance learning quality [4]. The Regulation of the Minister of Education and Culture Number 22 year 2016 adds that the standards of learning process are integrated with the use of digital technology as an effort to improve pedagogical efficiency and effectiveness [5]. While there are top-down mandates for teachers to use technology, at the school level, a large gulf remains between national systemic expectations and what teacher's digital capacity actually are.

The current situations at SMA Negeri 1 Nagreg in Bandung Regency serve as a stark reminder of the need for a methodical approach to teacher development. Based on the analysis of the Rapor Pendidikan (Education Report Card) for 2024 and 2025, there was a concerning stagnation in learning quality in this school. The indicator for "Learning Quality" (D.1) experienced a decline from 61.4 in 2024 to 60.0 in 2025 which is linked to the sub-indicator "Learning Methods" (D.1.3). This has been identified as a critical root cause for the school's suboptimal educational services. The result of these stagnant pedagogical methods can be seen in student outcomes, where as students achieving minimum literacy competence dropped significantly from 88.89% in 2024 to 75.56% in 2025, marking a wide 13.33-point drop [6].

From an interview with the school principal, there is a 25% gap in the utilization of tehcnology by the teachers. The principal said that "only approximately 25% of the teaching staff regularly incorporate digital tools into their classrooms, and even within this minority, usage is largely limited to simple, non-interactive presentations". He added that this happens because most of the teacher remains within a "manual comfort zone". This zone exist due to lack of sustainable internal training systems [2]. All the previous effort at the professional development for teacher usually relied on incidental workshops or traditional face-to-face sessions. These often fails to address the individual needs and tight schedules of the teachers [7]

Another fact that arises from this situation is a notable research gap in the field of teacher professional development. E-learning has been widely used in higher education and corporate training. But there is a lack of empirical action research that focus on the implementation of e-learning based self-paced learning models.

Especially for the secondary school teachers in a resource-constrained environments. Most research only measuring what teachers know without a structured or iterative intervention. This iterative intervention will provide evidence of how teachers can improve through digital means. Teachers as adult learners also benefits from this model, because self-paced models are theorized to reduce transactional distance by allowing teachers to control their learning rythim and repetition. This is important, because teachers need to balance their heavy daily workloads [8][9].

This study suggests an iterative intervention using a Moodle-based self-paced e-learning platform to improve the situation. Moodle is an open-source Learning Management System (LMS) that provides a versatile environment for managing instructional content, interactive forums, and automated evaluations.This is an ideal tool for fostering teacher autonomy [10]. ADDIE (Analysis, Design, Development, Implementation, and Evaluation) is used as an instructional design model within a Classroom Action Research (CAR) framework, this study tries to bridge the gap between theoretical policy and classroom practice.

The main objective of this research is to evaluate how a Moodle-based self-paced program improves teacher digital competencies with the six domains of the European Framework for the Digital Competence of Educators (DigCompEdu) as the main indicators. These domains include Professional Engagement, Digital Resources, Teaching and Learning, Assessment, Empowering Learners, and Facilitating Learners' Digital Competence [1]. Pre- and post-intervention data is used to provide evidence-based insights into the effectiveness of self-paced digital training as a viable strategy for human resource development in Indonesian high schools.

Method

This study utilizes a qualitative approach using the principles of the iterative cycles of Classroom Action Research (CAR) with the structured instructional framework of the ADDIE model. The research follows the model developed by Kemmis and McTaggart (1988), which consists of four fundamental stages: Planning, Acting, Observing, and Reflecting [11]. This cycle is merged with the ADDIE model to ensure a systematic development of the e-learning intervention.

The "Planning" phase of the CAR cycle integrates the Analysis and Design stages of ADDIE. In this stage, the researcher looks for any competence gaps and structured a learning plan. The “Acting” phase contain the Development of learning modules for Moodle and the start of Implementation stage (announcement of the program to the teacher). In the “Observing” phase, every progress the teacher made during the program was monitored, including their difficulties and Moodle digital logs. Lastly, the “Reflecting” phase is done as a part of Evaluation stage. This is the stage where the effectiveness of the intervention is evaluated to determine future cycles. All this integration was done to make sure that the platform isn’t just a fixed product, but a tool that can be adapted and improved based on teachers feedback and performance.

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Two main theoritical fameworck is used to evaluate this intervention: the DigCompEdu framework and Kirkpatrick's Evaluation Model. The DigCompEdu Framework: Developed by Redecker (2017), the European Framework for the Digital Competence of Educators (DigCompEdu) provides a comprehensive map of 22 individual competences organized into six domains:

1. Professional Engagement: Using digital technologies for communication and professional collaboration.
2. Digital Resources: Identifying, creating, and sharing digital learning assets.
3. Teaching and Learning: Managing and orchestrating digital teaching interventions.
4. Assessment: Utilizing digital tools to enhance formative and summative evaluation.
5. Empowering Learners: Using digital tools to foster student inclusion and personalization.
6. Facilitating Learners' Digital Competence: Enabling students to use technology creatively and responsibly.

To measure the impact of the self-paced training, the study employs the first two levels of Kirkpatrick's model [12]. Level 1 (Reaction) measures the teachers' perceptions of the Moodle platform's usability, flexibility, and relevance. Level 2 (Learning) evaluates the teachers' actual growth in knowledge and abilities, particularly whether they improved to higher DigCompEdu competency levels.

The study was carried out at Bandung Regency's SMAN 1 Nagreg with 88% of the 73 teachers on the school's faculty are government-certified (ASN/PPPK), comprising 36 government employees with work agreements (PPPK) and 28 civil servants (PNS). All teachers have a minimum of a Bachelor's degree as a baseline of academic readiness for professional development [13]. The study utilized purposive sampling to select eight primary informants (Informants 1-8). Purposive sampling, according to Creswell (2018), enables the researcher to choose participants who are "information-rich" about the main topic [14]. To capture a range of experiences, the informants were divided into three groups: (1) those who finished all modules, (2) those who only partially participated, and (3) those who did not use the platform. This allowed for a comprehensive understanding of the incentives and obstacles related to self-paced e-learning.

Both qualitative artifacts and descriptive quantitative measurements were used in the multifaceted data collection process:

1. Moodle Activity Logs: The system's Activity Completion Reports and Log Statistics offered unbiased information on the frequency of teacher logins, the materials they accessed, and the duration of their involvement.
2. In-depth Interviews: Semi-structured interviews were carried out both before and after the intervention to record the reflecting experience and to set a baseline. This made it possible to investigate "affective filters" such as anxiety or confidence, that quantitative tools could overlook [14].
3. Questionnaires: After the intervention, a 4-point Likert scale questionnaire was given out with the omittance of the neutral "middle" choice. To give a quantifiable overview of the program's

reception, it comprised of 30 elements divided into 15 items for Reaction and 15 items for Learning.

4. Document Study: Secondary data included the school's Rapor Pendidikan, annual work plans (RKT), and student learning artifacts produced by the teachers during the training.

Qualitative data were analyzed using the model proposed by Miles and Huberman (1994), which involves data reduction (filtering relevant interview segments), data display (using matrices and charts), and conclusion drawing/verification [15]. Triangulation was done to ensure the credibility and validity of the findings. The method used was comparing interview transcripts with Moodle digital logs and questionnaire result. This is the triangulation of sources and method. Furthermore, the interview summaries was returned to the participants for member checking. This is to make sure that the interpretations made was accurately reflect the teachers' experiences, perspectives, and feedbacks. All this step was done as a way to ascertain that the result were empirically grounded.

Result And Discussion

A. Baseline (Pre-Intervention) Competencies

The initial assessment of digital competencies at SMAN 1 Nagreg revealed a significant gap between the school's infrastructure and the teachers' pedagogical application. Based on the DigCompEdu framework, the majority of teachers were situated at the Newcomer (A1) or Explorer (A2) levels [1].

Table 1. *Pre-Intervention Interview Analysis on Teachers' Digital Competence*

No	DigCompEdu Domain	Key Findings
1	Professional Engagement	Teachers generally use digital tools for basic professional communication (e.g., messaging applications), but digital platforms for professional collaboration and knowledge sharing are still rarely utilized.
2	Digital Resources	Teachers frequently search for online learning materials but face challenges in evaluating the credibility of sources and developing interactive digital learning media.
3	Teaching and Learning	The integration of digital technology in classroom practice is still inconsistent and often limited by technical issues and varying levels of digital skills.
4	Assessment	Some teachers have used digital assessment tools, but difficulties remain in developing digital question banks and interpreting assessment data.
5	Empowering Learners	Digital technology is occasionally used to increase student engagement, yet strategies for personalized and differentiated learning through digital tools remain limited.
6	Facilitating Learners' Digital Competence	Teachers acknowledge the importance of students' digital competence, but systematic approaches to support digital literacy and responsible technology use are still minimal.

Source: Research Findings (2025)

Analysis results of pre-intervention interviews finds unique deficiencies across all six domains. In Domain 1 (Professional Engagement), even though teachers frequently used WhatsApp for basic communication, digital collaboration remained informal and unstructured. The profound finding in Domain

2 (Digital Resources) was that the teacher relies on search and copy method to find teaching materials online. As Informant 3 admitted, "I often find materials on the internet but worry if they are credible or suitable... I usually just copy what looks close enough." This finding translates to the lack of evaluative skill from the teachers while searching for information online. Meaning, the teacher already experimented with digital tools, but still lacking critical and systematic approach [1].

A key qualitative data found during the baseline phase was that of high "affective barriers" among the teachers. According to Knowles' (1984) andragogy theory, this finding implies that psychological elements like anxiety and dread frequently impede adult learners [9]. Interviews also revealed that teachers were not just struggling with technical steps, but were paralyzed by a fear of "wrong clicks" or "system errors." Informant 1 noted, "I've joined training before, but the login process was so complicated it made me frustrated and afraid I'd click the wrong thing." Additionally, there was a great deal of confusion about the legality of digital content; many educators were unable to discern between legitimate government repositories and potentially dangerous or unreliable websites, creating a "manual comfort zone" that hindered innovation [2].

B. The Intervention: Self-Paced Moodle Design

To address these gaps, the researcher developed a structured e-learning environment on Moodle. The intervention was mapped into six thematic modules designed to move teachers toward the Integrator (B1) level:

1. Digital Ethics and Security: Focusing on safe communication and professional identity.

Legal Digital Resources: Teaching the use of Creative Commons and Open Educational Resources (OER).

2. Visual Learning Media: Basic production using tools like Canva.
3. AI in Education: Ethical use of prompting for lesson planning.
4. Interactive Media: Transforming static content into engaging student activities.
5. Digital Assessment: Using Google Forms and Moodle for automated evaluation.

A core design principle was the application of microlearning to mitigate the cognitive load issues identified in the baseline phase. According to Clark and Mayer (2020), breaking complex information into small, manageable "units" prevents learner burnout and increases retention [16]. As shown in Table 2, the Moodle course used a "Step-by-Step" navigation style, where materials were presented as short videos, concise infographics, and immediate formative quizzes. This design reduced "transactional distance" by providing a clear, low-friction pathway for teachers to follow at their own pace [8].

Table 2. *Instructional Design of Moodle Learning Modules and Activities*

Learning Module	Activity / Material	Moodle Activity Type
P1 – Digital Ethics & Security	What is Digital Literacy?	Page

P1	Four Pillars of Digital Literacy (CABE)	Lesson / Page
P1	Ethical or Unethical?	Forum
P1	Teachers' Digital Ethics	Page
P1	Practical Guidelines for Digital Ethics	Resource
P1	Ethical Challenges Discussion	Forum
P1	Digital Security & Data Protection	Lesson
P1	Digital Behavior Evaluation	Quiz
P1	Case Study & Final Evaluation	Quiz / Assignment
P2 – Legal Digital Resources	What is Copyright?	Lesson
P2	Creative Commons (CC)	Page / URL
P2	How to Search for Legal Digital Resources	Page
P2	Guidelines for Evaluating Digital Resources	Book
P2	Self-Tutorial for Legal Digital Media	Video
P2	Downloading Creative Commons Images (Task)	Assignment
P2	Case Study on Legal Resources	Forum
P3 – Visual Learning Media	Introduction to Canva	Page / Video
P3	Principles of Visual Design	Lesson
P3	Creating Visual Learning Media	Assignment
P4 – AI Utilization for Learning	How to Create Effective Prompts	Page
P4	Examples of AI Prompts	Page
P4	Ethics of Using AI	Forum
P4	AI Literacy Quiz	Quiz
P4	Applying AI Prompts (Task)	Assignment
P5 – Interactive Media with Canva AI	Introduction to Interactive Media	Page
P5	Canva AI for Interactive Media	Video / Page
P5	Steps for Creating Interactive Media	Page
P5	Examples of Canva AI Prompts	Page
P5	Prompts for Interactive Games	Page
P5	Creating Interactive Media	Assignment
P6 – Digital Assessment	Fundamentals of Digital Assessment	Page
P6	Tutorial for Creating Automatic Quizzes	URL / Video
P6	Developing Digital Assessment (Task)	Assignment
P6	Assessment Rubric Guidelines	Page

Source: Research Findings (2025)

C. Implementation Dynamics

The implementation phase provided a realistic look at how teachers interact with self-paced systems. A major finding was the "Login Barrier". Log data showed that many unique error types occurred during the first week. These were rarely due to system failure but rather to "technical friction": teachers using institutional NIPs as emails, capital letter sensitivity in passwords, and browser autofill issues.

This technical friction acts as a filter; those who fail at the login stage often experience a sharp drop in motivation. A "Dual-Modus" support system, which consists of quick in-person orientations and a reactive

WhatsApp support, was used by the study to lessen this. Once the login barrier was cleared, the flexibility of access became the program's greatest strength. While some teachers used 20-minute breaks in between teaching hours, others accessed modules around 11:00 PM following homework. This demonstrates the value of self-paced education for Indonesian schools' "time-poor" professional population [7].

D. Post-Intervention Competency Shift

The primary outcome of the research is the measurable shift in teacher proficiency levels. Table 3 details a holistic transition from A1/A2 to the Integrator (B1) level across all participants who completed the modules.

Table 3. *Comparison Matrix of Teachers' Digital Competence Before and After the Intervention*

Domain	Pre-Intervention Condition	Post-Intervention Condition	Competence Development
Professional Engagement	Teachers mainly used digital tools for basic communication (e.g., messaging applications). Professional collaboration and digital professional development were still informal and incidental.	Teachers showed increased confidence in using digital learning platforms such as Moodle and began engaging in self-directed digital professional development.	From A1–A2 (Newcomer–Explorer) to A2–B1 (Explorer–Early Integrator)
Digital Resources	Teachers experienced difficulties in selecting credible and legal digital learning resources and managing digital files effectively.	Teachers were able to identify legal digital resources (e.g., Creative Commons), understand copyright principles, and apply them in learning materials.	From A1–A2 (Newcomer–Explorer) to B1 (Integrator)
Teaching and Learning	Technology use in teaching was limited to simple presentations, and teachers lacked confidence in integrating digital media into classroom practice.	Teachers began integrating visual and interactive digital media into learning activities and showed readiness to apply digital tools in teaching.	From A1–A2 (Newcomer–Explorer) to B1 (Integrator)
Assessment	Digital assessment tools were rarely used. Teachers faced difficulties in creating digital quizzes and managing question banks.	Teachers were able to design simple digital assessments (e.g., automated quizzes) and recognized the benefits of immediate feedback for learning evaluation.	From A1 (Newcomer) to A2–B1 (Explorer–Early Integrator)
Empowering Learners	Digital technology was rarely used to support differentiated instruction or enhance student engagement.	Teachers began exploring digital media to design more engaging and varied learning activities for students.	From A2 (Explorer) to B1 (Integrator)
Facilitating Learners' Digital	Teachers rarely guided students systematically in digital literacy, digital ethics, or responsible technology use.	Teachers demonstrated increased awareness of digital ethics and began incorporating digital literacy and responsible	From A1–A2 (Newcomer–Explorer) to A2–B1 (Explorer–Early Integrator)

Competence		technology use into classroom discussions.	

Source: Research Findings (2025)

In Domain 2 (Digital Resources), the shift was most visible in the transition from "blind copy-pasting" to "legal curation." Teachers successfully completed tasks requiring them to find and attribute images using Creative Commons licenses. Informant 2 reflected, "Now I am more selective... I understand the ethics of taking someone else's work and how to find things that are actually legal to use."

In Domain 4 (Assessment), there was a move beyond simple paper-to-digital conversion. Teachers began utilizing the analytical features of digital tools. Informant 2 reported that using Quizizz and Google Forms allowed them to see "clusters" of student performance instantly. This indicates a shift to the B1 level, where digital tools are no longer just "add-ons" but are integrated into the pedagogical decision-making process [1].

E. Teacher Reactions

Quantitative data from the post-intervention questionnaire (Table 4) supported the qualitative findings, showing a 79.05% positive response rate. The aspect of Flexibility received the highest score (3.57/4.0), validating the self-paced approach. Teachers expressed high satisfaction with being able to "repeat lessons without embarrassment" and "control their learning speed."

Table 4. *Summary of Reaction-Level Questionnaire Results*

Aspect	Number of Items	Mean Score	Positive Response (%)
Positive aspects: flexibility, ease of use, and learning motivation	9	3.57	100%
Barriers: time constraints, workload, and technical issues	3	1.95	19.05%
Support: mentoring, institutional policy, and external motivation	3	3.07	76.19%
Overall reaction	**15**	**3.15**	**79.05%**

Source: Research Findings (2025)

However, the data also highlighted a persistent challenge: Time Management (scored at 1.95/4.0 on the scale of obstacles, indicating it was the most severe hurdle). Many teachers were unable or postpone their participation because they were busy preparing for the Final Semester Assessment or Sumatif Akhir Semester (SAS). This serves as a considerable workload burden for the teachers despite the flexibility of the learning framework. As informant 5 noted, "The timing was tough... I was busy with student grades and SAS preparation, so even though the link was there, I couldn't find the 'mental space' to start." This also means that the teacher still needs protected time from the institution for this framework to be effective, even though self-paced learning remove the physical constraint of location [2].

F. Discussion

The findings of this study provide a nuanced understanding of how digital transformation in education is as much a psychological and organizational challenge as it is a technical one. The transition of teachers at

SMAN 1 Nagreg from the "Explorer" (A2) to the "Integrator" (B1) level highlights several critical factors in the landscape of professional development.

The implementation of the Moodle platform demonstrated a significant shift from the traditional incidental workshop model. By utilizing a self-paced learning (SPL) approach, the program effectively reduced what Moore (2003) identifies as "transactional distance"—the cognitive and psychological gap that can occur in remote or digital learning environments [8]. Unlike one-day classical workshops, where information is often lost once the session ends, the Moodle environment allowed teachers to revisit complex materials such as AI prompting or Creative Commons licensing at their point of need. As seen in Table 5, Moodle activity logs confirmed this in practice: some teachers accessed modules as late as 10:00 PM after household duties, while others completed units during 20-minute intervals between teaching periods, or even as early as 04:00 AM in the morning. Access patterns like this would be structurally impossible within any fixed-schedule workshop format.

Table 5. *Moodle Activity Log*

Time	User full name	Affected user	Event context	Component	Description
27/11/25, 04:01:10	V****	-	User: V****	System	The user with id '24' has logged in.
27/11/25, 04:09:54	V****	-	Course: 01 - Pengenalan Literasi Digital - Etika dan Keamanan Digital	System	The user with id '24' viewed the profile for the user with id '24' in the course with id '6'.
26/11/25, 22:21:55	R****	-	Forum: Latihan Analisis Kasus	Forum	The user with id '93' viewed the 'forum' activity with course module id '69'
26/11/25, 22:22:15	R****	-	Course: 01 - Pengenalan Literasi Digital - Etika dan Keamanan Digital	System	The user with id '93' viewed the course with id '6'.

Source: Research Findings (2025)

This reduction in distance also places a heavier burden on the learner's self-efficacy. The results finds that the system's adaptability has two drawbacks, in which although it offers independence, navigating it demands a great level of personal drive and self-assurance. This aligns with the theory of andragogy, which suggests that adult learners thrive under autonomy but may struggle if their self-concept as a "competent learner" is threatened by unfamiliar technology [9]. Based on this findings, in order for self-paced models to be successful, the instructional design needs to be both clear and actively increase the learner's confidence through successful, low-stakes early encounters.

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A recurring theme in this research is that the actual technical difficulty of the tasks (e.g., creating a Google Form) was often secondary to the "affective filters" of the participants. As illustrated by Informant 1's fear of "making a mistake" and Informant 8's admission of feeling "left behind" due to being from a pre-digital generation, anxiety acts as a gatekeeper to competence. This statement is reinforced by the Moodle digital log data. Many unique error types were recorder during the start of implementation, but none of them comes from platform failures. The error types recorded mostly from user-side hesitation, such as entering the wrong credentials (institutional NIP instead of email), wrong passwords, or forgetting their credentials to login properly. These are all behavioral, not technical errors. They fit directly onto the physhological barriers indentified by Knowles (1984) as the primary obstacles for adult learners engagement [9].

Table 6. *Login Error Log*

No	Teacher Name (if detected)	Username/Email Used	Date and Time of Failed Login	Error Type	Description
1	Teacher I	i****	19/11/25, 17:06:03	Password mismatch (Error ID 3)	Two failed login attempts before successfully logging in
2	Unidentified (unregistered user)	m****d**@yahoo.com	21/11/25, 13:10:55	User not found (Error ID 1)	Email does not match the Moodle account
3	Unidentified (unregistered user)	Mel**********@gmail.com	21/11/25, 13:06:03	User not found (Error ID 1)	Account not recognized in the Moodle database
4	Unidentified (unregistered user)	Id********@guru.sma.belajar.id	26/11/25, 22:32:11	User not found (Error ID 1)	Incorrect email format or not yet registered
5	Unidentified (unregistered user)	h*******@gmail.com	26/11/25, 22:31:15	User not found (Error ID 1)	Username not registered
6	Unidentified (unregistered user)	id**********guru.sma.belajar.id (without @)	26/11/25, 22:29:11	User not found (Error ID 1)	Email format error (typo)
7	Unidentified (unregistered user)	t*********@guru.sma.belajar.id	27/11/25, 07:36:59	User not found (Error ID 1)	Email does not match LMS data
8	Unidentified (unregistered user)	19**********	27/11/25, 07:32:07	User not found (Error ID 1)	User entered employee identification number as username

9	Teacher C	c***	26/11/25, 19:19:07	Password mismatch (Error ID 3)	Three consecutive failed login attempts
10	Unidentified (unregistered user)	s**********@gmail.com	26/11/25, 18:47:09	User not found (Error ID 1)	Email does not match the Moodle account

Source: Research Findings (2025)

These psychological barriers suggest that digital competency is not a purely cognitive skill set. If a teacher is paralyzed by the fear of breaking the system or appearing incompetent in front of colleagues, the best-designed LMS will remain unused. The intervention's success in moving teachers to the B1 level was largely due to the "human-centered" support provided via WhatsApp and face-to-face orientations, which served to lower these affective filters and restore the teachers' "readiness to learn" [9] [2].

Perhaps the most pragmatic finding from this study involves the role of institutional "pushes." Interviews with Informants 5 and 6 revealed that while teachers value digital skills, they are often driven by extrinsic motivators. Informant 5 explicitly mentioned that "reward and punishment" are high-impact factors, while Informant 6 highlighted that a certificate signed by the School Principal would be a significant driver for completion: “A reward or recognition is necessary. It is very motivating. For example, at least there is visible support from leadership, such as a certificate from the school. That would also greatly increase our enthusiasm.”

This underscores the necessity of integrating e-learning into the school’s formal policy and performance appraisal systems. As Fullan (2016) argues, educational change fails when it is treated as a “sidebar” activity [17]. The survey support dimension scored 3.07 out of 4.0, with 76.19% of responses positive, directly reflecting teachers’ expectations for institutional reinforcement. The School Principal also provided explicit endorsement for issuing internal certificates to teachers who complete modules, a statement that provides an existing foundation for formalizing such recognition. Without converting these intentions into binding policy, teachers will inevitably prioritize immediate administrative demands over long-term competency development. This evidence leads to three specific actions. First, self-paced online courses ought to be included in the Kurikulum Operasional Satuan Pendidikan (KOSP) and Rencana Kerja Tahunan (RKT) as required professional development activities rather than optionals. Second, the school should designate two protected 90-minute sessions per month during school hours when teachers are released from administrative duties to complete modules. Third, an internal certification system tied to the Penilaian Kinerja Guru (PKG) should be established so that completing digital training modules carries the same formal weight as attending external workshops. Digital transformation must be positioned as an essential component of the school’s human resource development strategy rather than a voluntary elective [2].

Conclusion

This study concludes that a Moodle-based self-paced e-learning model is an effective intervention for enhancing teacher digital competencies in a secondary school setting. By applying the ADDIE framework

within an action research cycle, the program successfully transitioned the participating teachers from "Newcomer" and "Explorer" levels (A1/A2) to the "Integrator" (B1) level of the DigCompEdu framework. Teachers demonstrated improvements in critical areas, including the curation of legal digital resources, the production of interactive visual media, and the application of data-driven digital assessments. However, not every teacher has reached the same level of improvements that is caused by time constraints, readiness to learn, and the heavy administrative workload associated with the end-of-semester period, which prevented teachers from engaging in the deeper, more complex experimentation required for mastery.

To make sure that the sustainability of these gains, it is recommended that school management formalize digital professional development within the institutional framework. SMAN 1 Nagreg is advised to integrate self-paced e-learning into their Rencana Kerja Tahunan (RKT) and Kurikulum Operasional Satuan Pendidikan (KOSP). With this integration, teachers have a clear regulatory basis for protected learning time. Hopefully, this will allow teachers to develop their skills during work hours. Beside the regulation, the school is also advised to implement publicly internal certification system for module completion. This needs to be done to ensure that teachers' digital competency becomes a recognized professional component. The certificate also acts as a powerful extrinsic motiator. Beyond these practical implications, this study contributes to the literature on teacher digital competency development by demonstrating that a CAR-ADDIE integrated self-paced e-learning model is a viable school-based professional development strategy for secondary institutions operating under resource constraints. The findings also establish empirically that the primary barriers to teacher digital transformation are psychological and organizational in character rather than technical, a contribution that extends the existing literature dominated by infrastructure-focused explanations of digital adoption gaps.

This research shows that there is an immediate improvement in teachers' competency. However, further research is suggested to assess the long term retention of teachers' competencies. Future research needs to observe these digital practices for a longer time. This is needed to examine whether these digital practices persevere and whether they translate into measureable improvements in student learning outcomes. A more collaborative digital culture can also be observed by examining the effects of peer-mentorship model in the Moodle setting to provide more insights. This research also had a limited setting and participants (only one school), so a broader settings may also be an option for future research, such as observing multiple schools or covering schools in a wider area.

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