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# Development of the INDEEP-MOODLE Model: An Innovative Deep Learning–Integrated Training Framework to Enhance Teachers' Pedagogical Competence

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**Abstract:** This study aims to develop a MOODLE-based training model for innovative learning integrated with deep learning to enhance teachers' teaching abilities. This research employed the Borg and Gall research and development (R&D) model up to the expert validation stage. The participants consisted of five school principals and twenty teachers. Data were collected through interviews, open-ended and closed-ended questionnaires, and focus group discussions. Qualitative data were analyzed using the Miles and Huberman model, while quantitative data were analyzed using descriptive statistical techniques, including percentages, categories, and mean scores. During the Research and Information Collecting phase, the findings indicated that teachers' ability to implement innovative learning methods integrated with deep learning was categorized as sufficient, highlighting the need for further improvement. The developed training model is an online training program based on the MOODLE learning management system. The model consists of a visual representation and a detailed description outlining the concept of online training for innovative learning integrated with deep learning. Based on the validation conducted by four experts in content, technology, and instructional design, the conceptual model was rated very good, with an average score of 4.2. This result indicates that the model is valid and feasible to be further developed into a procedural training model to improve teachers' pedagogical competence. This study implies that technology-supported professional development models, such as INDEEP-MOODLE, provide a structured, sustainable, and scalable alternative to conventional workshop-based training for integrating innovative and deep learning principles into teachers' pedagogical practices.

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## Introduction

The transformation of education in the digital era requires teachers to possess increasingly complex competencies, including pedagogical, professional, social, personal, and technological skills. UNESCO (2021) emphasizes that educators must be adaptive to change, capable of integrating technology, and able to design innovative learning environments that foster critical thinking, problem solving, collaboration, creativity, and digital literacy. Contemporary education no longer focuses solely on the transmission of factual knowledge but prioritizes the development of higher-order thinking skills and meaningful learning experiences.

In response to these demands, various innovative learning models such as project-based learning, problem-based learning, inquiry learning, and contextual teaching and learning (CTL) have been widely promoted. Empirical studies show that these approaches enhance student engagement, collaboration, self-regulated learning, and critical thinking skills (Wu et al., 2024; Gombo, 2022; Samadun et al., 2023; Laksmita, 2019). Furthermore,

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meta-analyses confirm that inquiry-based approaches strengthen motivation, reflective ability, and conceptual understanding (Santana-Vega et al., 2020). However, the effectiveness of innovative learning largely depends on teachers' competence in designing and implementing such strategies (Alfitasari et al., 2023).

At the same time, the concept of Deep Learning in education emphasizing meaningful, mindful, and joyful learning has gained increasing attention. Deep learning goes beyond surface-level content acquisition by encouraging conceptual understanding, reflection, intrinsic motivation, and emotional engagement (Feriyanto & Anjariyah, 2024). When implemented effectively, deep learning enhances student engagement, cognitive development, and 21st-century competencies (Nurul et al., 2025; Zebua, 2025). Conceptually, deep learning integrates strategies such as project-based learning, personalization, gamification, and collaborative inquiry, although its implementation often faces challenges related to teacher readiness and infrastructure (Andayanie et al., 2025).

Despite strong theoretical support for both innovative learning and deep learning, empirical evidence indicates that teachers' mastery of these approaches remains limited. Studies reveal that many teachers demonstrate low understanding of innovative learning models due to insufficient training opportunities and limited facilities (Lestari et al., 2024). Similarly, teachers show interest in deep learning but lack technical and pedagogical confidence in applying it effectively (Sari & Arta, 2025). These findings indicate that teachers' instructional practices often remain at a moderate or surface level, preventing optimal development of students' higher-order thinking skills.

Moreover, existing teacher training programs have not adequately addressed this challenge. Many professional development activities are conducted in short-term workshop formats without sustained mentoring or follow-up support (Amemasor et al., 2025; Huang et al., 2024). Such one-shot training models frequently adopt a one-size-fits-all approach and fail to accommodate teachers' diverse needs and classroom realities. As a result, knowledge transfer to actual teaching practice remains weak (Rama & Ucang, 2024). Although digital platforms offer opportunities for flexible and scalable professional development (Trust et al., 2020), most technology-based training initiatives focus primarily on technical tool usage rather than systematically integrating pedagogical innovation and deep learning principles.

Based on this review, three significant research gaps can be identified. First, there is a conceptual gap: while innovative learning and deep learning have been widely discussed separately, limited studies have developed a structured training model that explicitly integrates both approaches within a unified pedagogical framework. Second, there is a practical gap: current teacher training programs tend to be episodic and lack continuous monitoring, reflection, peer collaboration, and feedback mechanisms necessary for sustainable professional growth. Third, there is a technological gap: although Learning Management Systems such as Moodle are frequently used for online instruction, they are rarely conceptualized as comprehensive pedagogical training models that systematically connect theory, instructional design, implementation, reflection, and evaluation within a coherent professional development structure.

Addressing these gaps requires the development of a structured, theory-based, and technology-integrated training model that not only introduces innovative learning and deep learning concepts but also facilitates sustained practice, collaboration, feedback, and progress monitoring. Therefore, this study aims to develop a MOODLE-based training model INDEEP-MOODLE that integrates innovative learning with deep learning principles to enhance teachers' pedagogical competence. The model is designed as a conceptual framework that aligns training inputs, processes, outputs, and outcomes with relevant LMS

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features to support sustainable and meaningful professional development. Moodle was selected because its open-source architecture, extensive customization features, integrated analytics, peer-review workshop modules, and flexible course design capabilities enable the structured, reflective, and sustainable professional development framework required by the INDEEP-MOODLE model capabilities that are less adaptable in more closed or content-delivery-oriented platforms.

## Research Method

This study employed a mixed-methods approach using the Research and Development (R&D) method. The research and development procedures follow the (Borg & Gall, 1983) model. Data collection techniques included interviews, open and closed questionnaires, and focus group discussions. Qualitative data were analyzed using the Miles and Huberman (1994) , which consists of the stages of data collection, reduction, display, and verification. Meanwhile, quantitative data were analyzed using descriptive quantitative techniques through percentages, categories, and mean scores.

The research stages consisted of: 1) Research and information collecting, which involved gathering data and information regarding teachers' abilities in using innovative learning strategies and deep learning, as well as the availability of teaching materials. The subjects of this study consisted of 5 school principals and 25 secondary school teachers who were determined using purposive sampling techniques; 2) Planning, which included conducting a literature review and planning the product to be developed, designed based on the results of the preliminary study so that the research could proceed systematically; 3) Developing the Preliminary Product, which involved developing the design of the MOODLE-based training model for innovative learning integrated with deep learning. At this stage, expert validation was conducted to determine the feasibility of the developed product. The validation involved two experts in learning and two experts in information and technology. The expert validation in this conceptual model development aimed to ensure that the model possessed content validity, theoretical feasibility, and practical relevance.

Data collection began with distributing questionnaires to identify how innovative learning and deep learning were implemented in classroom practice. The questionnaire on teachers' ability to implement innovative learning was developed based on (Schunk, 2020) theory of learning innovation. The questionnaire used to assess teachers' ability to apply deep learning in instruction was developed based on the theory of (Fullan & Langworthy, 2014). The INDEEP MOODLE training model that has been developed needs to undergo expert validation to determine its feasibility. Expert validation is carried out by education experts and information technology experts. The validation process was carried out through focus group discussions and the use of questionnaires as assessment sheets filled out by 4 validators, consisting of 2 Professors in the field of information technology and 2 associate professors in the field of learning design.

## Results and Discussion

At the Research and Information Collecting stage, the data obtained through the questionnaire were processed to obtain the average score for each aspect. The criteria were then determined using the following guidelines:

**Table 1. Criteria for Score Interpretation**

| Score Range | Criteria |
|---|---|
| 4,2-5,0 | Very Good |

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| | |
|---|---|
| 3,4-4,1 | Good |
| 2,6-3,3 | Fairly Good |
| 1,8-2,5 | Less Good |
| 1-1,7 | Not Good |

The results of the study on teachers' implementation of innovative learning, after being analyzed, are illustrated in Figure 1.

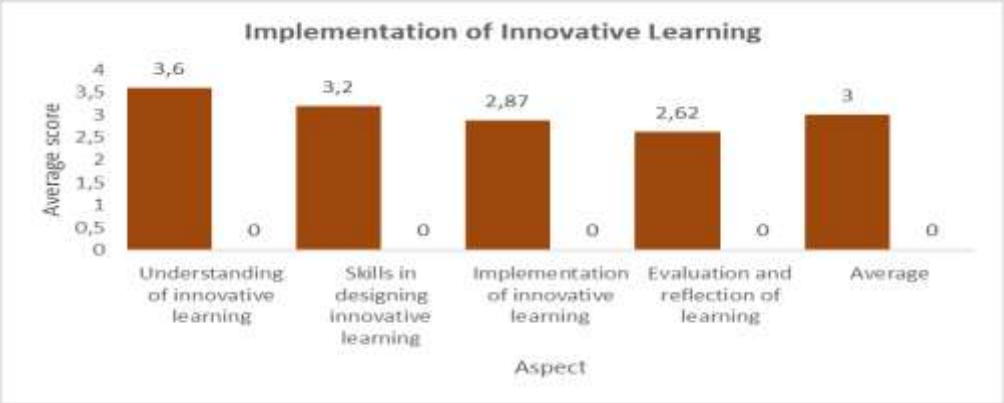


**Figure 1. Implementation of Innovative Learning by Teachers**

Based on the figure, it can be seen that most aspects indicate that teachers' abilities fall into the fairly good category, particularly in the aspects of designing innovative learning, implementing innovative learning, as well as evaluation and reflection. Meanwhile, the aspect of understanding innovative learning falls into the good category. The overall average score for all aspects is 3.00, which means it is categorized as fairly good. Teachers' ability to implement deep learning was obtained through a questionnaire and then analyzed based on the average score for each aspect and its corresponding criteria. The results of the analysis of deep learning implementation are presented in Figure 2 below.

Based on Figure 2, it is shown that the average ability of teachers in implementing deep learning in the classroom falls into the fairly good category. There is one aspect in the less good category, namely reflection and feedback. Out of the eight aspects, four fall into the fairly good category: critical thinking skills, collaboration and communication, use of technology, and motivation and learning atmosphere. Three aspects fall into the good category: conceptual understanding of deep learning, contextualization, and problem-solving and project work.

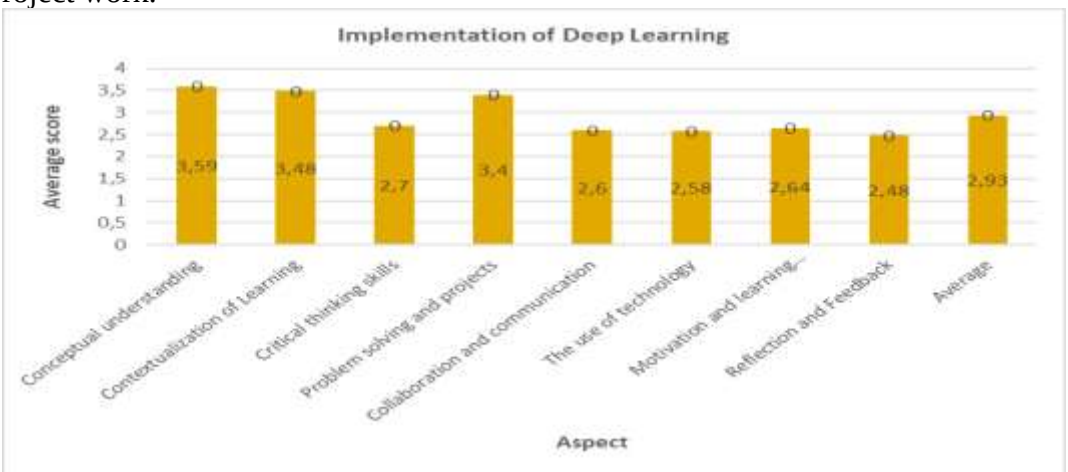


**Figure 2. Teachers' Ability to Implement Deep Learning**

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Interview results revealed that some teachers still use only conventional methods when teaching. Low scores on the ability to apply innovative learning were validated by R2: "I use lectures, discussions, question–answer sessions, and games. I have never used a deep learning approach because I do not understand it yet." Regarding the lack of ability to evaluate and reflect on learning, this is indicated by a low score in this aspect. As expressed by one teacher, R4: "I have never participated in training on innovative learning and deep learning, so I didn't design the evaluation instrument properly and didn't use the evaluation results for learning reflection."

Meanwhile, the low score on the collaboration and communication aspects is supported by R7's statement which reveals: "Regarding deep learning, I have previously learned about it through the teacher working group (KKG), but I do not yet fully understand the stages and how to implement it in teaching." Similarly, R11 expressed: "I learned about deep learning by reading books and articles. I once participated in a training held by the Department of Education, but it was not sufficient to equip me to implement it."

Based on the results of the Research and Information Collecting stage, the planning and development of the model were carried out. This model is a conceptual model, which is a visual abstraction of a real-world system or phenomenon that uses concepts and ideas to represent the relationships among its elements. The model was developed using information technology, specifically the Moodle LMS. The model, termed INDEEP-MOODLE, a training model for innovative learning integrated with deep learning based on the Moodle LMS. The following is the diagram of the INDEEP-MOODLE model.

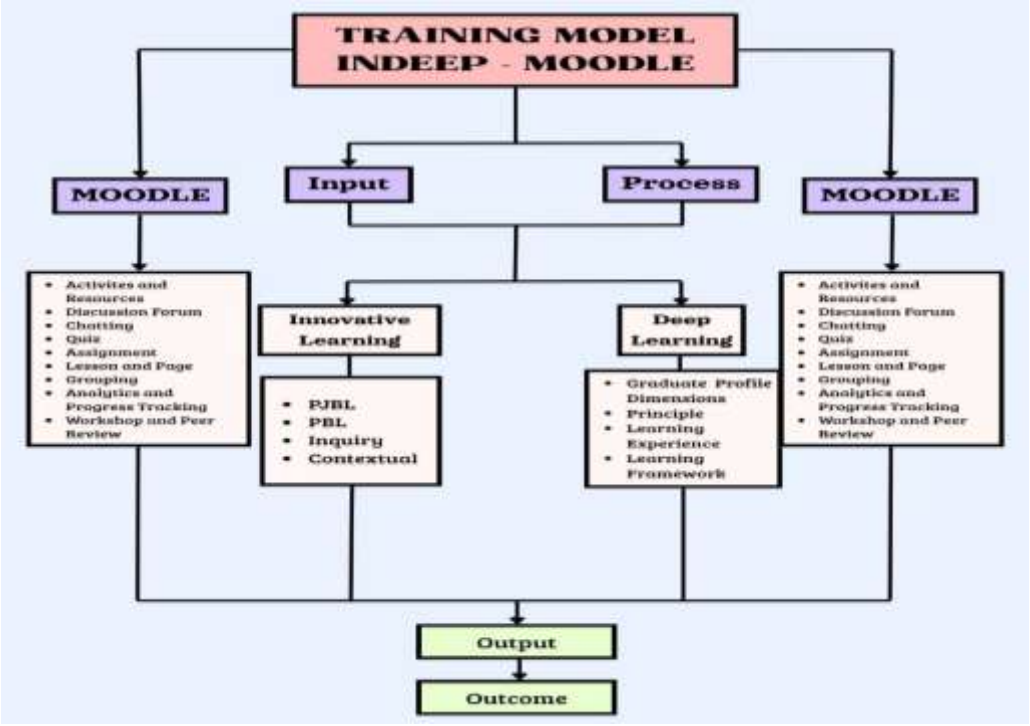


**Figure 3. The INDEEP-MOODLE Model**

Based on the figure, it can be explained that the inputs in this training include human resources consisting of: (1) teachers participating in the training, resource persons, and administrators who will manage the MOODLE learning management system; (2) the INDEEP-MOODLE Learning Management System for training; (3) facilities and infrastructure, including laptops/computers/tablets/mobile phones and internet access.

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In the training process stage, the following steps are carried out: (1) Participants register to obtain an account that allows them to access the INDEEP-MOODLE Training LMS; (2) Participants receive an orientation on how to use the LMS and the training procedures. They may also independently study the user guide and training steps; (3) After obtaining an account and creating a password, participants may begin the training according to the steps outlined in the guide.

The activities that teachers complete during the training include: (1) Viewing the training structure through the dashboard and course management; (2) Analyzing the learning outcomes and training objectives; (3) Studying the training materials through the lesson & page features; (4) Watching videos on innovative learning integrated with deep learning; (5) Participating in discussions with fellow participants and resource persons through the discussion forum; (6) If needed, participants may be grouped into small learning groups through the group and grouping feature; (7) Completing questions or quizzes through the quiz feature. After submitting, participants automatically receive their scores and may revise answers that were incorrect; (8) Completing an assignment, which is designing a lesson plan using innovative learning integrated with deep learning; (9) Asking questions or sharing difficulties through the chat feature; (10) Uploading the completed lesson plan or teaching module through the assignment feature; (11) Resource persons review the submitted lesson plans or modules and provide feedback; (12) Participants and resource persons discuss the feedback through the discussion forum; (13) All participants and resource persons meet virtually via Google Meet or Zoom to discuss each participant's assignment; (14) Participants upload the revised lesson plan through the assignment feature; (15) To monitor participant activity (login duration, completed tasks, quiz results, etc.), resource persons use the analytics & progress tracking features; (16) To train reflection, analysis, and professional feedback skills, participants evaluate each other's work (peer assessment) through the workshop & peer review activity.

The output of this training is an increase in participants' knowledge, skills, and attitudes regarding innovative learning strategies integrated with deep learning. The expected outcome of the training is that, through the implementation of learning practices gained from the INDEEP-MOODLE training, the quality of learning in schools will improve, thereby enhancing students' academic achievement. This training is also expected to have an impact on the school's organizational culture, including the development of a Professional Learning Community (PLC); increased collaboration among teachers and school management; the establishment of a culture of innovation and continuous learning; and greater adaptability of schools to technological changes and the dynamics of 21st-century education. The INDEEP-MOODLE model was validated by four experts through Focus Group Discussions (FGD), questionnaire completion, and recommendations for model improvement.

**Table 2. Validation Results by Experts**

| NO | ASPECT | AVERAGE | CRITERIA |
|---|---|---|---|
| 1 | Needs & Relevance | 4,6 | Very Good |
| 2 | Design and Content | 3,8 | Good |
| 3 | Platform & Technology | 4,4 | Very Good |
| 4 | Facilitation and Mentorship | 4,2 | Very Good |
| 5 | Transfer & Implementation Readiness | 3,6 | Good |
| 6 | Outcomes and Satisfaction | 4,4 | Very Good |

The results of the analysis of the assessments provided by the four experts show that four aspects were rated very good, and two aspects were rated good. In terms of the need and relevance aspects, which were assessed as very good, it shows that the urgency of

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technology-based training in the era of pedagogy driven by artificial intelligence is considered very important by experts. Based on the open-ended questionnaire responses and the FGD, several suggestions for improving the model were obtained, namely the need to add detailed descriptions of the tasks of the LMS administrator, the resource persons, and the participants. In addition, a guide is needed to assist users in applying this model. However, because this model is a conceptual model, the guide will be developed when creating the procedural model that is ready for implementation. Thus, the INDEEP-MOODLE model can be considered valid and conceptually feasible.

**Discussion**

The findings indicate that teachers' ability to implement innovative learning integrated with deep learning falls into the "fair" category. Although teachers demonstrate conceptual awareness of innovative strategies, their capacity to systematically design, implement, and evaluate instruction aligned with deep learning principles remains limited. This condition suggests that instructional transformation has not yet reached a structural level but remains fragmented and procedural.

The relatively moderate score in designing innovative learning implies that teachers are familiar with approaches such as project-based learning or inquiry-based learning, yet they encounter difficulties in aligning objectives, activities, assessment, and reflection in a coherent pedagogical framework. This finding is consistent with Zhang (2024), who argues that teachers' instructional strategies significantly influence student engagement, yet the adoption of innovative models often remains superficial. Similarly, Himmi (2025) highlights that teachers frequently struggle in structuring project plans, managing time, and designing contextual assessments. In the context of inquiry-based learning, Talavera-Mendoza (2024) and Lu (2024) note that teachers tend to remain at guided or structured inquiry levels rather than facilitating higher-order inquiry requiring scaffolding and formative assessment.

More critically, the findings regarding deep learning implementation reveal weaknesses in reflection and feedback. This suggests that teachers have not fully internalized deep learning as a pedagogical mindset but rather as an additional instructional component. Han and Song (2024) emphasize that insufficient teacher capacity in facilitating deep learning results in shallow learning and limited development of students' analytical and synthesis skills. Tian and Xu (2022) similarly argue that teachers often prioritize content delivery over task-based inquiry and reflective processes, thereby constraining students' higher-order thinking development. The present findings confirm that without structured professional development, the integration of innovative learning and deep learning remains partial and inconsistent.

These results also reveal systemic weaknesses in existing teacher professional development. Many training programs are short-term, workshop-based, and lack sustained mentoring (Amemasor et al., 2025; Huang et al., 2024). As noted by Sims et al. (2023), effective professional development requires iterative practice, reflection, and feedback cycles. Furthermore, low implementation fidelity often undermines training effectiveness (Calvert et al., 2025). When training materials are overly theoretical and detached from classroom realities, knowledge transfer becomes minimal (Kahmann et al., 2022). Therefore, the issue is not merely teachers' limited competence but the structural design of professional development itself.

In response to these challenges, the INDEEP-MOODLE model was developed as a structured, technology-supported professional development framework. Unlike conventional training that separates theory from practice, this model integrates conceptual understanding, collaborative discussion, task-based design, peer assessment, mentoring, and progress

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monitoring within a single LMS ecosystem. The use of Moodle enables systematic organization of materials, interactive features, and learning analytics (Dougiamas & Taylor, 2020; Bojiah, 2022; Gamage et al., 2022). Moreover, online training offers flexibility, scalability, and broader accessibility compared with face-to-face models (Huang, 2024; OECD, 2024).

Within the INDEEP-MOODLE model, innovative learning and deep learning are not positioned as parallel constructs but as mutually reinforcing dimensions of instructional transformation. Innovative learning provides the structural and methodological framework, such as project-based learning, inquiry-based learning, collaboration, and contextual instruction through which learning activities are designed and implemented. Deep learning, on the other hand, functions as the cognitive and reflective orientation that gives meaning and depth to these instructional strategies by emphasizing conceptual understanding, critical thinking, reflection, and meaningful engagement (Feriyanto & Anjariyah, 2024; Nurul et al., 2025; Zebua, 2025). In this model, innovative learning operationalizes *how* learning occurs, while deep learning defines *the quality and depth* of the learning process. For example, project-based tasks are not merely collaborative activities but are structured to require analysis, reflection, feedback, and knowledge transfer across contexts. Thus, deep learning strengthens the epistemic depth of innovative learning, while innovative learning provides the pedagogical vehicle through which deep learning principles are enacted. This reciprocal relationship ensures that instructional innovation does not remain procedural but evolves into meaningful and transformative classroom practice.

By embedding reflection, peer review, and analytics-based monitoring, the INDEEP-MOODLE model addresses key weaknesses identified in previous professional development initiatives. It operationalizes principles of sustained professional learning as emphasized by Darling-Hammond et al. (2017) and Guskey (2021), particularly the alignment between training activities and classroom implementation. Thus, the model not only introduces pedagogical innovation but also restructures the professional learning process itself.

First, it conceptualizes the integration of innovative learning and deep learning within a unified training framework. Previous studies have discussed these approaches separately (Feriyanto & Anjariyah, 2024; Nurul et al., 2025; Zebua, 2025), yet limited research has systematically combined them into a structured professional development model. The INDEEP-MOODLE model bridges this conceptual separation by aligning innovative instructional design with deep learning principles of meaningful, mindful, and joyful learning. Second, this study reconceptualizes Moodle from a content delivery platform into a pedagogical transformation system. While Moodle has been widely used for online learning management (Dougiamas & Taylor, 2020; Bojiah, 2022), this study positions it as an integrated professional development ecosystem that connects theory, practice, reflection, feedback, and monitoring within a coherent structure. Third, the model extends professional development theory by embedding sustainability mechanisms peer assessment, mentoring, analytics tracking, and collaborative forums within a digital environment. This contributes to the discourse on implementation fidelity (Calvert et al., 2025) and sustained professional learning (Sims et al., 2023) by demonstrating how technology can support iterative and reflective teacher development processes.

For teachers, the model provides structured guidance in designing lesson plans that integrate innovative strategies with deep learning principles, moving beyond procedural adoption toward reflective pedagogical practice. For schools, the model supports the development of a Professional Learning Community (PLC) culture by facilitating collaboration, peer review, and continuous improvement within a digital ecosystem. For

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policymakers, the study suggests that teacher professional development should shift from short-term workshop models toward sustained, technology-supported training systems that incorporate mentoring and monitoring mechanisms. The scalability and flexibility of online training (Huang, 2024; OECD, 2024) make it particularly relevant for broader educational reform initiatives.

## Conclusion

This study found that teachers' ability to integrate innovative learning and deep learning remains at a moderate level, particularly in instructional design coherence and reflective feedback practices, indicating the need for more structured professional support. In response, the INDEEP-MOODLE model was developed as a technology-supported professional development framework that systematically integrates conceptual understanding, collaborative learning, mentoring, peer review, and progress monitoring within the ecosystem of Moodle. The model was validated by experts as conceptually feasible and offers a structured and scalable alternative to short-term workshop-based training. These findings imply that sustainable, LMS-based professional development systems are essential to strengthening teachers' pedagogical competence and supporting deeper classroom learning practices.

## Recommendation

Based on the findings, teachers are encouraged to actively engage in sustained, technology-supported professional development to strengthen their capacity to integrate innovative and deep learning principles into classroom practice. Teacher professional development should shift from short-term, workshop-based models toward structured systems utilizing platforms such as Moodle to facilitate mentoring, collaboration, reflection, and progress monitoring within a continuous learning framework. Future research should empirically test the effectiveness of the INDEEP-MOODLE model through pilot implementation and longitudinal studies to examine its impact on teachers' pedagogical competence and student learning outcomes across diverse educational contexts.

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