A NEW MODEL FOR BLENDED LEARNING IN ISLAMIC HIGHER EDUCATION: INTEGRATING PEER INSTRUCTION WITH JUST-IN-TIME TEACHING

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ABSTRACT

High-order thinking skills are crucial in pursuing competency mastery within Islamic higher education. A viable approach to attain these educational goals is implementing the Peer Instruction strategy. Nevertheless, a comprehensive model for peer instruction in blended learning environments still needs to be developed. This research seeks to create a model for instructional system design that outlines learning procedures, integrating the Peer Instruction strategy within a blended learning framework informed by a just-in-time teaching methodology. The built model is intended to guide instructors in creating learning to stimulate learners' higher-order thinking skills. The development process follows the formative evaluation procedure, consisting of several stages, such as selecting a design theory, designing an instance of the theory, collecting and analyzing formative data on the instance, revising the instance, repeating the data collection and revision cycle, and offer tentative revisions for the theory. The resulting product has also undergone several validity tests by experts, including instructional designers, blended learning experts, lecturers, and students. The product's effectiveness in improving critical thinking and problem-solving was carried out through a test instrument for students. Validation and effectiveness tests showed that this product was valid, practical, and effective in improving critical thinking and problem-solving skills.

Keywords: Instructional system design, peer instruction, just-in-time teaching, higher order thinking skills.

INTRODUCTION

The development of higher-order thinking skills (HOTS) poses a significant challenge for Islamic higher education institutions in Indonesia, primarily due to their reliance on conventional lecturing methods that emphasize rote learning over critical thinking (Hammad, 2014). Research indicates that many educators need more proficiency in HOTS-oriented pedagogies, leading to resistance against innovative teaching strategies (Br. Sinulingga & Dahlan, 2022). Consequently, they often revert to traditional methods, which are easier to implement, focusing on lower-order thinking skills (LOTS) through lectures and recitations (Aziz, Ibrahim, Shaker, & Nor, 2016; Azzahra Indriani, Munawaroh, & Garut, 2024). As a result, assessments mainly evaluate LOTS (Wigati, Mardeli, Astuti, Yuniar, & Ramdani, 2023).

Thus, an instructor is expected to facilitate HOTS achievement by providing a learning environment based on real problems (Degeng et al., 2021). One way is to choose suitable learning models and methods (Kuswandi, Surahman, Thaariq, & Muthmainnah, 2018). Peer instruction (PI) is a constructivist pedagogical method that allows active involvement in collaborative learning, thereby improving students' critical thinking skills. Applying the PI method allows students to develop their understanding of basic concepts toward deeper critical thinking (Kannan & Gouripeddi, 2018).

The varied blended learning (BL) model transforms university learning (Feng, 2023). The identical PI method is applied face-to-face, but the delivery system can change. Several studies have reported the application of PI in one of varied BL environments, namely Just-in-Time Teaching (JiTT) (G. Novak, Gavrin, Christian, & Patterson, 1999; Russell, 2006). Zou & Xie (2019) applied PI to the JiTT environment, finding that the model exceeded conventional models in students' writing skills, motivation, and critical thinking tendencies. Hung (2017), who tried to combine the application of PI in a JiTT environment assisted by the student response system (SRS), found that the treatment created interactive, communicative, and satisfying learning. Sayer et al. (2016) found that students' performance on the clicker questions increased after group discussion following individual clicker question responses in the JiTT class. Since its early development, the JiTT approach has often been combined with peer discussion in the classroom (G. Novak et al., 1999). Some of this empirical evidence implies that the implementation of PI in JiTT-based BL environments can be a learning strategy worth trying by lecturers in higher education.

Watkins & Mazur (2010) provide a rationale for integrating these two strategies. They argue that PI is an interactive learning technique to discuss ununderstandable aspects of complex material. For optimal learning, students need to understand the material sufficiently before coming to class. The JiTT strategy perfectly complements the PI implementation because JiTT requires students to read the material and do assignments before class. Consequently, teachers can monitor learning progress while providing feedback so that they can adjust PI follow-up questions that target students' learning difficulties. Moreover, a report shows that integrating JiTT and PI has advantages over the conventional flipped learning approach. JiTT complements PI with instructors having information about students' independent learning progress before class (Clark, 2016).

The previous two paragraphs have presented several reports of PI implementation in JiTT. Several critical analyses conducted by researchers have found several conclusions. First, Watkins and Mazur's writing is still a rational narrative about the integrated efficacy of these two strategies. They do not describe the conceptual learning model, let alone its operational model. Second, Hung (2017) only describes the implementation of the PI strategy in the JiTT environment. It does not detail the activities that instructors and learners must carry out. The model is also not based on any learning theories in every aspect. In addition, the model's validity from the perspective of learning design and practicality has not been tested because the study report has not described the review process from relevant learning experts. Third, the article by Sayer et al. (2016) only reported the effect of implementing students' response systems for in-class conceptual clicker questions in JiTT classes that implemented the PI strategy. They did not explain precisely how they experimented. Therefore, their study cannot be used as operational guidelines for implementing the strategy in the JiTT environment.

The only procedural model as an operating framework is Zou & Xie (2019). Zou and Xie created a procedure for teachers when integrating PI strategies into the JiTT environment. However, the model has yet to be developed based on the leading learning principles in every aspect. In learning activities, the model does not refer to the learning principles as stated by leading theorists.(e.g., Gagne, Wager, Golas, & Keller, 2004; Landa, 1983; Merril, 2013). In addition, the learning activities proposed also do not have the specific objective of developing learner competencies (see Anderson & Krathwohl (2001)). The model is also not based on the theory of blended learning environment development, which is the basic platform for the learning process. The built model did not undergo a model development process using a specific learning design model. The built model also did not undergo the validation-revision procedure from blended learning experts, instructional designers, lecturers and students as its main users. As a result, the feasibility aspect of implementing the learning design model still needs to be questioned.

Thus, the main objective of this study is to develop and produce an instructional system design (ISD) model in the form of guidelines or procedures that integrate PI strategies into JiTT-based BL. The resulting model is in the form of stages or syntax extracted from theoretical approaches, synthesis of relevant literature, and practical approaches to applying PI and JiTT strategies. In addition, the model built also considers several learning conditions that underlie the BL environment.

JUST-IN-TIME TEACHING-BASED BLENDED LEARNING

BL can be seen as aligning face-to-face learning with online learning. This learning mode allows for integrating technological innovations bridging online and face-to-face learning. A typical example is the combination of technology-based materials and face-to-face sessions implemented simultaneously (Chaeruman, 2011) so that learning can be done anytime and anywhere (Ulfa, Bringula, Kurniawan, & Fadhli, 2020).

Conceptually, BL can be defined in two perspectives, namely synchronous and asynchronous learning (Septantiningtyas, Degeng, Kuswandi, & Purnomo, 2024; Varkey et al., 2023). Synchronous learning is a learning activity that occurs simultaneously between learners and instructors. Asynchronous is a process of interaction between learners and all learning resources that occurs anytime and anywhere.

The BL concept utilizes the best learning conditions from synchronous and asynchronous aspects. Several researchers have recently proven the advantages of combining these two learning modes. Evans & Perry (2023) highlighted the interaction between asynchronous and synchronous online activities. Synchronous activities complement independent learning activities while students are in asynchronous sessions through correction and further exploration of the concepts discussed. Conversely, asynchronous activities build foundational knowledge that prepares students for interactive synchronous engagements. This combination gives students a more holistic learning experience, as they can reflect on asynchronous material before applying it to synchronous activities. Kelly & Lock (2021) utilized asynchronous and synchronous modes to overcome their limited teaching time. They developed teacher-created videos and regular written feedback to deliver material asynchronously, allowing students to learn independently. At the same time, limited synchronous sessions provided opportunities for class reflection and discussion, enhancing community interaction. In summary, blended learning creates a complementary and holistic learning experience, enabling students to build foundational knowledge independently while engaging in real-time interactions and reflection during synchronous sessions.

Experts have formulated several principles to guide instructors in planning learning activities in these two settings. Horton & Horton (2003) proposed the principle of an online learning flow consisting of three steps: absorb, do, and enact. Chaeruman et al., (2020) developed the principle of the BL model flow consisting of four steps: learning, deepening, applying, and evaluating (LDAE). The LDAE model can be illustrated in Figure 1.

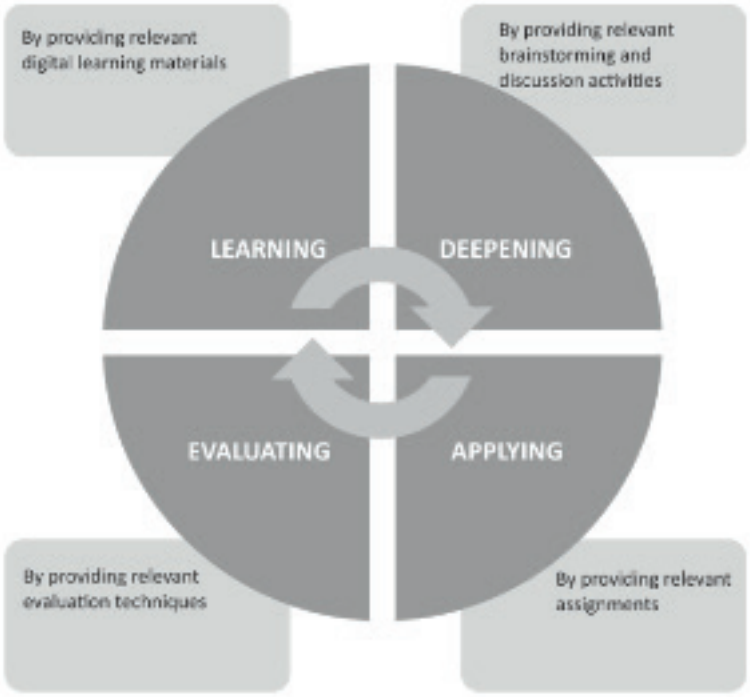

Figure 1. LDAE Model for Developing BL Activities

The learning path model includes four cycles: learning, deepening, applying, and evaluating. The LDAE model guides instructors to fill their BL learning activities in its four quadrants. For example, in the Learning quadrant, an instructor can provide learning content such as text, audio, visuals, videos, animations, simulations, games, and others. In the Deepening quadrant, an instructor can provide an online discussion forum or video conference, providing practice questions, and others. In the Applying quadrant, an instructor can provide problem-solving tasks so that learners can apply the concepts they have learned previously. In the Evaluation quadrant, an instructor can determine the success of BL by giving tests, collecting reports or products, reflection reports, and so on (Chang, 2019).

The LDAE model above will be the foundation for developing the ISD model in this study. The four quadrants indicate the activities proposed in the product being developed. Through this model, researchers can prescribe the activities that must be carried out by a teacher and all students when they are in the learning environment in the ISD model being developed. For example, in the asynchronous realm (see Figure 8), lecturers can provide material through LMS, Interactive Learning Videos, and others while students listen to the material. This activity is included in the learning quadrant. Then, students must complete several questions to test their understanding of the material. The students' activities in completing the questions are included in the deepening quadrant.

The JiTT (hybrid, flipped, or mixed learning) strategy allows an instructor to divide learning time into two sessions: synchronous face-to-face learning activities and asynchronous individual online learning tasks (Riskowski, 2015). Operationally, learners are required to deepen the material and work on assignments independently through asynchronous website technology. This activity is called a preclass activity and is a preparation stage for synchronously participating in class activities. In-class learning activities involve problem-solving (G. M. Novak & Beatty, 2017). Combining two main components of BL learning in the JiTT strategy is considered an ideal element in modern learning. Several experts have proven that optimizing pre-class and in-class activities can enhance the learning experience in BL. (Gross, Pietri, Anderson, Moyano-Camihort, & Graham, 2015; Liu, Liu, & Zhao, 2020; Zarrinfard, Rahimi, & Mohseny, 2021). Figure 2 illustrates the steps of the JiTT strategy.

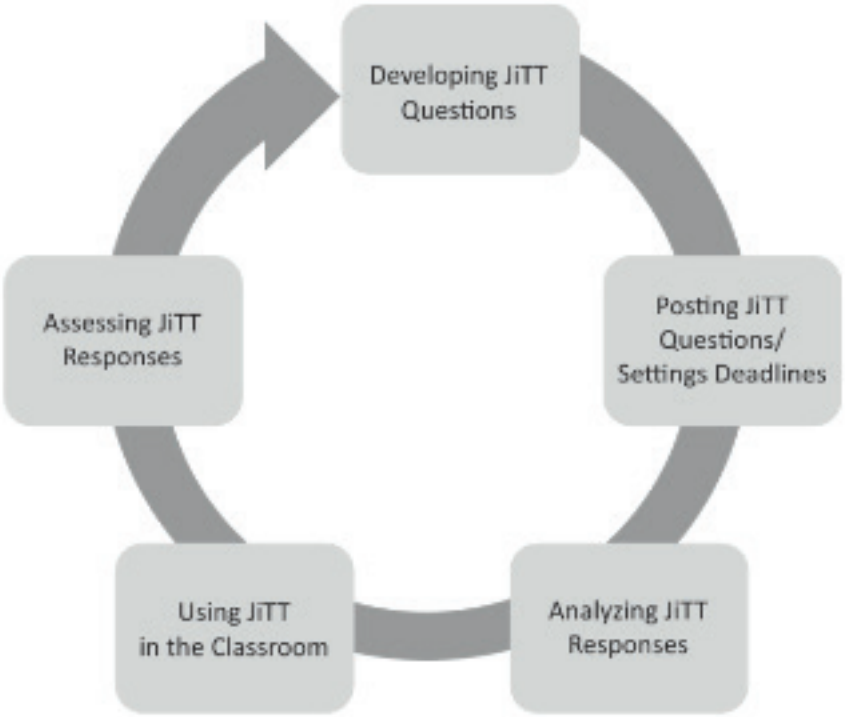

Figure 2. Prosedur Strategi JiTT Novak & Patterson (2010)

When the JiTT concept is adapted to the context of Islamic education, it is relevant to the principles of, among others, *tahqiq* (in-depth exploration) and *ijtihad* (intellectual effort). Both principles emphasize the aspect of in-depth preparation before implementation. The Islamic intellectual tradition encourages students to master basic knowledge, internalize it independently, and then discuss it with scholars to confirm the intellectual thinking of the students. The same thing is also reflected in the philosophical foundation of JiTT. It bases proactive learning activities on reflecting thoughts raised by pre-class questions in independent learning activities. This is the same as the concept of the *halaqah* (study group) tradition, which emphasizes critical dialogue and reflection (Nasr, 2006). Last, JiTT is a method that aligns with the perspective of teaching methods in the Islamic tradition because it encourages intellectual improvement based on deep understanding.

PEER INSTRUCTION

Peer Instruction (PI) is an instructional strategy that facilitates active collaboration among learners within the classroom environment. This method enhances the interactive nature of learning engagement and addresses challenging subjects students encounter (Cortright, Heidi L. Collins, & DiCarlo, 2005; Watkins & Mazur, 2010). PI fosters collaborative learning through in-class concept discussions. To maximize effectiveness, students need a basic understanding of the concepts, which can be supported by pre-class in JiTT activities. Thus, instructors can choose PI questions presented in class to address specific learning difficulties encountered by learners (Rowley & Green, 2015)

Unlike other constructivist strategies, which may focus solely on collaborative learning or project-based tasks, PI actively engages students in articulating their reasoning and confronting misconceptions through structured voting and discussion (Simon & Cutts, 2012). This method allows instructors to gauge student understanding in real time and adapt their teaching accordingly, enhancing the learning experience by making it more interactive and responsive to student needs.

PI emphasizes the collaborative aspect repeated between peer students through discussions, which is its unique feature. In PI, students are given conceptual questions designed to challenge their understanding of

the material. They then discuss with peers to refine or reinforce their understanding before the instructor provides a final explanation (Versteeg, Blankenstein, Putter, & Steendijk, 2019). Shortly, PI focuses on students discussing and solving conceptual questions in small groups, enhancing understanding through peer interaction and immediate feedback (Woods, 2013).

The PI strategy is well-suited for implementation in Islamic higher education because it supports fundamental Islamic values such as ijtihad and shura, emphasizing the importance of collective discussion and deliberation-based decision-making (Vasinayanuwatana, Wee, & Jeerawan, 2020). The PI encourages student engagement in critical dialogues that deepen understanding, reflecting the Islamic tradition of rational thought and communal reflection (Abdul-jabbar & Makki, 2024). PI becomes even more relevant in the context of blended learning because technology can be used to support the preparation phase before face-to-face classes, such as JiTT. Instructors can thus assess the difficulties students face and tailor PI discussions to their specific needs (Watkins & Mazur, 2010). This integration makes PI a practical and relevant approach to support the development of critical thinking skills in Islamic higher education.

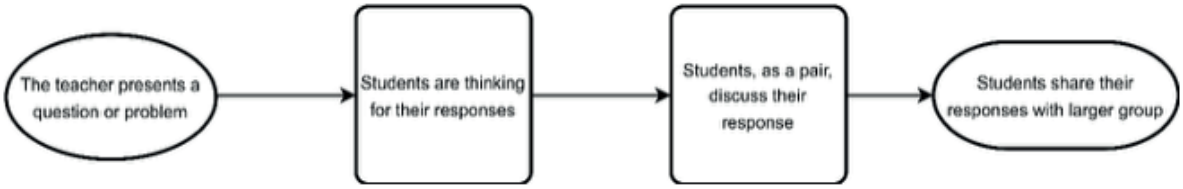

Figure 3. PI Strategy Procedure

The literature review results have yet to show the exact stages of implementing the PI process. However, some experts adopted the Think-Pair-Share strategy procedure (Cortright et al., 2005; Crouch & Mazur, 2001; Knight & Brame, 2018). In the PI strategy, an instructor poses a problem and gives students time to solve it independently. Then, the students discuss their answers in pairs before the pair submits theirs. Finally, the instructor can compare and discuss the responses built by each group to reach a consensus on the best answer (Kagan & Kagan, 2009). Figure 3 illustrates the PI process.

DEVELOPMENT OF LEARNING TECHNIQUES TO IMPROVE HOTS IN ISLAMIC HIGHER EDUCATION

Learning techniques in Islamic universities have undergone significant developments along with the demands to develop HOTS, which include critical thinking, creativity, and problem-solving skills. Islamic education traditionally emphasizes ta'lim (teaching) and ta'allum (learning) by focusing on memorizing and understanding religious texts. However, along with the changing paradigm of modern education, many Islamic universities have begun adopting a more constructivist learning approach, encouraging students to engage in higher-order thinking processes (Sumanti, Nunzairina, & Salminawati, 2024). For example, techniques such as Problem-Based Learning (PBL) and Collaborative Learning have begun to be implemented in various courses at Islamic universities to improve analytical and evaluation skills among students (Darmawan, Qomaruzzaman, Hanan, & Mauliddin, 2024).

Although PBL and Collaborative Learning have significantly improved HOTS in Islamic higher education, the PI integration model in JiTT developed in this study offers a more interactive and contextual approach. PI, introduced by Mazur (1997), focuses on student interactions to understand more profound concepts through peer-to-peer discussions. Integrating PI into JiTT allows students to utilize both learning modes: asynchronous to study the material independently and synchronous to discuss and solve problems with classmates. This supports the principle of shura in Islam, where collective deliberation and discussion are valued as wise decision-making methods (Ahmad, 2022).

METHOD

Research Design

The main objective of this study is to develop an instructional system design (ISD) model in the form of syntax or learning steps. The formative research method (Reigeluth & Frick, 2009) is the basis for developing and validating the developed ISD model. It consists of six stages, including 1) selecting a design theory; 2) designing an instance of the theory; 3) collecting and analyzing formative data on the instance; 4) revise the instance; 5) repeat the data collection and revision cycle; and 6) offer tentative revisions for the theory. However, Figure 4 represents the operational process.

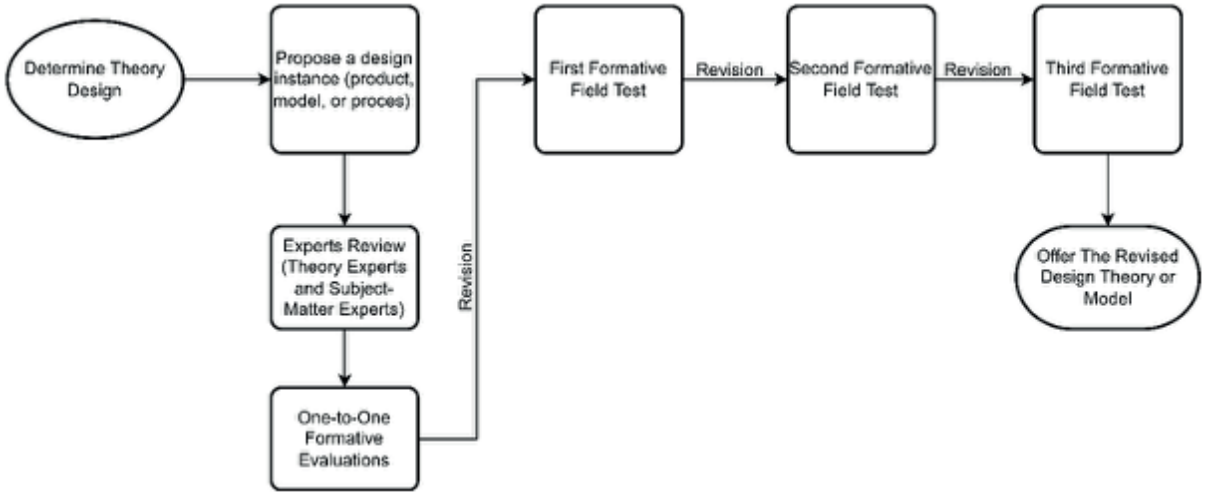

Figure 4. Formative Research Method Procedure

Based on the above procedure, after the researchers reviewed some relevant literature and theories, they established a design theory (in this case, PI and JiTT theories). In the second step, the researchers design an instance of the theory (the model of integrating PI theory into JiTT-based BL or the tentative ISD model). In the third step, the experts (three instructional designers, two BL experts, and lecturer representatives) review the tentative ISD model to validate the underlying issues regarding the underlying theories of the developed learning product and the practicality of its learning implementation). The review process by the experts uses interview techniques. Based on input from the third step, the researchers revise the model in the fourth step. In the fifth step, the revised ISD model undergoes three formative field Tests.

In the first formative field test, three experts (two instructional designers and one BL expert) and ten lecturers will validate the model's suitability to the underlying design theory. In the second formative field test, thirty students will test the practicality of the revised model to be implemented in regular learning. In the third formative-field test, forty students will test the efficacy of the developed ISD model to improve their HOTS. Finally, the final ISD model can be applied to a broader context.

Setting and Participants

This study was conducted in the Islamic Education Department at the Islamic University of Malang, Indonesia, in the even semester of the 2023-2024 academic year. The subjects consisted of five learning designers, two BL experts, and four experienced BL lecturers who conducted expert reviews and one-on-one formative evaluations. The researchers conducted three formative tests. The first field test involved two learning designers, a BL expert, and ten lecturers. The second involved 30 students. The third involved 40 students.

This formative evaluation selected learning designers and blended learning experts based on criteria. The main criteria for selecting participants included: (1) at least five years of experience in designing technology-based learning in higher education settings, (2) active involvement in blended learning projects for the

past three years, (3) active in conducting research and publications in the field of blended learning, and (4) Minimum of a doctoral degree in curriculum and instructional technology studies. Experts were obtained through a network of friends and professionals who are involved in the field of curriculum and educational technology.

Although the selection process was carried out carefully, the potential for bias remains. Most experts are from the researchers' limited professional networks, which could lead to bias in terms of representation. For example, learning designers in Islamic learning are only represented by three, while the remaining are from general learning designers. In addition, due to time and resource constraints, which may not fully represent the entire blended learning expert community.

Context

The model has been designed considering Islamic educational values, local cultural learning preferences, and students' previous Islamic educational backgrounds (input from madrasah aliyah and Islamic boarding schools). In more detail, PI supports the principles of ijtihad and shura, which encourage collective discussion and critical thinking so that students can construct their understanding through open dialogue. Meanwhile, JiTT is in line with the value of ta'lim, ensuring that the material taught is tailored to the needs of students on time. In addition, the model is adaptive to consider local cultural preferences that often prioritize memorization (especially for student input from Islamic boarding schools). It allows students to deepen their understanding of the religious context before discussing it synchronously. Integrating these two strategies is also very relevant in Islamic courses, such as tafsir and fiqh, where PI and JiTT can improve students' ability to criticize and understand complex theological or Islamic legal concepts.

Instruments

This study uses several measurement instruments (scales and tests) to obtain information about the developed product. The scale accesses responses from respondents (such as experts, lecturers, and students) regarding the feasibility and practicality of the developed product, as well as accessing the students' level of critical thinking tendencies (Sosu, 2013). The test, in the form of essay questions, assesses students' problem-solving abilities in classroom management.

The product feasibility, practicality, and critical thinking skills scale were validated with the help of three educational technology and assessment experts. The reliability of the three scales was tested using Cronbach's Alpha. The feasibility scale yielded a reliability value of 0.77, the practicality scale yielded a reliability value of 0.71, and the critical thinking skills scale achieved a value of 0.85, indicating high internal consistency (Taber, 2018). Regarding the essay test on problem-solving, inter-rater reliability was estimated, which gave a Cohen's Kappa of 0.76, which suggests good agreement among the evaluators.

Data Analysis

The research data is in the form of descriptive quantitative and qualitative data. Quantitative data was obtained by distributing questionnaire items regarding product feasibility and practicality, providing essay questions to measure problem-solving skills, and a scale of critical thinking skills. Qualitative data was from input and suggestions from experts, lecturers, and students.

For the quantitative data from the questionnaire to be more informative, data analysis uses the presentation of the values for each measurement with the formula 1 from Arikunto (2020).

$$P = \frac{\sum X}{\sum X_i} \times 100$$

Where :

P : Percentage

X : Respondents' answer scores for all items

Xi : The ideal score value in one item

100 : Constants

Interpretation of the analysis results for each instrument is:

Table 1. Eligibility Criteria (Akbar, 2017)

Achievement Level	Qualification
81% - 100%	Very valid, can be used without revision
61% - 80%	Quite valid, usable but needs a little revision
41% - 60%	Less valid, not recommended for use as it needs major revision
21% - 40%	Invalid, should not be used
0% - 20%	Very invalid, absolutely should not be used

To determine the extent of the product's effectiveness on HOTS, researchers conducted Cohen's d effect size analysis (Cohen, 1988) for paired samples using formula 2:

$$d = \frac{\bar{D}}{\sqrt{s_D^2}}$$

Where:

d : Eeffect size value

$\bar{D}$: The average difference between the two conditions (pretest dan posttest)

$\sqrt{s_D^2}$: Standard deviation of the sampling distribution of $\bar{D}$

Interpretation of the results of the Cohen's d effect size calculation:

Table 2. Interpretation of d values

Values of d	Interpretation of Effect Size
d = .2	Small effect
d = .5	Medium effect
d = .8	Large effect

FINDINGS

Propose Instance Design

The initial phase of formative research involves identifying a case that will inform the creation of the design theory. In this investigation, the design theory formulated serves as a provisional model for applying the PI strategy within a JiTT-based blended learning context. A design theory or model ought to closely mirror the foundational principles of a theory, aiming to reduce the influence of subjective intuition during its formulation. Consequently, the researcher established a more practical theoretical framework grounded in the design theory of the PI strategy and the JiTT-based blended learning strategy.

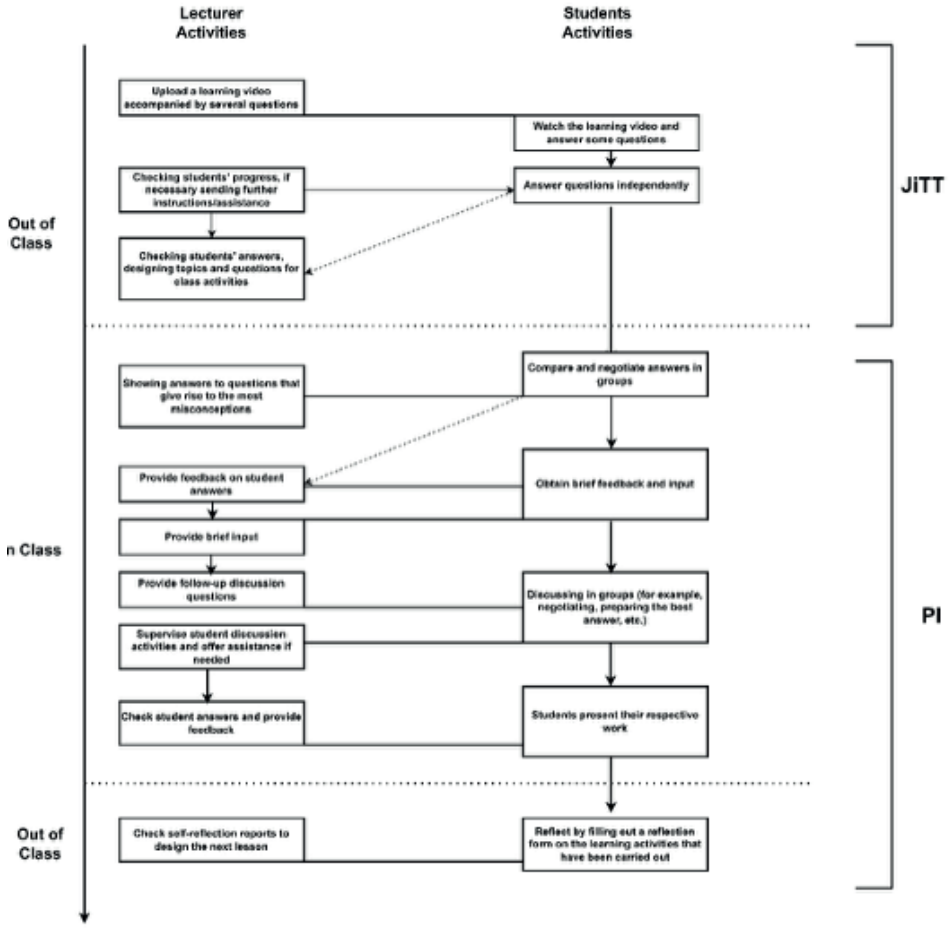

Figure 5. Tentative PI Learning Model in JiTT Environment

The researchers created a theoretical framework as an operational model, integrating PI design theory and JiTT-based BL design theory from leading scholars. They based their work on foundational concepts from outstanding contributors in PI learning strategies, models, and cooperative learning (Crouch & Mazur, 2001; Kagan, 2003; Kagan & Kagan, 2009; Mazur, 2014; Rowley & Green, 2015; Slavin et al., 1985; Zhang, Ding, & Mazur, 2017). The JiTT-based BL concept draws upon theoretical foundations established by various notable scholars (Gavrin, 2006; Maier & Maier, 2010; Marrs & Novak, 2004; G. M. Novak & Beatty, 2017; G. Novak & Patterson, 2010; Watkins & Mazur, 2010; Zou & Xie, 2019). Figure 5 shows the ISD learning model.

Referring to the tentative ISD model, an instructor can execute the PI strategy in a JiTT-based BL environment. First, in an out-of-class session, the lecturer uploads learning materials (text or video) and online tasks via a learning management system platform (Moodle, Google Classroom, Edmodo, Etc.) or interactive learning videos (such as EDpuzzle, PlayPosit, hapyak, Etc.). Then, the students attend to the material and respond to the assignments independently through the platform used. Second, the lecturer reviews the students' answers and documents their understanding and misperceptions of the concepts taught. This report will then be used to decide the starting juncture of learning activities in the classroom. Third, entering the class session, the lecturer commences the learning by revealing answers that indicate misconceptions. Then, the students formulate and submit revised answers in pairs. Fourth, the lecturer gives follow-up questions based on the prior discussion. At the end of the session, the lecturer invites the students to reflect on the learning activities and write them on a Google Docs sheet as a post-class learning activity. This tentative model (prototype) will then undergo improvements when entering the validation process by experts and users.

Validation of the Tentative Model

The second to fifth steps are part of an iterative formative evaluation process to validate and revise the tentative ISD model. After the tentative model has been developed, the next step is validation. The first validation is by experts (5 learning designers and 2 BL experts), followed by one-to-one formative evaluation (4 lecturers) and three field tests from users. The sequence of validation processes and the focus of the study can be described in Table 3.

Table 3. The Stages of Tentative Model Validation

The Stages of Tentative Model Validation			
No.	Validator Expertise	Total Person	Focus Scope
1	Instructional designer	5	The relevance of the model to learning theory, the model's systematisation, logicality, ease of the model to follow, and practicality.
2	Expertised BL Instructor	2	Design and integration of online and face-to-face components, clarity of structure and learning flow, engagement and interactivity, quality and accessibility of digital content, flexibility and adaptability, and evaluation and learning assessment.
3	Lecturer	4	Clarity and ease of instruction, technology and learning tools use, student engagement and participation, support and resources, and evaluation and learning assessment.

Experts from the three groups positively assessed the tentative model, noting its clear and logical flow that effectively encapsulates the foundational design theories. They affirmed its potential for implementation but provided additional suggestions for enhancement, detailed in Table 4.

Table 4. Notes for Improvement from Experts

Experts	Input Given
Instructional Designer 1	The activities developed are more integrated between the PI and JiTT concepts; Classroom learning in PI should involve problem-solving.
Instructional Designer 2	Each stage of the model has a target for achieving cognitive abilities.
Instructional Designer 3	Researchers need to provide more varied choices in each activity in the model syntax.
BL Expert 1	The developed model refers to the basic concept of BL as a support for implementing PI and JiTT strategies.
BL Expert 2	Learning activities are based on the basic principles of developing BL environmental activities.
Lecturer 1	Explicitly write PI sessions to the model.
Lecturer 2	Explains the meaning of the dotted lines in some model syntaxes.

Revision of the Tentative Model

The revision process began with feedback from the instructional designer. In response to Designer 1's suggestions, the researchers integrated pre-class activities into the JiTT framework as preparation for classroom tasks and reformulated follow-up questions into case-based inquiries to replace follow-up questions. Following Designer 2's insights, the researchers adopted a model for determining appropriate BL strategy from Chaeruman, Wibawa, & Syahrial (2018), illustrated in Figure 6.

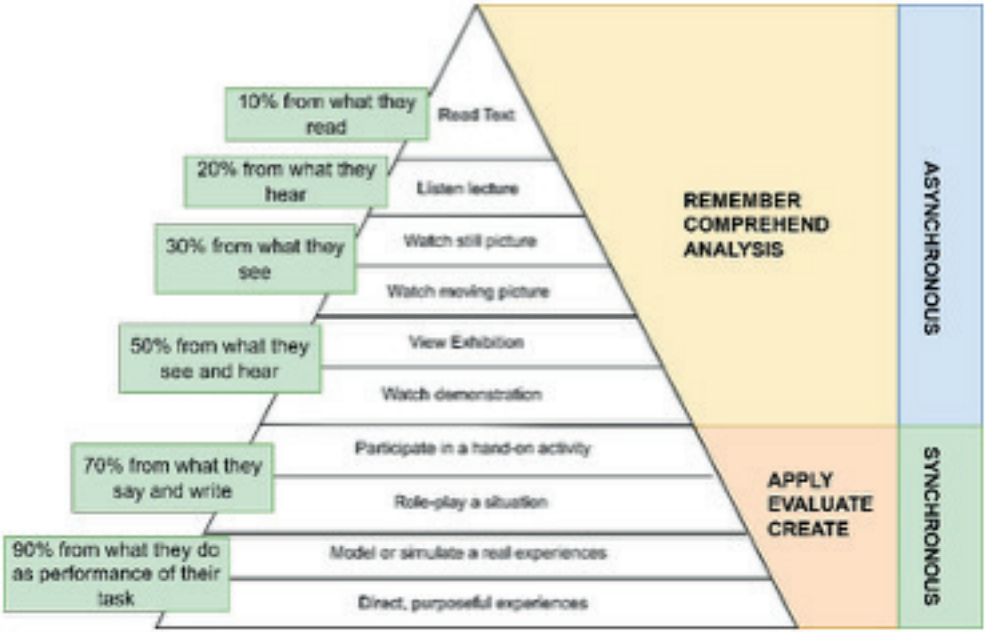

Figure 6. Model of Criteria for Determining Appropriate BL Strategy

Figure 6 guides researchers in targeting cognitive capabilities at each step of learning. For instance, when instructors provide material asynchronously, the activities are instructed toward proficiency of the material in remembering, comprehending, or analysing domains. Synchronously, each activity stage targets proficiency in the application, evaluation, and creation domains.

In addressing Designer 3's feedback, the researchers employed a conceptual framework established by Chaeruman & Maudiarti (2018) and Chaeruman et al. (2018) to formulate blended learning (BL) activities. They assisted instructors in developing learning experiences across the four quadrants of BL: Live Synchronous Learning, Virtual Synchronous Learning, Self-Directed Asynchronous Learning, and Collaborative Asynchronous Learning. The activities associated with the quadrants are detailed in Table 5.

Table 5. Learning Activities in Synchronous and Asynchronous Learning Settings

BL Setting			
Synchronous Learning		Asynchronous Learning	
Live Synchronous Learning	Virtual Synchronous Learning	Self-Directed Asynchronous Learning	Collaborative Asynchronous Learning
Learning Activities			
Lecture Discussion Practice Workshop Seminar Lab practice Field trips et cetera	Virtual class Audio-conference Video-conference Web-based conference (webinar)	Reading Watching (video, webcast) Listening (audio, audio cast) Online Study Simulation Drill and practice Test/quiz Journal/publication (wiki, blog, etc.)	Participating in discussion forum Online assignment (individual or group) Group research/project et cetera

Table 5 helps researchers refine the model by adding supplementary activities at each stage. For example, after a preclass content presentation (JiTT), suggested activities include reading articles, listening to podcasts, engaging in exercises, and completing quizzes.

The next phase involves adjustments based on feedback from two BL experts. Following the suggestions of BL expert 1, the researchers developed the blended learning environment using the conceptual framework by Chaeruman et al. (2020), as shown in Figure 7.

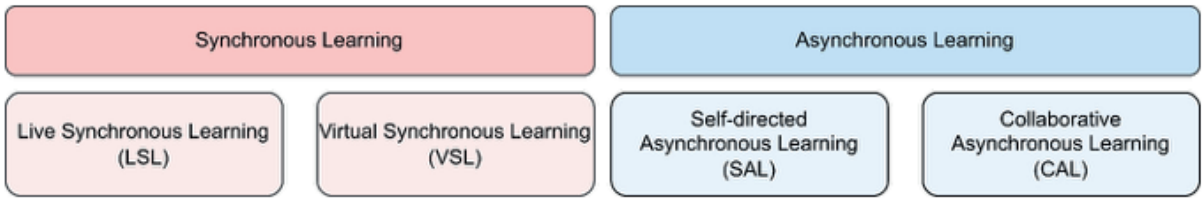

Figure 7. Conceptual Framework in BL Setting

Referring to Figure 7, the researchers revised the setting description in the initial model because there was information such as in-class and out-of-class activity stages. Then, the researchers changed the activity setting by referring to the conceptual framework of the BL setting, as in Figure 7. It becomes an environmental background for creating BL in the developed model. In the ISD model developed (see Figure 8), researchers have prescribed that the flow of learning activities starts from the *Asynchronous* dimension to *Synchronous* and ends back to *Asynchronous*.

In the *first* A*synchronous dimension*, all activities are carried out through LMS and ILV. A lecturer delivers materials through LMS and questions in ILV. Then, the students study the material and work on the questions independently in ILV. These activities occur in the *Self-directed Asynchronous Learning* (SAL) realm. Then, the learning shifts to class, where the lecturer can give a problem, enabling students to apply the concepts learned in the previous SAL domain. These two activities occur in the *Live Synchronous Learning* (LSL) domain. Finally, after LSL domain activities end, the lecturer can give a reflection task on the learning process that has been carried out. In addition, the lecturer can also give a transfer of learning task, which requires students to work together to solve more complex problems to deepen their understanding. This last activity occurs in the *second Asynchronous* dimension (the *Collaborative Asynchronous Learning* realm).

To address Expert 2's contributions to foundational principles for activities in a BL environment, the researchers used the model flow by Chaeruman et al. (2020), which includes four phases: learning, deepening, applying, and evaluating (see Figure 1). This model helps instructors organize activities by learning stages. For example, during the pre-class stage (self-directed asynchronous learning), they can select tasks that improve students' comprehension of the material.

In the one-to-one formative evaluation, the researchers incorporated the "pairing" activity into the PI activity based on Lecturer 1's feedback. In response to Lecturer 2's suggestions, they removed the "dotted arrows" from the model. The revisions based on the experts' recommendations are detailed in Table 6.

Table 6. Revisions Summary

Experts	Revisions Made
Instructional Designer 1	a. Placing pre-class activities in JiTT as a warm-up session for concept application activities in PI class; b. Asking questions in the form of cases (problems).
Instructional Designer 2	Using the Model of Criteria for Determining Appropriate BL Strategy (Chaeruman et al., 2018) to determine learning targets.
Instructional Designer 3	Using a conceptual model to design various BL activities from Chaeruman et al. (2018) and Chaeruman & Maudiarti (2018)
BL Expert 1	Applying A conceptual framework of BL setting from (Chaeruman et al., 2020)
BL Expert 2	Applying the flow model principle (LDAE) from Chaeruman et al. (2020)
Lecturer 1	Write down PI activities explicitly in a particular session.
Lecturer 2	Remove diagonal dashes in model syntax.

The Revised Tentative ISD Model

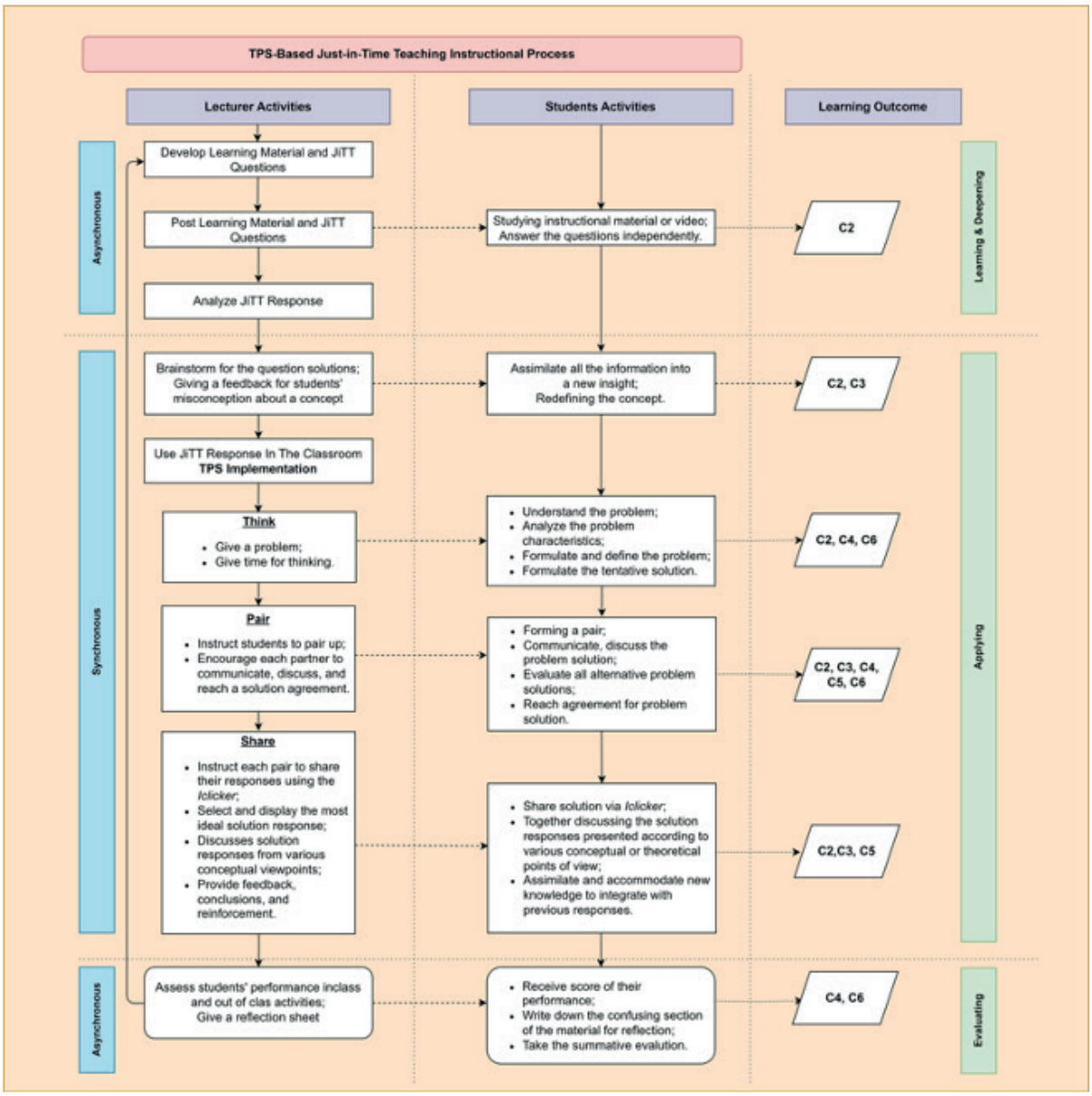

Figure 8. ISD model of PI strategy implementation in JiTT-based BL environment

Figure 8 illustrates the revised ISD model. The model can be briefly explained through the following steps:

- A lecturer creates learning resources and assessment questions, which are then uploaded to the LMS or ILV. Students then independently engage with the content and respond to the questions.
- The instructor evaluates the students' responses and subsequently aligns their comprehension to inform the development of classroom learning.
- The instructor will address students' misunderstandings based on their comprehension levels and reformulate their conceptual frameworks.
- The educator presents a relevant problem, and students then consider potential solutions.
- The instructor pairs the students for a discussion to find the best solution to the problem.
- The instructor asks each pair to present their solution using the SRS platform (like Iclicker or Socrative) and then reviews all responses to identify the best solution.
- The instructor asks students to document their learning experiences and challenges, and an evaluation is conducted after all instructional content is completed.

First Field Test

The revised ISD model will be assessed by two instructional designers and a BL expert, along with ten lecturers teaching three course types: three on learning strategies, four on classroom management, and three on citizenship education. The experts did initial validation, followed by the lecturers' validation. Findings from the experts' assessment are detailed in Table 6.

Table 6. The Feasibility Test Results of the Developed ISD Model

No.	Aspects Assessed	Score			Maximum Score
		Validator 1	Validator 2	Validator 3	
1	Relevant to learning theories	4	4	4	15
2	Relevant to BL concept	4	4	4	15
3	Provide a framework	5	5	4	15
4	Logic and systematic	5	5	5	15
5	Understandable and easy to follow	4	4	5	15
6	Systemic as an instructional model	5	4	4	15
7	Operational enough as a framework	4	4	4	15
Overall		31	30	30	105

Table 6 shows that experts rated the product's feasibility at 87%, indicating high viability within a learning system design model or theory perspective (see Table 1). Additionally, ten lecturers will validate the product's practical application, with results summarized in Table 7.

Table 7. The Practicality Test Results of the ISD Model by Lecturers

No.	Aspects Assessed	Mean Score	Category
1	The steps in this model are logically and systematically arranged.	95	Very valid
2	This model can increase student involvement in the learning process.	92	Very valid
3	This model encourages active interaction between teachers and students.	90	Very valid
4	This model supports various student learning styles.	80	Quite valid
5	This model is flexible and adaptable to various learning contexts.	78	Quite valid
6	This model is adjustable to individual student needs.	85	Very valid
7	This model encourages creative and innovative learning methods and techniques.	90	Very valid
8	The resources needed to implement this model are easily accessible.	84	Very valid
9	This model encourages students to think critically in solving problems.	91	Very valid
10	I would recommend this model to other fellow lecturers.	80	Very valid
Overall		86,5	Very valid

Table 7 indicates that the lecturers assigned a score of 86.5% to the product, signifying that it was evaluated as highly feasible regarding its practicality (refer to Table 1).

Second Field Test

At this stage, thirty students will assess the practicality of the ISD model for use in daily learning activities. Table 8 describes the results of the ISD model practicality test.

Table 8. Results of the Practicality Test of the ISD Model by Students

No.	Aspects Assessed	Mean Score	Category
1	The steps to be taken in this model are easy to follow.	87	Very valid
2	The learning method in this model helps me understand the learning material better.	80	Quite valid
3	This model encourages me to be more actively involved in learning activities.	94	Very valid
4	This model increases my motivation to learn.	87	Very valid
5	The resources required in this model are easy to access and use.	86	Very valid
6	This model helped me develop critical thinking skills.	85	Very valid
7	This model is flexible and can be adapted to my learning needs.	89	Very valid
8	I am satisfied with the learning experience using this learning model.	90	Very valid
Overall		86,5	Very valid

Table 8 indicates that students provided an evaluation score of 86.5%, suggesting that the product was highly feasible (see Table 1).

Third Field Test

This session evaluates the effectiveness of the ISD model in improving students' HOTS, specifically problem-solving and critical thinking. The study involved 40 students in a classroom management course, assessing problem-solving through essay questions and critical thinking using the Critical Thinking Disposition Scale (Sosu, 2013).

The evaluation followed a paired-sample t-test, revealing a significant difference in students' problem-solving and critical thinking abilities before and after instruction using the ISD model. The model's impact on these variables was measured using Cohen's d-effect size test (Cohen, 1988).

Figure 9 shows the score changes from the pretest to the post-test for problem-solving and critical-thinking variables, with the ISD model's impact assessed using formula 2. The statistics for problem-solving ability are $\bar{X}_1 = 59, \bar{X}_2 = 70, s_1 = 19, s_2 = 21,$ and an effect size of 0,549 is obtained to fall into the medium criteria (see Table 2). The statistics for critical thinking ability are $\bar{X}_1 = 63, \bar{X}_2 = 79, s_1 = 19, s_2 = 21,$ is obtained so that it falls into the significant criteria.

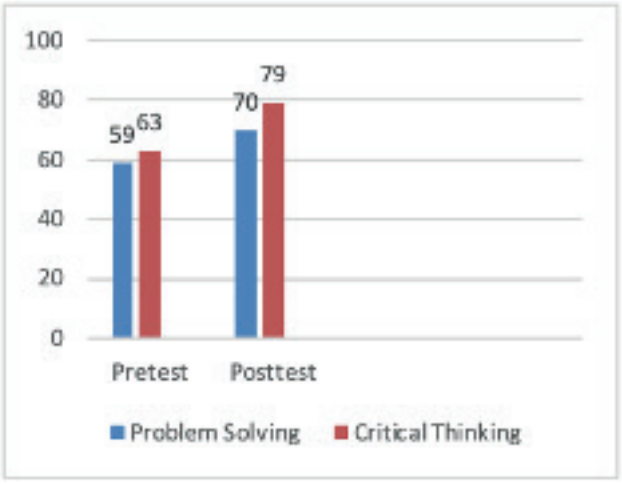

Figure 9. Differences in pretest and post-test scores for the variables problem-solving skills and critical thinking skills

DISCUSSIONS

Developing an ISD model requires a context-specific theoretical foundation. Therefore, ISD model developers must reference relevant theories during construction (Reigeluth, 2009). In this study, researchers developed a PI learning model within a BL environment using the JiTT strategy, a variant of the BL model.

Chaeruman et al. (2020) identified two main categories of BL: synchronous (further divided into live synchronous learning and virtual synchronous learning) and asynchronous (divided into self-directed and collaborative asynchronous learning). Similarly, Ulfa et al. (2020) describe BL through four dimensions: Onsite Synchronous Mode, Virtual Synchronous Mode, Personal Asynchronous Mode, and Collaborative Asynchronous Mode. These frameworks serve as a foundation for implementing the JiTT environment.

Learning activities in the JiTT strategy occur in four domains (G. Novak & Patterson, 2010). The First is developing effective questions. The Second is uploading the questions and setting a response time limit. The third is analyzing learners' JiTT responses. In this session, an instructor evaluates students' understanding of the material. The instructor can find and map the students' thinking skills. Information from this session becomes the basis for designing learning activities in the classroom. These three sessions are included in pre-class activities.

Pre-class activities are generally conducted asynchronously, using SAL or CAL mode. In SAL mode, instructors use various LMS or ILV platforms. In CAL mode, learners can create discussion groups to carry out activities. However, researchers implement learning activities in SAL mode in this ISD model.

The Fourth focuses on using the JiTT strategy in classrooms, applicable in LSL or VSL formats (Ismail & Abdulla, 2019; Rowley & Green, 2015). An instructor bases their teaching on students' pre-class activities, often using PI and concept tests with multiple-choice questions to enhance understanding (Sayer et al., 2016; Watkins & Mazur, 2010). Li et al. (2021) implemented PI in LSL with a mobile chatbot for polls and discussions, while Rowley & Green (2015) created an interactive peer discussion to develop students' knowledge. Alfadda et al. (2022) proposed a scenario for PI within JiTT, encouraging instructors to ask thought-provoking questions for engaging discussions.

According to the researcher above, the PI scenario has various variations, but one concept is typical: the discussion process. The discussion applied can be factual-conceptual questions or problem-solving. In other words, the syntax and content of the strategy are flexible. Therefore, the developed ISD model wants to provide a complete or patent concept in terms of syntax and learning content.

The PI activities in this framework focus on the TPS strategy, emphasizing problem-solving to enhance learning. Currently, there are no standardized protocols for applying the PI strategy in the JiTT context, and

some researchers equate PI with TPS (Mundelsee & Jurkowski, 2021; Ragan, 2024). Studies have shown that TPS effectively improves problem-solving skills (Alsmadi, Tabieh, Alsaifi, & Al-Nawaiseh, 2023) and promotes critical thinking (Ganatra et al., 2021).

The JiTT strategy's basic concept, which combines pre-class activities (asynchronous) with direct learning in class (synchronous), requires theoretical consideration in its application. Instructors must harmoniously align the time and proportion of the two modes (Nurrijal, Setyosari, Kuswandi, & Ulfa, 2023). There is no definite measure of when and how long each learning mode lasts. Therefore, it is an art to harmonize synchronous and asynchronous learning activities to provide a maximum learning experience (Varkey et al., 2023).

This ISD model, based on Chaeruman et al. (2018) model (in Figure 6), evaluates time and focus in synchronous and asynchronous activities. It shows that as learning objectives become more complex, learner engagement increases, and greater sensory and motor involvement leads to more emphasis on activities and longer durations for each learning mode.

Instructors refer to the level of thought involvement for each learning target to determine the emphasis of activities and duration at each stage of the ISD learning model. For example, at the "Pair" stage, where there are five learning targets (C2-C6), an instructor and students can devote a lot of time and activities to it.

Instructors need a structured learning path in both synchronous and asynchronous environments to support applied learning activities. This path guides interactions among instructors and students (Sarac & Dogan, 2022), among students (Lin & Wang, 2024), and between students and content (Kumar, Saxena, & Baber, 2021) while outlining the sequence of activities in the ISD model. Scholars have proposed various frameworks for BL. For example, Machumu et al. (2018) highlight group work, online collaboration, and assessments, while Sitthiworachart et al. (2021) present Kolb's learning cycle, which includes concrete experience, reflective observation, abstract conceptualization, and active experimentation. Chaeruman et al. (2020) suggest a learning path of learning, deepening, applying, and evaluating (LDAE) activities, which serves as a foundation for planning and developing learning activities within the ISD model.

The selection of LDAE as a template for activities in the BL environment is very appropriate for several reasons. First, the pre-class activities (JiTT sessions) used as a preparation stage for learners in learning and measuring conceptual understanding (Rowley & Green, 2015), are considered relevant to the sequence of Learning and Deepening concepts. Then, entering the classroom learning session, which requires learners to apply the concepts they have learned in pairs to solve problems given by the instructor (Liberatore, Morrish, & Vestal, 2017; Zou & Xie, 2019), is considered relevant to the "Application" activity. Meanwhile, the reflective activities and summative evaluation at the end of learning are relevant to the "Evaluation" activity (Chang, 2019).

CONCLUSION

This research produces a learning product in the form of an ISD model in a systematic learning syntax form that guides instructors in Islamic Colleges to integrate the PI approach in a JiTT-based BL environment. The product is built from interrelated learning components that form a procedure. These components come from various learning and teaching theories, e-learning BL concepts, Etc. The learning and teaching theories that underlie this model are taken from theories closely related to the development of active, collaborative learning, critical thinking, and problem-solving.

The final ISD model results from improvements in the validation test process by experts from various fields, instructors, and students from several courses. The results of the validation test from several learning designers, the practicality test of the ISD model by several lecturers and students, and the effectiveness test of the ISD model in improving HOTS overall showed very decent results.

This study significantly contributes to instructors and policymakers in higher education, especially in Islamic colleges. It provides a practical model combining constructive strategies such as PI into a JiTT-based BL environment, which enhances students' cognitive engagement. It supports the development of fundamental Islamic values such as ijtihad and shura, emphasizing the importance of collective discussion and deliberative decision-making. It engages students in reflective discussion, emphasizing rationality and collective reflection, aligning with the Islamic intellectual tradition.

Although the final ISD model has been proven effective in improving HOTS, its effectiveness has yet to be tested in mathematics and science learning. However, basic guidelines for implementation in both areas can follow this path. When the final ISD model is used to develop problem-solving in mathematics, an instructor can use warm-up questions (JiTT) to review mastery of key concepts before class. Students discuss complex problems during the PI in class, sharpening their insights through collaboration. In science, an instructor can assign assignments before lab (out of class in JiTT) that allow students to conduct real-world experiments. Other researchers can test the model's potential to enhance HOTS in computational and experimental fields such as physics and chemistry, allowing for a broader potential of the model.

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