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Flipped Direct Instruction (FDI): A New Practicum Learning Model in Vocational Education

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Abstract. The Flipped Direct Instruction (FDI) learning model was introduced as a new learning model for practicum learning. It was developed to mitigate the limitations of the Direct Instruction (DI) model in improving vocational education graduates' competencies. Therefore, the purpose of this study is to examine the formation of the FDI learning model. This research uses an exploratory sequential mixed methods design with Mile and Huberman methods and Confirmatory Factor Analysis (CFA). The FDI learning model is formed through conceptual, theoretical, hypothetical, and final modeling stages. Research data were obtained through document analysis and Focus Group Discussion (FGD). FGD was conducted with 7 experts as the research sample and non-test instruments were used. The result of this study is an FDI learning model formed from several theories including Joyce (2003), Cooper (2012), Ktoridou (2018), and Indrajit (2021). The FDI model consists of an orientation phase, procedure-based simulation phase, case-based simulation phase, structured practice phase, guided practice phase, and independent practice phase. Each phase obtained CFA values of 0.464, 0.492, 0.292, 0.009, 0.016, and 0.018. All values are below 2, revealing that the FDI model has a goodness-of-fit-model criteria. The FDI model is presented as a contribution to the development of science and as a new learning model option recommended for vocational education. In the future, this research will contribute to the evaluation of the FDI learning model in measure its level of practicality, effectiveness, and impact on model application.

Keywords: Flipped Direct Instruction; New Learning Model; Vocational Education

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1. Introduction

The learning model has major implications for the formation of student competence. In the process of forming student competencies, learning models are implemented according to the mode of learning (Joyce & Weil, 2003). Popular learning models currently used in theoretical learning are Problem-Based Learning (PBL), Discovery Learning, Contextual Learning, Flipped Classroom, and Project-Based Learning (Joyce & Weil, 2003; Yulianto et al., 2019). Meanwhile, learning models widely used in practical learning are Self Directed Learning, Role Playing, Simulation and Direct Instruction (Joyce & Weil, 2003; Yulianto et al., 2019). Each learning model is organized in structured and systematic phases (Joyce & Weil, 2003). For example, the Direct Instruction (DI) learning model, conceived by Jere Brophy and Tom Good in 1986 (Joyce & Weil, 2003, p. 20), is a learning model that consists of orientation, presentation, structured practice, guided practice, and independent practice phases. It manages the ability to think and behave in a practical learning environment (Joyce & Weil, 2003; Patandean & Indrajit, 2021).

The DI model is one of the earliest learning models found and is widely used today (Chamidy et al., 2020; Flynn et al., 2012; Glogger-Frey et al., 2015; Gurses et al., 2015; Warju et al., 2020; Winarno et al., 2018; Winarsih et al., 2019). However, at present, the implementation of the DI model has several drawbacks, including the formation of students' initial knowledge. In this model, initial knowledge cannot be adequately formed because this learning style is very dependent on the teacher (Warju et al., 2020). In fact, initial knowledge should be obtained before learning commences, not built during learning in the classroom (Dehham & Albayati, 2021). This is because knowledge must be assimilated in students' active process and through good mental capacities, so that complexity can be developed through understanding. Following this, understanding is assembled by students through an equilibration process, where initial knowledge is compared against acquired knowledge (Gurses et al., 2015; Paulsen et al., 2019).

Interaction in the Direct Instruction learning model is dominated by the teacher. The domination of the teacher in the classroom suppresses student activity in the learning process (Aziz et al., 2018). This forms the next problem in the DI learning model (Gurses et al., 2015; Winarno et al., 2018). A teacher's suppression of active learning leads to student passivity in the classroom (Zayyadi et al., 2020). Students' passivity in learning reduces their ability to build their own understanding and knowledge (Winarno et al., 2021). This reduces the interest and motivation of students to learn. A lack of interest and motivation will make learning boring, thereby reducing students' enthusiasm (Warju et al., 2020; Winarno et al., 2021; Winarsih et al., 2019). This low enthusiasm will impact students' ability to understand the learning material provided by the teacher.

High teacher dominance in the learning process reduces the freedom and independence of students in learning. This in turn will reduce students' ability to independently adapt to their learning environment (Winarno et al., 2021; Zayyadi et al., 2020). A lack of student independence leads to passivity (Budiman et al., 2020; Warju et al., 2020), and passive learning inhibits students from generating innovative ideas (Ahmad et al., 2022; Glogger-Frey et al., 2015). Students' ideas impact their problem-solving ability, born from good critical thinking skills. For this reason, critical ability is one of the weaknesses of the DI learning model (Budiman et al., 2020; Gurses et al., 2015; Winarsih et al., 2019).

Critical thinking skills can only be built if students are granted sufficient learning opportunities to be creative and innovative. Creativity and innovation can be stimulated by problem-based learning or case-based learning (Courtney et al., 2015; Ktoridou et al., 2018). Students can be given the opportunity to solve problems or cases independently or collaboratively in teams (Winarno et al., 2018). Independent learning allows students to build their own knowledge, while teamwork-based learning promotes students' creativity, innovation, and teamwork (Aziziy et al., 2020; Nuris & Istyaningputri, 2021). In problem-solving or case-based learning, teachers are required to always monitor student work, provide the necessary facilities, and offer evaluative and constructive directions and suggestions (Joyce & Weil, 2003).

In the DI learning model, independent learning and teamwork for problem solving are not well facilitated. This is because this model has the characteristics of guided and procedural learning (Winarno et al., 2018). Therefore, the DI model cannot facilitate these capabilities, even though the ability to strengthen initial knowledge, think critically, be creative, and collaborate are some of the competencies that students need to have in the 21st century (Huda et al., 2021; Viinikka et al., 2019). For this reason, several researchers have proposed various solutions to maximize the use of the DI model.

Gurses et al. (2015) combined the DI model with the Constructivist Learning base, which was named the Interactive Direct Teaching Based Constructivist Learning (IDTBCL) model. The IDTBCL model was developed to strengthen learners' ability to conceptualize ideas and use their mental abilities. Winarsih et al. (2019) merged the DI model with the Problem Based Learning model in accounting subjects. The combination was able to improve students' critical thinking skills as measured by the ANOVA method. Warju et al. (2020) used Real Condition Video media in the application of the DI model. It was tested in Basic Automotive Engineering subjects with an increase in student learning outcomes. Winarno et al. (2021) utilized multimedia in the DI model combined with Problem Based Learning. The combination of these models is named multimedia Direct Problem Based Learning (mDPBL). The mDPBL model is able to improve problem solving skills and mastery of subject matter by students.

Based on the development of the DI model that has been proposed, there is still a weakness: each proposed model has its own advantages. There is no development of DI learning models that have comprehensive advantages. On the other hand, the DI learning model is still widely used, especially in vocational education. This is based on Stockard's research in 2020 which has reviewed more than 500 articles from DI learning models which dominate in vocational education (Stockard et al., 2020).

The implementation of the DI learning model in vocational education has not produced graduates ready to work in Indonesia. This can be identified from the number of vocational education graduates in Indonesia, who form the largest contributor to open unemployment in Indonesia with 9.42% as of August 2022 (Central Bureau of Statistics Indonesia (BPS), 2022). Due to the weaknesses of the DI model in improving initial knowledge, critical thinking skills, independent learning, cooperation, and creativity of students in improving the competence of vocational education graduates, the DI learning model requires urgent improvement. Therefore, this study explores the development of DI learning models from a different perspective.

The perspective of DI model development in this research occurs by combining direct and indirect learning models. The reason for this combination is because direct learning is excellent for teaching facts, rules, and learning sequences that will improve technical skills, investigation, and discovery, while indirect learning is excellent for teaching concepts, patterns, and abstractions in improving the ability to solve problems, think critically, and collaborate (Budiman et al., 2020; Rüütmann & Kipper, 2011). Therefore, to present a more optimal practicum learning model, the DI model as a direct learning model is combined with the Flipped Classroom (FC) learning model. The FC learning model is part of a blended learning model that can be used indirectly (Staker & Horn, 2012). The indirect learning model in the FC learning model allows students to prepare their prior knowledge better (Patandean & Indrajit, 2021).

Stable prior knowledge promotes further creativity, critical thinking, and collaboration to help achieve practicum learning (Gurses et al., 2015). In practicum learning, students require cognitive skills, interpersonal skills, and attitudes that demonstrate competent behavior in a particular field or profession (Holmes et al., 2021). In achieving all these competencies, it is necessary to use an improved DI learning model. Therefore, the main objective of this research is to increase the capability of the DI learning model by combining it with the FC learning model, where the combination of the two models is named the Flipped Direct Instruction (FDI) learning model. Specifically, the purpose of this research is to discuss the process of forming the FDI model from the conceptual, theoretical, hypothesis, and final model stages as a new alternative in practicum learning.

2. Method

2.1. Research Design

This study used an exploratory sequential mixed methods design research approach to determine the impacts of the FDI learning model as a new alternative in practicum learning. The qualitative research approach was conducted using the Mile and Huberman method. Then, the researcher proceeded to using method Confirmatory Factor Analysis (CFA) for quantitative research approaches (Creswell, 2012, p. 543).

2.2. Participants of The Study

The participants in this study were 7 experts in the field of learning models. This participant selection uses saturated sampling, where the population becomes the sample. This is because the number of participants in the population is less than thirty (Riyanti & Parulian, 2023).

2.3. Development of The Research Instrument

The instrument used in collecting data is a non-test instrument. This instrument is based on the factors that make up the FDI model. This instrument uses a Likert scale. The Likert scale used is one for 'strongly disagree' to five for 'strongly agree'. The instruments used have passed the validity and reliability tests. Instrument validity uses Aiken's V formula and reliability uses Cronbach Alpha formula. For categories in the measurement of validity and reliability can be seen in Table 1.

Table 1. Categories of Validity and Reliability Test Data

Aiken's V value	Category	Cronbach Alpha r Value	Category
0,67 – 1,00	Valid	0,81 – 1,00	Very High
		0,61 – 0,80	High
≤ 0,66	Invalid	0,41 – 0,60	Medium
		0,21 – 0,40	Low
		0,00 – 0,20	Very Low

Source: (Azwar, 2019, p. 113; Tambunan et al., 2021)

The data obtained uses instruments to build the FDI model. The stages of building the FDI model can be seen in Figure 1.

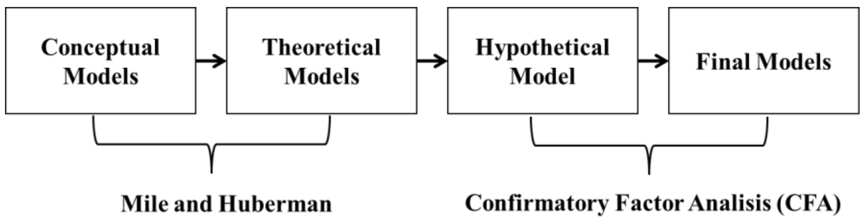

Figure 1. The Stages of Establishing The FDI Learning Model

Based on Figure 1 above, the Mile and Huberman method was used to construct a conceptual and theoretical model of the FDI learning model. The CFA method was used to develop a hypothetical model and the final iteration of the FDI learning model.

2.4. Data Gathering

Data were obtained through document analysis and through Focus Group Discussion (FGD) with 7 experts as research participants. Data obtained through document analysis are used as a conceptual and theoretical FDI model builder using the Mile and Huberman method. Then, the data obtained through FGD use the CFA method to hypothetically formulate the FDI model and the final model.

2.5. Data Analysis

Mile and Huberman Method

The Mile and Huberman method is a method for processing and analyzing qualitative data. The Mile and Huberman method has stages, namely collection, reduction, display, and verification (Miles et al., 2014, p. 33). Each stage is carried out to create the conceptual and theoretical nature of the FDI learning model. The conceptual model has the form of concepts and ideas from the formation of the FDI model. The concept is built from the analysis of problems and opportunities obtained from each literature review, while in the theoretical model, the FDI model has been formed in the learning phase. Here, each phase is built based on the analysis of relevant concepts and theories. For this reason, each stage of the Mile and Huberman method is used.

The first stage is data collection from document analysis. The document analysis comes from documents in the form of articles and books themed on learning models. At this stage, the data obtained from documents is compiled and grouped for analysis. Data that has been arranged according to groups is processed at the reduction stage.

At the reduction stage, the necessary data is sorted and analyzed. Analysis is achieved by comparing, eliminating, and compiling data. Data that has been organized by group is compared with data from other groups. The same data is then eliminated, until one item of data is left that is representative of the removed data. The remaining data is then combined with other data to build a complete data set. The complete data is then presented. Data presentation is in the form of descriptive text information which is then verified before a conclusion is made (Miles et al., 2014). The conclusion is the result of qualitative data analysis.

Confirmatory Factor Analysis (CFA)
Confirmatory Factor Analysis (CFA) is an analytical technique that aims to determine how many factors exist and whether these factors need to be correlated. Such factor testing can be used in testing the construct validity of a model (Ashari et al., 2019; Maksum & Purwanto, 2019, p. 206; Nofriansyah, 2020). The construct validity test of a model can be used to answer the hypotheses in this study. The hypotheses in the development of the FDI learning model consist of:

Ha: FDI learning model is valid for use

H0: FDI learning model is not valid to use

The CFA method is used to answer the hypotheses. The CFA method uses quantitative data obtained from FGD. Obtained data were calculated using the CFA method with the help of statistical applications, namely Lisrel 8.80. In the CFA calculation, criteria proposed by Stevens and Mayers is used. The chosen criteria proposed by Stevens and Mayers are the chi-square (x2) divided by the degrees of freedom test (df), (Meyers et al., 2013, p. 871). The description of the technique (x2/df) is presented in Table 2.

Table 2. Categorizing The Fit Index (Test)

Categorizing the fit index (test)	Target values
x^2/df	< 2

Source: (Jackson, 2018, p. 5; Meyers et al., 2013, p. 870)

Based on table 1, data (x^2/df) can be considered valid if the value is below 2. Therefore, a phase or learning model is deemed valid or as a goodness-of-fit-model if the value of (x^2/df) is below 2 (Anderson et al., 2001; Jackson, 2018; Maksum & Purwanto, 2019).

3. Research Result
The results of this research are categorized into qualitative and quantitative results. Qualitative results are described by themes that constitute conceptual and

theoretical models. On the other hand, quantitative results are described according to the hypothesis model and the final model. In obtaining quantitative data using non-test instruments, the results of the validity and reliability tests can be seen in Table 3.

Table 3. Validity and Reliability Test Results of Research Instruments

Test	Test Score	Category
Validity	0,867	Valid
Reliability	0,751	High

Based on Table 3, the instruments used are valid and reliable. Therefore, this research instrument is appropriate for use in obtaining research data. The description of the data analysis of the research results is as follows.

3.1. Conceptual Models

The FDI learning model is established through the development of the DI learning model combined with the FC learning model. The development of the FDI learning model is needed to increase the effectiveness of using the DI learning model as a new practicum model or alternative practicum practice. Therefore, conceptually, the DI learning model was combined with the Flipped Classroom (FC) learning model, as reflected in Figure 2.

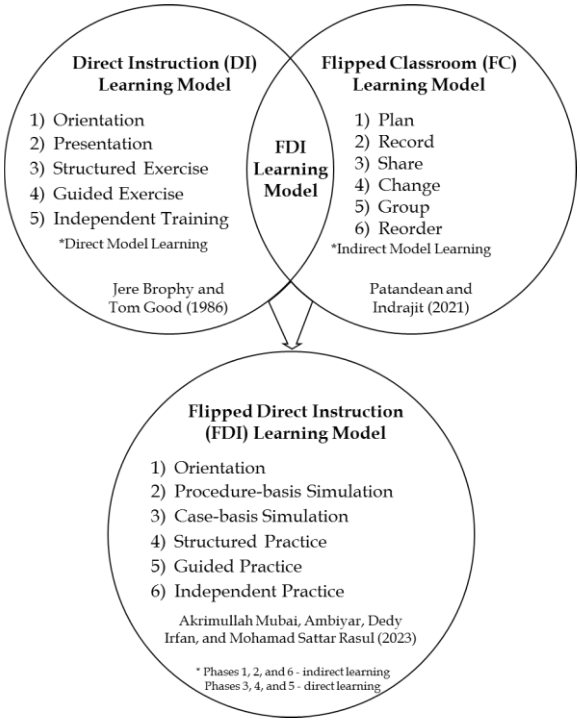

Figure 2. The Concept of Forming The FDI Learning Model

Conceptually, on Figure 2, the combination of the DI and FC learning models formed a new learning model called Flipped Direct Instruction (FDI). The FDI model obtains indirect learning from the FC model and direct learning from the DI model. Therefore, the concept of this new learning model requires theoretical support, whether from a combination of learning models or by establishing each phase of the FDI learning model.

3.2. Theoretical Model

The establishment of the FDI learning model is theoretically based on the theory of Brophy in 1989 as an inventor of the DI learning model and Patandean in 2021 as a developer of the FC learning model (Joyce & Weil, 2003; Patandean & Indrajit, 2021). In particular, the formation of an FDI learning model using these two theories is possible because the models' characteristics are complementary. The FC model was used for asynchronous and indirect learning, while the DI model was for synchronous and direct learning. The formation of phases in the FDI model is built based on several theories forming each model phase. The forming theory of the FDI model phase is presented in Table 4.

Table 4. Theory Formation of the FDI Learning Model Phases

Phases	The Source of Phase Formation	The Theory of Phase Forming	Factors
1 Orientation (ORI)	The accommodation and phase modification in the DI model (orientation and presentation) and phases of the FC model (planning, recording & sharing)	Joyce & Weil (2003, pp. 349–350) Patandean & Indrajit (2021, p. 28) Vanek et al. (2020, p. 40)	The implementation of learning preparation (ORI1) The availability of easy and cheap teaching materials (ORI2) The formation of perception and initial knowledge (ORI3) The implementation of asynchronous learning communication (ORI4) Facilitating the independent learning (ORI5)
2 Procedure-based simulation (SBP)	A new phase in the FDI model	Cooper et al. (2012) Joyce & Weil (2003, pp. 355–357) Salminen-Tuomaala (2019) Smaldino et al. (2014) Warwick et al. (2016)	The availability of simulation tools and materials (SBP1) The reliable simulation tools and materials (SBP2) The capability and mobility of simulation tools and materials (SBP3) The formation of initial knowledge in the Lower Order Thinking Skills (LOTS) category (SBP4) The communication implementation for learning simulation (SBP5)
3 Case-based Simulation (SBK)	The new phases of the FDI model and implementation phases of the FC model (group)	Courtney et al. (2015) Joyce & Weil (2003, pp. 357–358) Ktoridou et al. (2018)	The cooperation (SBK1) Discussion to resolve cases (SBK2) The formation of critical thinking skills (SBK3) Growing the creativity (SBK4)

Phases	The Source of Phase Formation	The Theory of Phase Forming	Factors
		Patandean & Indrajit (2021, p. 28) Ridho (2019) Smaldino et al. (2014) Warwick et al. (2016)	Growing the Higher Order Thinking Skill (HOTS) (SBK5) Discussion of cases to avoid misperceptions and misconceptions (SBK6)
4 The structured Practice (PTR)	The accommodation of DI model phases (structured practice) and the proofing of procedural basis simulation	Joyce & Weil (2003, pp. 347–350)	Procedural-based simulation proofing (PTR1). Increased the understanding of form, function, and how to use practicum tools and materials (PTR2). Increased understanding of Standard Operating Procedures and Occupational Health & Safety (PTR3). Psychomotor enhancement (PTR4). Increased motivation (PTR5). Lockstep method in increasing understanding and ability (PTR6). The meaningful experiences for the future (PTR7). Corrective and constructive feedback to build confidence (PTR8).
5 Guided Practice (PTB)	The accommodation and modification of phases in the DI model (guided practice) and phases of the FC model (change) as well as proof of case-based simulations.	Joyce & Weil (2003, pp. 347–350) Patandean & Indrajit (2021, p. 28)	Case-based simulation verification (PTB1) Independence in practice (PTB2) The ability to solve technical cases (PTB3) The ability to cooperate technically (PTB4) Corrective and constructive feedback in finding solutions (PTB5).
6 Independent Practice (PTM)	The accommodation and modification of phases in the DI model (self-practice) and phases of the FC model (rearranging)	Joyce & Weil (2003, pp. 350–351) Patandean & Indrajit (2021, p. 28)	Strengthening memory (PTM1) Strengthening understanding (PTM2) Strengthening knowledge (PTM3) Implementation of documentation (PTM4) Flexible implementation (PTM5)

The results of the theoretical analysis of the FDI learning model would strengthen the foundation for the formation of the learning model. To make the FDI model more testable, it was necessary to test the validity of the FDI learning model to ensure that the developed model was ready for use. The FDI model validity test is presented in the hypothetical model.

3.3. Hypothesis Models

The hypothetical model was formed based on the results of the Focus Group Discussion (FGD) with 7 experts. The resulting data from the FGD is calculated and presented in Figure 3.

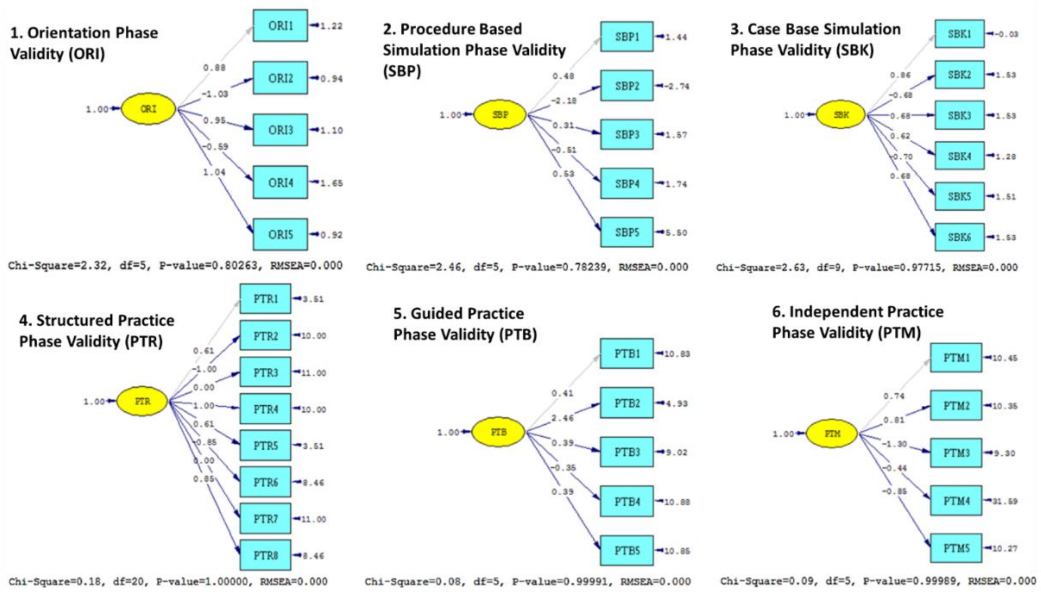

Figure 3. Validation of Each Phase of The FDI Learning Model

Based on Figure 3, the data obtained from the FGD results were calculated using the CFA method. Calculations ware continued in CFA to obtain values (x2/df) for each phase of the FDI model. The first phase was the Orientation phase (ORI) with five forming factors (ORI1-ORI5) obtaining a Chi-Square (x2) value of 2.32, a df value of 5, and a value (x2/df) of 0.464. The value of 0.464 < 2 showed that the Orientation phase (ORI) in the FDI model was valid/fit. The second phase was the Procedure Based Simulation (SBP) phase with five forming factors (SBP1-SBP5) obtaining a Chi-Square (x2) value of 2.46. The df value was 5 and the value (x2/df) was 0.492. The value of 0.492 < 2 indicated that the Procedure Based Simulation (SBP) phase in the FDI model was valid/fit. The third phase was the Case Base Simulation (SBK) phase with six forming factors (SBK1- SBK6) obtaining a Chi-Square (x2) value of 2.63. The df value was 9 and the value (x2/df) was 0.292. The value of 0.292 < 2 showed that the Case Base Simulation (SBK) phase in the FDI model was valid/fit.

Furthermore, the fourth phase, the Structured Practice (PTR) phase with eight forming factors (PTR1-PTR8) obtained a Chi-Square (x2) value 0.18, the df value 20, and the value (x2/df) 0.009. The value of 0.009 < 2 indicated that the Structured Practice (PTR) phase of the FDI model was valid/fit. The fifth phase, the Guided Practice (PTB) phase, with five forming factors (PTB1-PTB5) obtained a Chi-

Square (x2) value of 0.08, df value of 5, and value (x2/df) of 0.016. The value of 0.016 < 2 indicated that the Guided Practice (PTB) phase of the FDI model was valid/fit. Finally, the sixth phase was the Independent Practice (PTM) phase with five forming factors (PTM1-PTM5) obtaining a Chi-Square (x2) value of 0.09, a df value of 5, and a value (x2/df) of 0.018. The value of 0.018 < 2 indicated that the Independent Practice (PTM) phase of the FDI model was valid/fit. All phases in the valid FDI model form the goodness-of-fit-models and answer the research hypothesis. The hypothesis accepted in this study is the alternative hypothesis (Ha). The hypothesis (Ha) revealed that the FDI learning model is valid for use. The results of the accepted hypothesis model could be continued in the formation of the final model.

3.4. The Final Model

The final model was proposed after going through a conceptual and theoretical formation which showed that the FDI model was created by combining the DI model initiated by Brophy in 1986 with the FC model initiated by Patandean in 2021 (Joyce & Weil, 2003; Patandean & Indrajit, 2021). Based on Figure 3, the final iteration of the FDI model was presented in Figure 4.

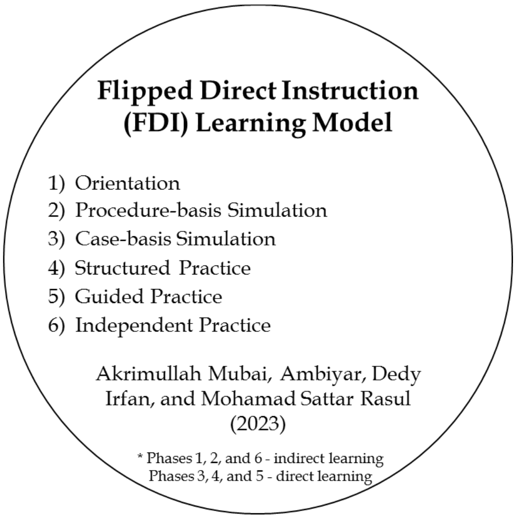

Figure 4. Flipped Direct Instruction (FDI) Learning Model

Based on Figure 4, the final iteration of the FDI learning model consisted of Orientation, Procedure-Based Simulation, Case-Based Simulation, Structured Practice, Guided Practice, and Independent Practice phases. Based on the model hypothesis testing, the final FDI model was ready to be used as a new learning model in contributing as an alternative for practicum implementation.

4. Discussion

The FDI learning model was successfully developed. Conceptually, the FDI learning model was formed from a combination of the DI learning model and the FC learning model. The combination of the two models represented a combination of direct and indirect learning models. The DI learning model is part of the direct learning model and the FC model is part of the indirect learning model. The combination of direct and indirect learning models aligns with the theories of Budiman et al. (2020) and Rüütmann and Kipper (2011), who state that direct and indirect learning models can be combined for enhanced learning. This combination looks to optimize students' technical competence, critical thinking, creativity, and cooperation. The FDI learning model was a learning model combining direct and indirect learning, as shown in Figure 2.

Theoretically, the FDI learning model is formed by a combination of Brophy's DI learning model theory with Patandean's FC model theory (Joyce & Weil, 2003; Patandean & Indrajit, 2021). Based on Table 2, the FDI learning model had six learning phases. The first phase in the FDI learning model was the Orientation phase, formed from the accommodation and modification of the DI and FC models and based on the theories of Vanek et al (2020), Joyce & Weil (2003), and Patandean & Indrajit (2021), according to Table 2. The modification of this phase was the merging of the Orientation and Presentation phases (DI model section) with the planning phase, recording phase, and sharing phase (FC model section). The Planning phase (part of the FC model) was similar in content to the Orientation phase (section of the DI model). The equation was in the formation of learning preparation.

The next phase is the Presentation phase (part of the DI model). The Presentation phase can be combined with the Record phase and the Share phase (part of the FC model). This can be combined as the recorded presentation can be shared in one phase. This is a substitute for direct presentations as a mode of distributing learning information. In this case, direct presentations were in the form of delivering subject matter directly and synchronously, while presenting, recording, and sharing are a revolution in conveying learning material indirectly and asynchronously (Stein & Graham, 2020). Activities in all phases can be combined into 1 phase, namely the Orientation phase. The Orientation phase of the FDI model included presentations of learning objectives, explanations of learning materials, and simulated explanations of learning topics. All presentation explanations were recorded on video and distributed to students to watch and learn.

The second phase in the FDI model was the Procedure Based Simulation Phase. The Procedure-Based Simulation Phase was a novelty in the FDI model and was formed based on the theory of Cooper (2012), Joyce & Weil (2003), Smaldino (2014), Salminen-Tuomaala (2019), and Warwick (2016). Warwick (2016) states that students will be able to understand a lesson better if there are observations in it. Observation of learning can be carried out in the form of a simulation. Simulation was initiated by Smith (1966) in (Joyce & Weil, 2003, pp. 355–356).

Simulation involved a comparison of biological control mechanisms (such as humans) with electromagnetic control mechanisms (such as computers). Simulation was closely related to simulator media. Therefore, the Procedure Based Simulation phase used a simulator. The use of simulators can represent reality with customizable problem complexity (Joyce & Weil, 2003, p. 357). In addition, the use of simulators can provide students with learning tasks that they can respond to, but these responses do not have the same consequences as with real-life situations. Furthermore, simulation can also increase the level of students' self-confidence when learning in the laboratory (Cooper et al., 2012). This procedure-based simulation phase can be the best way to direct students who are new to a portion of learning material (Salminen-Tuomaala, 2019).

Simulation is proven to improve skills through complex attributes such as problem-solving, emotional intelligence, and situational sensitivity through practice (Forneris et al., 2015). This is also in line with reality: if a person practices more often, they will become more proficient and agile. Just like an athlete, they will be able to run fast, weightlifting, play fast, and achieve other things that are obtained from intense and consistent training. The implementation of a procedure-based simulation allowed students to carry out exercises and observed the practical implementation material in the laboratory. This was because, in the procedure-based simulation phase, students carried out step-by-step practicum simulations using a simulator according to the procedures that have been given and carried out outside the laboratory indirectly, asynchronously, and independently.

This activity allowed students to try out virtual practicum tools and materials in a structured procedure, so that their Low Order Thinking (LOTS) abilities could be formed. Procedure-based orientation and simulation phases were solutions to the weaknesses of the DI model. These weaknesses included strengthening students' initial knowledge (Warju et al., 2020; Winarno et al., 2021). The problem of increasing students' initial knowledge in the DI model had actually been proposed by various previous researchers. Warju et al. proposed providing real video conditions in the DI model (Warju et al., 2020). While this is helpful, in the FDI model, learning videos are also provided along with simulation media, which are distributed to students with the Orientation and Procedure-Based Simulation phases in the FDI model.

Next, the third phase was the Case Based Simulation Phase. The Case Based Simulation Phase was the third phase in the FDI model. The Case Base Simulation phase was also a novelty in the FDI model. The Case-Based Simulation Phase was formed based on the theories of Courtney (2015), Joyce & Weil (2003), Ktoridou (2018), Patandean (2021), Ridho (2019), Smaldino (2014), and Warwick (2016). Case-Based Simulation accommodated the Group phase (part of the FC model), which aligns with Patandean and Indrajit’s (2021) theory that the group formation stage aims to separate the topics of the lesson into student observation and student exploration. Cases are given in this phase, which will be more effective if completed in practice and in groups by students (Courtney et al., 2015; Hartanto et al., 2022; Joyce & Weil, 2003, p. 361).

The Case Based Simulation phase was based on the same theory as the Procedure Based Simulation phase. However, in this phase, there was a case that must be resolved by students. Cases are suitable for use in simulation because among the purposes of simulation, problems potentially more complex than real-world problems can be found or solved (Joyce & Weil, 2003, p. 358). Therefore, a case can be used to solve more complex problems. The use of cases refers to the theory from Courtney et al. (2015) which states that the case method provides elements of effective learning such as discovery, probing, continual practice, contrast and comparison, as well as involvement and motivation. Based on Corey's theory, the case-solving method is very effective in continuous practical learning, so the main goal of solving cases is to encourage students' Higher Order Thinking (HOTS) abilities. The case-based simulation phase was carried out directly in the laboratory. This is in line with the FC learning model, which suggests that the formation of students' HOTS abilities needs to be done directly in class (Patandean & Indrajit, 2021, p. 39).

Providing cases that were relevant to current conditions would be useful in offering an overview for students to find out the benefits of the practicum being studied at that time in the industrial field. This can also bring students closer to the real world that they will encounter (Ridho, 2019). The case-based simulation phase would increase students' collaborative abilities as the case-solving phase in the FDI model was carried out using a group technique. Collaboration in groups would develop collaborative skills as a solid team would solve cases with theoretical and practical evidence and making a conclusion.

Aspects of students' critical thinking skills are a weakness in the DI learning model (Gurses et al., 2015; Winarno et al., 2018). This problem was solved by previous researchers. Winarno et al. (2018) proposed useful problem-based learning in the DI model. However, in the FDI model, the problems presented and contained in a case are more complex; in a case, the collection of problems has a complex pattern (Rohmadi, 2015). For this reason, this case-based simulation was carried out directly, synchronously, in groups, and with a simulator.

The fourth phase in the FDI model was the Structured Practice Phase. The Structured Practice Phase was formed from the accommodation of the DI model which was based on the theory of Joyce and Weil (2003). The Structured Practice Phase is based on the principle of practice itself, namely to "form" (Joyce & Weil, 2003). This formation is intended so that students can have skills that can be used independently and with little or no mistakes. In addition, the Structured Practice phase was intended to meticulously practice the practicum material in a real and direct way on students who have carried out a procedural basis simulation. In achieving independent practice with a high degree of accuracy, practicum must be carried out through structured practice, guided practice, and independent practice (Joyce & Weil, 2003). This makes it necessary to carry out the structured practice phase directly and synchronously in the laboratory.

The fifth phase in the FDI model was the Guided Practice Phase. The Guided Practice phase was formed from accommodation and modified from the DI model, which is based on the theories of Joyce and Weil (2003) and Patandean and Indrajit (2021). The modification of this phase was the merging of the Change Phase (part of the FC model) into the Phase of Guided Practice (part of the DI model). The Change Phase (part of the FC model) aimed to create demonstrable changes in student interactions with the learning environment. Therefore, the Structured Practice phase can facilitate proof of these changes to shape students' skills (Joyce & Weil, 2003). In the Guided Practice phase, students are given the opportunity to practice alone or in groups under teacher monitoring in the laboratory. Students will practice in the laboratory to prove the case-based simulation that has just been discussed. The previous case-based simulation was used only to strengthen students' understanding and to reduce the level of accidents that may occur in Guided Practice.

The sixth phase in the FDI model was the Independent Practice Phase. This phase is formed from the accommodation and modification of the DI model. This phase is based on the same theory as the fourth and fifth phases. The modification of this phase involved the merging of the Independent Practice phase (DI model section) with the Rearrangement phase (FC model section). This can be combined because the Rearrangement phase (part of the FC model) and Independent Practice (part of the DI model) aim to strengthen memory and increase students' knowledge, skills, and work attitudes (Joyce & Weil, 2003; Tasrif et al., 2021). This phase was a repetition in nature carried out by students outside the laboratory. Independent practice could be made in the form of assignments. The assignments can be in the form of simulations repetition or lab reports.

Based on the results of the FDI learning model formation in theory, the FDI learning model was tested with the Hypothesis model. The hypothetical model of the FDI learning model was studied in a Focus Group Discussion (FGD). The data from the study was presented in Figure 3. Based on the data calculation in Figure 4, each sequential phase of the FDI learning model had a value (x2/df), namely 0.464, 0.492, 0.292, 0.009, 0.016, and 0.018. The value (x2/df) obtained for each phase of the FDI learning model was below 2, which indicated that each phase was valid/fit (Jackson, 2018; Meyers et al., 2013, p. 870). All valid phases reflecting the FDI learning model were included in the goodness-of-fit-model category. The goodness-of-fit-model answered the research hypothesis by accepting the alternative hypothesis (Ha), revealing that the FDI learning model was valid to use.

The FDI learning model that had passed the hypothesis test was then incorporated final model. In accordance with Figure 4, the final FDI learning model had 6 learning phases that were carried out directly and indirectly. The combination of direct and indirect learning in the FDI learning model aims to optimize technical competence, critical thinking, creativity, and collaboration by students (Rüütmann & Kipper, 2011). Good competence would produce efficient educational graduates in industry, continuing education, or entrepreneurship. Therefore, the FDI learning model can be presented as a new learning model and as a good alternative in increasing the effectiveness of implementing practicum learning.

5. Conclusion

The problem of limitations in the DI learning model has been solved by the presence of the FDI model. The FDI model had phases of orientation, procedure-based simulation, case-based simulation, structured practice, guided practice, and independent practice. Each phase had a valid category with the value (x2/df) sequentially as 0.464, 0.492, 0.292, 0.009, 0.016, and 0.018. The validity of all phases reveals that the FDI learning model is in the goodness-of-fit-model category. The goodness-of-fit-model of the FDI learning model reveals development of this model is successful and ready to improve students' prior knowledge, technical skills, critical thinking, creativity, and work ability. Therefore, the FDI learning model was presented as a new learning model to offer new options that help improve the effectiveness of practicum learning implementation and contribute to the development of science in the field of learning models. The FDI model is highly recommended in vocational education, which holds a dominant portion of practical learning. This research was limited to the stages of forming the FDI model. In the future, the FDI learning model should continue to be evaluated and developed to improve the capabilities of this model. The improvement is carried out to measure the level of practicality, effectiveness, and impact of the application of the FDI model.

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