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Implementation of the Kirkpatrick evaluation model in Building Information Modeling (BIM) training program

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ABSTRACT

This research evaluates BIM WIKA Intermediate Allplan training, especially batch 8. The evaluation guide refers to Kirkpatrick's evaluation model, which is limited to levels 1 and 2. This research uses evaluation research methods with a quantitative approach. The respondents in this study were all participants who had participated in the BIM WIKA Intermediate Allplan Batch 8 training series from beginning to end. The data was collected using questionnaires and testing instruments. The data obtained were analysed using a weighting formula from Kirkpatrick to determine participants' reactions to the training program and the improvement and achievement of participants' learning outcomes during training activities. The result of the participant's reaction evaluation to implementing the BIM WIKA Allplan Intermediate Training Program in batch 8 raised a highly positive reaction from trainees. The highest satisfaction level is the training material component at 89%, and the lowest satisfaction level is the learning media component at 80%. Meanwhile, the learning evaluation found that the training can increase BIM knowledge for most trainees. They could practice the knowledge gained during the session by conducting practical tests well.

Keywords: BIM, Evaluation, Kirkpatrick

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INTRODUCTION

Building Information Modeling, known as BIM, is a form of digital technology development in the Architecture, Engineering & Construction (AEC) industry. BIM is a technology capable of simulating the physical and functional characteristics in three-dimensional form, containing building information used as the basis for making decisions during a building's lifecycle, from concept to demolition (Parung et al., 2019). Implementing BIM in the construction sector can produce design needs saving about 50%, a reduction in construction human resource needs by 26.66% and operational needs saving approximately 52.25% (Adhi et al., 2016). Thus, BIM technology allows actors involved in a project to collaborate, increasing human resource productivity and project activities effectively, efficiently, and accurately during the building lifecycle (Dinas PUPR, 2020). McGraw Hill said that the increasing adoption and implementation of BIM in the AEC industry is causing a high demand for HR Professionals ready for BIM

technology (Suwal & Singh, 2018). It is necessary to provide BIM education to teachers and HR candidates to meet these needs. Because basically, knowledge of BIM starts through academic education (Bozoglu, 2016). However, it is currently known that the rate of BIM adoption in universities is still lagging due to the lack of availability of teaching staff who have competence in the field of BIM (Abbas et al., 2016; Macdonald, 2012; Nanisa et al., 2021; Yilei Huang, 2018; Yusuf et al., 2017). With these conditions, the AEC industry is currently starting to participate in BIM education through cooperation with higher education to hold BIM training.

PT. Wijaya Karya (WIKA) is one of many AEC industry companies organising a BIM Training Program. Initially, BIM Training Program was held for teachers, lecturers, and students in Indonesia, the aim was to accelerate the delivery of BIM development digital knowledge from WIKA to academics and students in Indonesia, making it easier for scholars and students to get basic BIM learning without being constrained costs, as well as building cooperation between WIKA, academics, and students. WIKA is reported to have collaborated with the Building Engineering Education study program at The State University of Jakarta to hold special BIM training for students and lecturers in the study program. The Building Engineering Education Study Program in Universitas Negeri Jakarta (State University of Jakarta) is one of the Higher Education Institutions in Indonesia. It is intended to produce and prepare prospective graduates to become vocational teachers, especially in the Field of Building Modeling Competence and Information Design Expertise. To be able to become a professional and competent teacher candidate requires qualified provisions. Thus, the collaboration between WIKA and the Technical Education Study Program of The State University of Jakarta to accelerate the entry of BIM is expected to be utilised well by all lecturers and students.

However, based on the data obtained, it turns out that some obstacles were found in the implementation of training. Some participants still plagiarised learning results, both on practice tests and written tests. In addition, the evaluation activities carried out are still not fully on target, because the evaluation model used as a reference in the planning and implementation of program evaluation activities has not been implemented. Even in the learning evaluation stage, it was not enough to gauge whether there was a change in the knowledge and skills of the participants after the training. So, it can be concluded that the evaluation activities that have been carried out haven't been able to provide a correct picture of the benefits or effectiveness of the Training Program that has been implemented. An evaluation is needed that refers to the evaluation model to determine the efficacy of BIMWIKA training. In this case, the evaluation activity will be based on Kirkpatrick's evaluation model. Kirkpatrick's evaluation consists of 4 interrelated levels (reaction, learning, behaviour, and results). In this study, the review only included the assessment of response and learning. The results of this study are expected to provide factual information about the strengths and weaknesses of the program so that by knowing the weaknesses or obstacles that occur during the implementation of training, it is possible to improve the training program immediately.

METHOD

This research uses evaluation research methods with quantitative research approaches. The training evaluated is focused on BIM WIKA Intermediate Allplan Batch 8 Training which was held on July 14 – 16, 2021. The respondents in this study were all trainees who had participated in BIM WIKA Intermediate Allplan Batch 8 Training from start to finish. There were 31 participants as respondents in this study, 27 participants from the Building Engineering Education study program and four others from Civil Engineering. The procedures for this evaluation research are as follows:

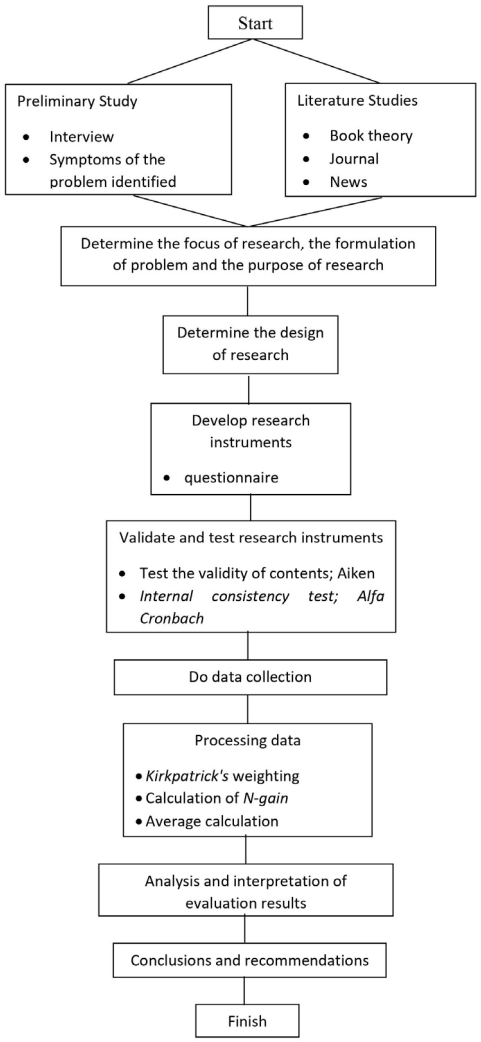

Figure 1. Research flowchart

The evaluation guide refers to Kirkpatrick's evaluation model, which is limited to level 2 only. The data collection techniques used are questionnaires and tests. Questionnaire instruments are used to evaluate the reaction stage. The preparation of questionnaires at the reaction stage is reviewed through 4 components, material quality, program implementation, learning media, and coach abilities. While test instruments are used to evaluate the learning stage, the instruments used are in the form of knowledge and psychomotor (practice) test questions that the organiser has provided. Before use, the instrument is validated first so that the data obtained is not biased. The results of the questionnaire instrument with content validity test were analysed using the Aiken formula. The Aiken index obtained 0.82, meaning that the instrument's validity was in the "highly valid" category. The internal consistency reliability test results are analysed using the Cronbach Alpha formula, and the alpha coefficient value is 0.98, meaning that the instrument's reliability is in the "very high" category. As for test instruments, instrument validation tests are not performed.

The data obtained is then calculated using the weighting formula from Kirkpatrick and then interpreted to obtain the analysis results. The weighting formulas and criteria are as follows (Kirkpatrick & Kirkpatrick, 2006):

1) Reaction (Level 1)

$$1st\ item\ score = \frac{\sum score}{Max \times R} \quad (1)$$

∑score = total score of answers from all respondents to item 1
Max = the highest score on the measurement scale
R = number of respondent

Table 1. Weighting criteria on reaction evaluation

	Interpretation
< 50%	Unsatisfactory/participants show unfavourable's reactions to the training
51 - 60%	Quite satisfactory/participants show a fairly good reaction to the training
61 - 80%	Satisfied/participants show a positive reaction to the training
81 - 100%	Very satisfactory/participants show highly positive results towards the training

Sources: (Kirkpatrick & Kirkpatrick, 2006); (Rukmi, Novirani, & Ahmad, 2014)

2) Learning (Level 2)

$$N\ Gain = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{100\% \times \langle S_{pre} \rangle} \quad (2)$$

Table 2. Weighting criteria on learning evaluation

	Interpretation
0 < 50%	Less/more than 50% of participants did not experience an increase in knowledge
50 - 60%	enough/half of the participants experienced an increase in knowledge
61 - 80%	good/more than half of the participants experienced an increase in knowledge
81% - 100%	Very good/almost all participants experienced an increase in knowledge

Sources: (Kirkpatrick & Kirkpatrick, 2006)

RESULTS AND DISCUSSION

1) Reaction Stage Evaluation Results

Table 3. evaluation of the participant's reaction to the training implementation

Component	Sub- Component	Score (%)	Average Score
Implementation of training	Suitability of material delivery with training time	81%	86%
	Timely implementation of training	88%	
	Committee attitude	87%	
	Committee readiness	88%	

In the evaluation of the participant's reaction to the training implementation component obtained, the trainees felt very satisfied with the implementation of the training program. The highest level of satisfaction was in the sub-component of the training implementation's timeline and the committee's readiness, meaning that the training activities had done well according to the

schedule and time that had been determined. In addition, the committee has also carried out its duties well, ranging from providing direction and guidance, preparing learning needs for participants to preparing training facilities. In contrast, the lowest level of satisfaction is in the sub-component of the material suitability delivery with training time. Some participants felt that the training time provided to be able to complete the training tasks provided was still less or not enough, considering the material provided was quite a lot and complex. One of the causes was due to the minimum PC specifications. So, it was not uncommon for obstacles that caused the work process to be slow and time-consuming.

Table 4. Evaluation of participants' reaction to the training material component

Component	Subcomponent	Score (%)	Average Score
Training Materials	Systematic conformity of presentation of training materials with training objectives	88%	89%
	Conformity of training materials with training objectives	92%	
	Conformity of training materials with the expectations and needs of participants	86%	
	Material ability to improve participants' knowledge and skills	91%	

The evaluation of participants' reactions to the training material component obtained results that the trainees feel very satisfied with the training material provided, with the highest level of satisfaction being in the sub-component of the conformity of the material with the purpose of training, meaning that the content of training material provided is not found problems and is in accordance with the purpose of the training. The lowest level of satisfaction is in the sub-component of the suitability of the training material with the participants' expectations and needs. Some participants felt that the explanation on some points of the training material still lacked detail, making it complicated.

Table 5. Evaluation of participants' reaction to learning media component

Component	Sub- Component	Score (%)	Average Score
Learning Media	Ease of learning media *(e-modules* and video tutorials) to be understood	78%	80%
	The appeal of the display of learning media *(e-modules* and video tutorials)	78%	
	The ability to learn media *(e-modules* and video tutorials) to support the learning process of participants	81%	
	The suitability of learning media *(e-modules* and video tutorials) with the content of the material presented.	86%	

In evaluating participants' reaction to the learning, the media component concluded that the trainees were satisfied with the learning media used. The highest level of participant satisfaction being in the sub-component of the suitability of the learning media with the content of the material presented, meaning that e-modules and video tutorials are suitable for BIM learning, especially materials that contain software operating steps. The lowest level of satisfaction is the ease of learning media to be understood and the attractiveness of the display of learning media. Some participants feel less satisfied because there are still points of material that are less detailed in e-modules and video tutorials that are used as teaching media, which sometimes inhibit participants from understanding the material and doing the assignment given.

Table 6. evaluation of participants' reaction to the component of trainer ability

Component	Subcomponent	Score (%)	Average Score
Trainer's Ability	Training model	78%	83%
	Training methods	78%	
	Level of material mastery	83%	
	Answering ability participants' questions	84%	
	The language used is easy to understand.	87%	
	Attitude	87%	

In the evaluation of participants' reactions to the trainer ability component, the result was that the trainees were satisfied with the ability/quality of the trainers who served in training. The highest level of satisfaction is in the sub-component of ease of language and attitude shown by the trainer during the training. In this case, the trainer is considered to have a more profound ability to use communicative language. So, it can be more easily understood by trainees. In addition, the attitude (discipline, friendly, and polite) shown is also able to give its impression to trainees so that participants feel satisfied with the service provided. While the lowest level of satisfaction is in the sub-components of the models and training methods used, in this case, it means that the models and training methods used by trainers are still insufficient according to trainees' expectations.

Based on the findings that have been outlined, the results of the evaluation of participants' reactions to the implementation of the BIM WIKA Intermediate Allplan Training Program in batch 8 raised a highly positive reaction. Almost all trainees were satisfied with the implementation of the training program activities that had been followed. The evaluation components that have been outlined before are interrelated. The training schedule or the implementation of training can be considered good if the training meets the rules of activity planning ranging from preparation, implementation according to planning, and evaluation (Siswanto, 2020). Training materials and learning media that will be delivered at the training also need to be prepared appropriately and based on the analysis of training objective needs to facilitate the participants' learning procesto achieve the necessary competencies (Paramarta et al., 2021). A trainer who will be in charge of training activities must also be ensured to have a background relevant to the type of training held. Haslinda & Mahyuddin (Haslinda & Mahyuddin, 2009) said thatrainer competence is a significant factoaffecting training effectiveness. Because in essence the learning process in the training program is related to the interaction that occurs between trainers and participants (Paramarta et al., 2021).

The evaluation results at this stage of reaction are considered very important, because the level of satisfaction of participants obtained will be a benchmark of the success of a training program (Yusnarita, 2020). It is in line with Ramadhon's statement (Ramadhon, 2014) that reaction evaluation needs to be done to improve and prepare future training programs as input for trainers on their performance in teaching and making teaching standards for future training programs. Based on this, the implementation of the Kirkpatrick evaluation model at the reaction stage was successfully used well, because it included components that describe participants' satisfaction level during the BIM WIKA Intermediate Allplan Batch 8 Training series.

2) Learning Stage Evaluation Results

Table 7. Evaluation of learning

No	Value Type	Pre test Score	Post test Score	Gain Score	Practice Score
1	Lowest Score	21	71	50 (63%)	67
2	Highest Score	71	99	28 (97%)	95
3	Average Value	51	88	37 (74%)	84

In the evaluation of learning of the overall knowledge component of participants, it was obtained that most trainees experienced increased knowledge during the learning process. This can be reviewed by comparing prepost-test scores and gain scores obtained by participants. While in the evaluation of learning of the skill component of participants as a whole, obtained the result that almost all participants are able to practice the knowledge gained during the learning process very well.

Based on the findings, it could be known that most trainees experience an increase in BIM knowledge, and almost all trainees were able to practice the knowledge gained during the training by doing a good practice test. So it could be concluded that BIM WIKA Intermediate Allplan Batch 8 training activities have successfully achieved its training objectives as a training program, namely to increase knowledge and develop skills in trainees. Basically the nature of learning is an activity carried out by someone consciously or intentionally that allows changes in oneself (Pane & Muhammad, 2017). While learning is a process that includes setting up, and organising the environment around a person that can grow and encourage someone to do the learning process (Pane & Muhammad, 2017). A learning activity would be successful if the results obtained from the learning process were able to develop potential, increase knowledge, or cause changes in one's attitude/behavior perhe learning goals to be achieved (Mahmudah, 2018).

The function of the evaluation process at this stage is actually to measure the achievement of a learning process up to a certain phase, where the results will be used as a basis in making improvements in the next learning process (Yusnarita, 2020). Suppose the evaluation results at level 1 are associated with the evaluation results at level 2. The statement that has been discussed earlier at the evaluation stage of the correct reaction is proven. The positive reaction given by participants to the implementation of BIM WIKA Intermediate Allplan Batch 8 training activities can foster learning motivation in participants, so that there is a change in knowledge and skills in trainees. This is supported by Arthur's research (Arthur, 2018); Budhianto (Budhianto, 2020); Nurjanah (Nurjanah, 2018); Rafiq (Rafiq, 2015) regarding the application of Kirkpatrick evaluation in the Training Program obtained a very positive reaction from the participants of the training, and it had an effect on the motivation of learning participants, resulting in an increase in knowledge and skills in participants after participating in activity. Based on this, the application of the Kirkpatrick evaluation model at the learning stage was successfully because it has included components that describe the improvement of knowledge and achievement of participants' skills after participating in the WIKA Intermediate Allplan Batch 8 BIM Training series.

CONCLUSION

BIM WIKA Intermediate Allplan Batch 8 training evaluated using the Kirkpatrick evaluation model on reaction evaluation and learning obtained good or positive results. As an evaluation result of participants' reactions to the implementation of the BIM WIKA Intermediate Allplan Training Program in batch 8 raised a highly positive response from the trainees. While

the results of the learning evaluation obtained the result that almost all trainees experienced an increase in BIM knowledge and were able to practice the knowledge gained during the training by doing a good practice test. It shows that the positive reaction of participants to the implementation of training can increase the motivation of learning participants so that the occurrence of increased knowledge and skills development at the learning stage. Thus, regarding the evaluation results obtained, it can be concluded that the overall purpose of implementing BIM WIKA Intermediate Allplan Batch 8 Training as a training program has been achieved and received a positive reaction from trainees. Based on the findings and discussions that have been outlined, several recommendations can be used to improve the quality of training in the future, namely: (1) the Kirkpatrick evaluation model can be applied to the next BIM WIKA training activities, (2) the provision of training time still needs to be reviewed and adjusted to the difficulty level of the training material provided, (3) the quality of the material needs to be improved by making the material points more straightforward and more detailed, (4) it is necessary to improve the quality of learning media by improving or developing learning media used as learning guidelines for participants so that the material to be given can be adequately conveyed.

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