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INQUIRY COLLABORATIVE TUTORIAL BASED BLENDED LEARNING MODEL FOR PHYSICS COLLEGE STUDENTS

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Abstract. Blended learning is basically a combination which was found in a learning practice. Blended learning is a further development of the e-Learning method, a learning method that combines e-Learning systems with conventional or face-to-face methods. The aim of this research was to determine the validity of the models and learning devices both in terms of content and model constructs, as well as to find out college students responses to the developed model. The developed model was validated through a forum mechanism, namely focus group discussion (FGD) which was followed by researchers and experts. Suggestions and improvements resulting from the validation activities were then followed up to revise the Inquiry Collaborative Tutorial-based blended learning model that developed. Inquiry Collaborative Tutorial-based blended learning, learning model and learning devices developed in this research have met valid criteria in content and construct. Valid content because there are elements of need and novelty, as well as valid constructs because there is consistency between parts of the model and there is relevance between the developed models with learning theories that underlie it**.** In general, the average college student responds positively to the blended learning model based on the Inquiry Collaborative Tutorial. The model applied was considered to provide opportunities for college students to actively participate.

Keywords. ***Blended Learning, Inquiry Collaborative Tutorial, Problem Solving skill***

INTRODUCTION

One of the challenges of education today is building 21st century skills. Education is faced with the demand for the importance of creating qualified and capable human resources. College students must have superior competencies, namely learning, innovating, technological skills and skills on information media and can work and survive using life skills, one of that is problem solving skills. Higher-order thinking skills such as critical thinking, creative thinking and problem solving are considered skills needed for individuals in the 21st century (Gunawan, 2017). In addition, technologies such as internet usage and the online environment are highly needed skills for the new generation (Kalelioglu & Gulbahar, 2014). Curriculum demands and the development of the globalization era require educational institutions to innovate that are beneficial to the world of 21st century skills-based education (Griffin & Care, 2014). The implementation of 21st century life skills can be summarized into simpler things there are: motivation, self-directed learning skills, critical thinking skills, problem-solving skills, communication and collaboration, leadership and responsibility (Kellogg, Hurley, & Clips , 2011).

Basic Physics is one of the compulsory subjects for physics college students at Educational Personnel Education Institution. This course is given in the first semester because it becomes a requirement for the next course. This course also underlies the development of engineering, design, planning, technology, and plays an important role in various other disciplines. Basic physics is one of the subjects that is considered difficult by college students. This is because Basic Physics requires complex mathematical equations, too much material and requires laboratory activities and frequent misconceptions (Sheppard & Robin, 2009 and Heller & Heller, 1999).

Factors that influence the weakness of student skills in solving physics problems include: there is no sufficient practice in the laboratory, confused writing unit conversions (Brad, 2011); learning has not been done by the scientific method through cognitive reasoning to the natural phenomena observed, weak understanding of the principles and laws of physics, lack of understanding questions, and students not having high motivation (Gok & Silay, 2010); students tend to use the pattern similarity approach in solving physics questions (Brad, 2011). The results of Erlina, Jatmiko, & Raharjo (2016) research, show that learning Physics integrates learning with laboratories and emphasizes reasoning that can improve the settlement skills of procedural and non-procedural problems. According to Planinic, Ivanjek, Susac, & Milin-Sipus (2013) college students have not been able to solve problems related to Basic Physics. The concept of physics in schools has not been sufficiently developed by teachers. Although college students have the required mathematical skills, this does not guarantee that they are capable of physics concepts and the context of other problems.

Physics learning innovation is very important to be developed and implemented. The aim is to prepare prospective teachers who are ready as professional educators and able to compete in 21st century fluctuations. Innovation is adjusted to the learning needs of this period through activities that are integrated with the system and well structured, so that it fosters a good academic culture and quality culture. According to Kennedy, Gloria, & Hélia (2016) the basic skills needed by educators regarding these skills are: critical thinking, problem solving, collaborative learning, student-centered teaching and having the ability to use technology. Technological advances show a variety of ease in gathering information effectively and efficiently. The use of media is also highly developed in this informatics era.

The use of media is absolutely necessary to visualize abstract concepts in the form of animations or computer simulations. The opportunity is also a challenge that requires innovation to combine conventional models such as face-to-face learning with online learning that can be done by students through the internet, including as a media in the learning management system format (Herayanti, Habibi, & Fuaddunazmi, 2017), or learning support devices (Herayanti, Fuaddunazmi, & Habibi, 2017).

Blended Learning is a combination of conventional face-to-face learning and online learning, adopted to foster active learning, interactivity, and collaborative learning experiences. College students try to understand, develop knowledge, and creativity in the learning process. Apart from the opportunities provided with Blended Learning, students, lecturers and institutions face several challenges with their implementation, including: research has shown that students enrolled in Blended Learning sometimes have unrealistic expectations. College students assume that Blended Learning is only an integration of online learning. This is because educators do not define and explain Blended Learning to college students.

The Blended Learning-learning model developed in this research provides learning stages that make it easier for educators to apply face-to-face and online learning so that the learning process is more directed. The results of

the research conducted by other researchers before, have not found a Blended Learning model that has established learning phases in combining face-to-face activities and lab practices with online activities, so the natural science learning or physics is specifically become as reference, so the fact of learning has not been fully fulfilled. The models used also have not explicitly taught college students to train or improve problem solving skills. The use of the Blended Learning model to be developed is expected to have implications for improving the mastery of physics concepts and college student problem solving skills. The Inquiry Collaborative Blended Learning Model Tutorial developed in this study adapts the inquiry model and collaborative principles integrated in learning activities by integrating the internet-connected "Moodle" application to support student independence and activity during the learning process. Many experts agree that inquiry and collaborative learning can train students' thinking skills (Arends, 2012). The principle emphasized in the model developed is in line with the opinion of Voughan (2010) which states that the key to successful learning in a community is collaboration.

METHOD

The subject of this research is the Inquiry Collaborative Tutorial-based Blended Learning Model which is applied to college students of the Department of Physics Education at IKIP Mataram who are attending basic physics lectures.

This research was conducted in the first semester of the school year 2017/2018. The location of the research was on the IKIP Mataram campus, Pemuda Street number 59A Mataram, West Nusa Tenggara. The purpose of this research was to determine the validity of the models and learning devices both in terms of the content of the model and the construct of the model and to determine the response of students to the developed model.

The validity of the model is the quality of the content and construction of the learning model that is assessed by the validators based on aspects such as supporting theory, syntax, social systems, the role of lecturers and college students, support systems, instructional impacts, and accompaniment effects, and the implementation of learning. The learning model is declared valid to be used if a minimum level of validity reaches a valid category with a score of 2.75 in the range of scores 1-4 (Ratumanan & Laurens, 2006).

The instrument validity sheet was prepared in accordance with the opinion of Nieveen et al (2009) that the validity that needs to be assessed is the content validity and the model construct that was developed. This validation sheet in the form of tables and columns contains aspects to be observed. This instrument is useful to support expert information about model components, namely: 1) supporting theory, 2) syntax, 3) social system, 4) lecturer and student role, 5) support system, and 6) instructional impact and accompaniment impact. The validation of the content of the model aims to record the validity of the Inquiry Collaborative Tutorial-based Blended Learning model in terms of the updates and needs that build the learning model. The model construct validation aims to measure the validity of the model in terms of the consistency aspects of the model components. Validation of the content and construct of the model is done through the Model Book assessment. The validation sheet is filled by experts who are competent in their fields. The validator gives a score based on aspects that are judged by a range of numbers 1-4. Table 1 shows the score of expert validity assessment for the learning model.

Table 1. Scores of validity assessment by experts for the learning model

Value Interval	Category	Explanation
$1{,}0 \leq P \leq 1{,}75$	Very invalid	Not yet usable and still need consultation
$1{,}75 \leq P \leq 2{,}75$	Invalid	Can be used with many revisions
$2{,}75 \leq P \leq 3{,}25$	Valid	Can be used with a few revision
$3{,}25 \leq P \leq 4{,}0$	Very valid	Can be used without revision

College student response is defined as students' responses which include attention, relevance, beliefs, and satisfaction with the learning model and learning tools developed. College students are said to have a good response if the score obtained is $\geq 61\%$ (Riduwan, 2010).

RESULT AND DISCUSSION

1. Validation Results of Contents of the Inquiry Collaborative Tutorial Based Blended Learning Model

Content validity describes the need and the state of the art. The content validity of the Inquiry Collaborative Tutorial-based blended learning model is rational model, supports theory, state of the art, model description, and learning environment. The results of the validity analysis of the contents of the model are shown in Table 2.

Table 2. Contents' Validity of the Inquiry Collaborative Tutorial Based Blended Learning Model

No.	Aspects of Assessment	Average of validation score	Category	R (%)	Reliability

1	Model Rational	3,42	Valid	99.94	Reliable
2	Model theoretical support	3,17	Valid	92.31	Reliable
3	Model description	3,50	Very valid	93.33	Reliable
4	Learning environment	3,33	Valid	85.71	Reliable

Remarks: validity criteria are obtained based on categories that often appear

Based on the results of content and construct validation from the development of learning devices for the Inquiry Collaborative Tutorial based blended learning model, it can be seen that the rationality of the development of this model is categorized as valid with reliability of 99.94%. Theoretical support for the learning model is also valid and reliable at 92.31%. Both of these things prove that the development of Inquiry Collaborative Tutorial-based blended learning model has a rational content and is in accordance with theoretical support related to the model. This means that both aspects of the assessment have steady measurement results, unchanged and there is a match between the one and another assessors. In addition, this description model is very good and very precise in explaining how the mixed learning model is based on Inquiry Collaborative Tutorial as a form of learning. The learning environment and managing the class in the description of the development of this model is also quite good, requiring a little improvement in its contents. This can be seen from the results of a very valid model description with reliability of 93.33% as well as reliability in the aspect of the learning environment of 85.71% with a valid category.

The validation results of the Inquiry Collaborative Tutorial based blended learning model have fulfilled the content validity requirements. The validity of the contents of the model is declared valid because it has fulfilled the need and was designed based on state of the art. Data on content validity shows that Inquiry Collaborative Tutorial-based blended learning model can be used to equip competencies according to the demands of 21st century skills, namely problem solving skills and use of technology.

The use of technology in its various forms in learning is proven to be able to help improve college students' problem solving skills in learning physics (Gunawan, Harjono, Sahidu, & Herayanti, 2017). Problem solving skills have been recognized as important skills for adapting to the environment in the 21st century (Kuo et al., 2012). Students must have superior competencies with various skills in the 21st century, namely learning and innovating, skills using technology and media information, and being able to work, and survive using life skills. Problem solving is often referred to as an important skill for everyone in modern society (Ryan et al., 2016). The problem solving ability of students studying with computer technology has varying levels in each stage (Gunawan, Suranti, Nisrina, & Herayanti, 2018).

2. Construct Validation's Results of Inquiry Collaborative Tutorial Based Blended Learning Model

Construct validation from Inquiry Collaborative Tutorial-based blended learning model deals with rational consistency of learning, consistency of models with supporting theories, consistency between phases in learning syntax, consistency of learning environment management, consistency of support systems, and consistency of instructional impacts and accompaniment impacts. A summary of the results of the analysis of the validity of construct models is shown in Table 3.

Table 3. Construct Validity of Blended Learning Model Based on Inquiry Collaborative Tutorial

No	Model Component	Average of Validation Score	Category	R (%)	Realibility
1	Model Rational	3,55	Very valid	90,50	Reliable
2	Theoretical Support	3,16	Valid	86,15	Reliable
3	Syntax	3,20	Valid	91,25	Reliable
4	Social System	3,53	Very valid	95,16	Reliable
5	Fundamental of Reaction	3,34	Very valid	91,65	Reliable
6	Support System	3,22	Valid	91,33	Reliable

Remarks: validity criteria are obtained based on categories that often appear

Based on Table 3 the assessment carried out by experts on the components of the model both rational model, social system and fundamental of reaction are in the very valid category with reliability of 90.50%, 95.16% and 91.65% respectively, which means that there is a match between the three validators with model components which is measured. Likewise in the model component seen from theoretical support, the model syntax and support system are in the valid category with reliability of 86.15%, 91.25% and 91.33% respectively. All supporting components of the Inquiry Collaborative blended learning model are consistent and related to each other. These results indicate that there is consistency between expert evaluations of the components of the blended learning model based on Inquiry Collaborative Tutorial, so that it meets the requirements and was suitable in learning.

The validation results of the Inquiry Collaborative Tutorial based blended learning model have fulfilled constructive validity requirements as listed in Table 3. The construct validity of Inquiry Collaborative Tutorial-based blended learning model is stated to be very valid

because it is logically designed and there is consistency between phases in model syntax, consistency between model components, as well as consistency between the model and the underlying theory. Consistency between phases can be seen from the rational phase sequence so that it forms the model syntax. Consistency between the components of the model is known based on the rational relationship of the model, the syntax of the model, the social system, the principle of reaction, the support system and the instructional impact and impact of accompaniment. Consistency between the model and the underlying theory can be reviewed based on the relationship between the model and Vygotsky's social constructivist theory, cognitive learning theory includes ARCS Keller theory, information processing theory, Ausubel meaningful learning theory, and Piaget's theory of intellectual development.

The construct validation data of the Inquiry Collaborative blended learning model in Table 3 shows the consistency between phases in the model. The syntax of the Inquiry Collaborative Tutorial-based blended learning model was developed to overcome weaknesses in online learning and inquiry, as well as theoretical and empirical support. The syntax of Inquiry Collaborative blended learning model Tutorial is composed of six phases that are logical and systematic, firstly, orientation, interpretation, planning, exploitation, explanation, and reflection. The six phases have been designed to be related to each other.

3. College Student's Response to the Blended Learning Model Based on Inquiry Collaborative Tutorial

The description of the student's response to the Inquiry Collaborative Blended learning based Tutorial model is obtained by giving a response questionnaire to students to be filled in according to the actual situation. Questionnaires were given at the end of the lesson containing 30 items of statements to find out students' responses to learning using the developed model. The response given by students is used as a reference to assess the level of student interest in the application of the blended learning model based on Inquiry Collaborative Tutorial. The results of observations of student responses are presented in Table 4.

Table 4. Analysis of Student Response to Inquiry Collaborative Based Blended Learning Model Tutorial on classes A, B, and C

No	Question/Statement	Average Response (%)				
		VA	A	LA	D	VD
1	The effectiveness of the model in increasing activity, motivation, participation in learning.	56.47	43.53	-	-	-
2	The ability of the model to encourage mastery of the material and thinking skills of students.	55.60	44.40	-	-	-
3	The ability of models and media to facilitate learning.	57.76	42.24	-	-	-
4	Innovation in learning that is interesting and fun.	55.17	44.83	-	-	-

Based on Table 4 above, it can be seen that the average college students' response is positive to the blended learning model based on the Inquiry Collaborative Tutorial. The model applied is considered to provide opportunities for students to actively participate. This model can be used to change perceptions about physics, so students are more motivated and interested in learning physics both individually and in group learning. The practice and feedback provided also makes college students feel confident and more valued. Challenges during the practice according to college students also provide a fun challenge. This model encourages curiosity in college students so that they are happy and satisfied following the whole series of learning activities.

The training or assignment given is able to clarify the material so that it can be understood by college students. The opportunity to ask both directly and online helps college students to understand the material that being studied easily. Likewise with the existence of simulations and enrichment in e-learning which is very helpful for students in learning physics concepts. College students become happy with the support of computer and internet media in learning. Learning becomes more interesting and fun. Likewise with the existence of media support and worksheets that support understanding the important concepts that already planned. They are free to create and express opinions / ideas. According to students this model is interesting and relatively new, including the worksheets used. Available material can be accessed wherever and whenever. This is certainly very helpful for students in learning physics concepts.

Validation of the design of the learning model developed was carried out through a process of discussion by experts in a discussion forum called Focus Group Discussion (FGD). FGD participants responded to a series of questions and suggestions focused on one topic. The main purpose of the FGD is to identify various views and gain understanding around the topic of research from the perspective of the participants. As stated by Cobb & Gravemeijer (2006) that to see the suitability of the theory relating to the steps of learning, how to teach the teacher, and student activities, validation was carried out.

The technique used in the FGD is expert panel techniques. In the expert panel activities, experts who understand a topic about their various knowledge in a discussion. Discussion groups function like an interview group with the facilitator asking a series of questions and each panel member gives an answer. The focus of the

discussion in the FGD activities discussed the validity of the learning model developed including content validation and construction validation.

The need for Inquiry Collaborative Tutorial-based blended learning models is also related to the National Education Standards Agency (2010: 20) education and technology. The use of digital media is in line with the National Standards for Higher Education about information and communication technology facilities in learning contained in Government Regulations No. 32 of 2013 Paragraph 32. Inquiry Collaborative Tutorial-based blended learning model is used as an innovative learning model that does not only train 21st century skills to participants students, but also able to combine face-to-face learning online. In the context of formal education blended learning is a formal education program in which learners learn in part through the delivery of content and online teaching with several elements (Hernandez et al., 2016).

Content validation data shows the novelty aspect of Inquiry Collaborative Tutorial based blended learning model is to train students' problem solving skills using mixed learning, online and face-to-face. The novelty of this model lies in the phase in learning. **1st Phase:** Orientation through face-to-face learning. This is in accordance with the ARCS Theory that is to arouse curiosity and interest in learning, so students must pay attention (Keller, 1984). Apart from that also Gagne's theory, learning must be supported by the existence of events / phenomena in learning (Moreno, 2010). In the orientation phase, based on the orientation capabilities possessed, one is able to identify their own location and direction in a variety of different and changing environments (Lin et al., 2014).

2nd Phase: Interpretation through online learning. This is in accordance with Constructivist theories, where students match new information with old rules and revise that old rules if they are no longer appropriate (Arends, 2012). Stages of interpretation, a series of uses of online learning help the college students to interact between each other. **3rd Phase:** Planning through online learning. This is in accordance with the Cognitive apprenticeship theory, that students gradually acquire expertise through interaction with teachers or peers who are more capable (Slavin, 2009). In addition, Piaget's theory states that students interact with other students and their environment to build knowledge through organization, assimilation, and accommodation of new information in their cognitive structure (Moreno, 2010). These arguments and theories are reinforced by the results of research by Solar et al. (2013) that in the planning phase, students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make decisions based on the use of appropriate digital tools and resources.

4th Phase: Exploration through face-to-face learning. This is in accordance with Piaget's theory, students interact with other students and their environment to build knowledge through organization, assimilation, and accommodation of new information in their cognitive structure (Moreno, 2010). This is confirmed by the opinion that exploration is the dominant phase in both environments; a much larger percentage of comments are coded to be integrated in online discussions (Vaughan & Garrison, 2005). **5th Phase**: Explanation through online and face-to-face learning. This is in accordance with the theory of Self regulated learning, students must have knowledge of effective strategies and how and when to use them (Moreno, 2010; Slavin, 2009). This theory is supported by Savelsbergh et al. (2011) that explanation is the result of students' ability to distinguish and describe the types of problems that are solved by using solutions in the form of approaches so that their problem solving skills increase. And lastly, **6th Phase**: Reflections are carried out online and face to face. The supporting theories like Arend (2012) states that in order to get good knowledge, feedback must be given specifically and as soon as possible. This is reinforced by the opinion that integration requires time for reflection to synthesize information received (Garrison et al., 2001).

The Inquiry Collaborative Tutorial-based blended learning model shows consistency between component models which include model syntax, social systems, reaction principles, support systems, and instructional impacts and accompaniment impacts. Learning syntax aspects obtained valid categories, this shows that the phases that are made logical, rational, describe the purpose of the model, and clearly can be implemented. Arends (2012) states that all the patterns contained in a good learning model can lead to the achievement of learning outcomes. The Inquiry Collaborative Tutorial-based blended learning model also shows consistency between the model and the underlying theory. The foundation of the theory that has been used in designing the model shows that this model can be said as a learning model. The use of the right learning theory foundation can also be used to determine problems, objectives, analysis, and assessment of learning.

The next stage is testing the model that aims to find weaknesses or shortcomings of the learning model, so that it gets a number of inputs that can produce a valid, practical and effective learning model. A valid learning model can help researchers in designing learning. The resulting model is expected to provide a variety of learning models that can help lecturers in overcoming difficulties with technology, namely computers connected to the internet, and can develop college students' ability to solve problems.

Validation of Inquiry Collaborative Tutorial-based blended learning model was carried out through FGD activities by experts consisting of science education experts and physics education experts so that models were valid and fulfilled aspects of need and novelty, based on strong theoretical and empirical foundations and consistency between component models. its constituents. This model validation is in line with the results of the Armenteros research, Ruiz & Zamora (2012) which states that the validation of a product can be done through FGD activities by experts, both face to face and online.

The results of the FGD activities show that the Inquiry Collaborative Tutorial-based blended learning

model with its components consists of rational models, theoretical and empirical support, the model syntax has high validity. Likewise with SAP, Textbooks, MFIs, Problem solving skills and student responses are all valid and reliable. This is in line with the opinion of Nieveen & Plomp (2007) which states that a product has good quality if it is based on content validity and construct validity and can describe needs, novelty, consistency between component models and supported by theory and empirical.

The Inquiry Collaborative Tutorial-based blended learning model is included in the valid category, both in content and construct, so that it can be used as a guideline in preparing plans to practice problem solving skills. This is in line with the research of Seechaliao, Natakuatoong, & Wannasuphoprasit (2012) stating that a valid learning model can help researchers and practitioners in designing learning based on understood learning principles. Valid learning models can be used as guidelines for academics and practitioners in planning a learning program (Kimbell & Stables. 2007).

CONCLUSION

Inquiry Collaborative Tutorial-based blended learning-learning model and learning devices developed in this research have met valid criteria in content and construct. Valid content because there are elements of need and novelty, as well as valid constructs because there is consistency between parts of the model and there is relevance between the models developed with learning theories that underlie it.

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