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Development of a Guided Inquiry-Based Moodle E-Learning System on the Topic of Salt Hydrolysis

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Abstract: The goal of this research to develop a guided inquiry-based flipped classroom learning system using Moodle on the topic of salt hydrolysis and determine the level of validity and practicality of the resulting learning system. This research is included in the Educational Design Research research with the Plomp development model. The research subjects were material experts, media experts, chemistry teachers, and students of class XII science at SMAN 8 Padang. The results of this study indicate that the learning system developed is valid with a validity value of 0.88 from material experts and 0.92 from media experts while for the percentage of practicality 92% of student responses and 94% of teacher responses with very practical categories so that it can be used as an alternative to online learning.

Keywords: flipped classroom, guided inquiry, salt hydrolysis

Abstrak: *Penelitian ini bertujuan untuk mengembangkan sistem pembelajaran flipped classroom berbasis inkuiri terbimbing menggunakan learning management system Moodle pada materi hidrolisis garam dan menentukan tingkat validitas serta praktikalitas sistem pembelajaran yang dihasilkan. Penelitian ini termasuk dalam penelitian Educational Design Research dengan model pengembangan Plomp. Subjek penelitian adalah ahli materi, ahli media, guru kimia, dan peserta didik kelas XII IPA di SMAN 8 Padang. Hasil dari penelitian ini menunjukkan bahwa sistem pembelajaran yang dikembangkan sudah valid dengan nilai validitas dari ahli materi 0,88 dan dari ahli media 0,92 sedangkan untuk persentase kepraktisanya 92% dari respon peserta didik dan 94% dari respon guru dengan kategori sangat praktis sehingga dapat digunakan sebagai salah satu alternatif pembelajaran secara daring.*

Kata kunci*: flipped classroom, inkuiri terbimbing, hidrolisis garam.*

▪ INTRODUCTION

The spread of the Covid-19 virus in Indonesia is still swift. The high number of cases of Covid-19 transmission in Indonesia has resulted in the learning system in Indonesia being switched to an online learning system. An online learning system is a learning system that utilizes internet media online via the web which results in the learning process being carried out indirectly or without face to face between educators and students (Himawan, 2011). This is done to minimize the spread of Covid-19. In addition to minimizing the spread of the Covid-19 virus, online learning can also support learning in the 4.0 industrial revolution era that utilizes technology in learning (Cholily, Putri, & Kusgiarohmah, 2019).

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The era of Industrial Revolution 4.0 is an era where knowledge and technology are developing very rapidly, resulting in rapid and competitive changes. The application of artificial intelligence (artificial intelligence) is one of the characteristics of the era of the industrial revolution 4.0. The central pillar of the industrial revolution 4.0 era is education (Astuti, Waluya, & Asikin, 2019). The development of the industrial revolution 4.0 era cannot be avoided by anyone. The success of a country is facing the era of the industrial revolution 4.0, especially in the world of education, is determined by the quality of the educators. So, in this case learning can optimize the use of technology as an educational tool to support the learning process (Rahman & Nuryana, 2019).

The transition from conventional learning systems to online learning systems and the development of the 4.0 industrial revolution era certainly impact teachers and students in the learning process. The challenge faced by teachers is that they have to think of strategies that can stimulate students to be able to take part in online learning (Nerantzi, 2020). Learning that can be used in the online learning system during this pandemic is blended learning. Blended learning is learning that combines learning using technology and traditional learning (Maulida, 2020). Blended learning is a formal education program where students learn (at least in part) through providing content and instructions delivered online with several components of student control over the time, place, path, and pace of learning and are still supervised by the teacher. based on learning plans that have been set remotely (Clayton & B, 2012). There are two learning states in blended learning, namely asynchronous learning and synchronous learning. Asynchronous learning occurs between teachers and students in different times and places according to each student's conditions and speed of learning. In contrast, synchronous learning occurs between teachers and students simultaneously and places (synchronous learning) or at the same time but in different places (virtual synchronous).

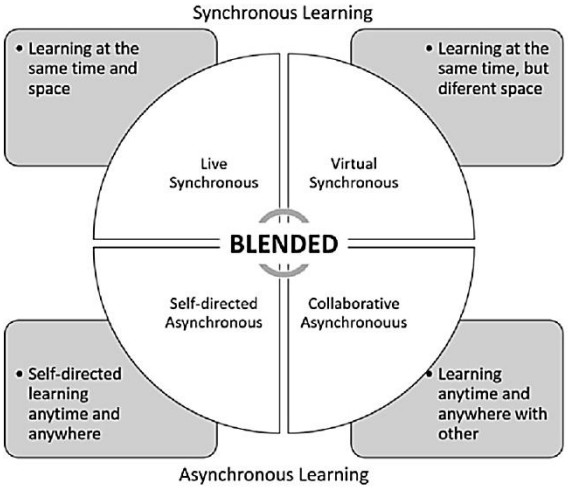

Figure 1. Quadrant of Blended Learning Setting (Chaeruman & Maudiarti, 2018)

Blended learning has four types of models that can be used. One type of blended learning model is the rotation model. In this rotation model, students' learning methods are rotated according to the schedule or at the teacher's discretion. This rotation model also has four types of submodels, namely station rotation, lab rotation, flipped classroom and individual rotation (Watson et al., 2020).

The flipped classroom is also called reverse classroom learning. The learning done in the flipped classroom is to reverse what usually happens during class and outside the class schedule. By using this flipped classroom learning, directions and materials are carried out outside the classroom in the form of lectures by the teacher. While in the class schedule, students solve problems by discussing. Thus, it can be seen that flipped classroom learning can apply learner-centered learning. Flipped classroom learning follows Permendikbud No. 3 of 2020, which states that one of the characteristics of the learning process is scientific.

Four types of learning models can be used in scientific learning, one of which is the inquiry learning model (Kemendikbud, 2014). The inquiry learning model consists of four types, one of which is guided inquiry. The guided inquiry learning model can increase student activity and cause students to be actively involved in the learning process (Kardena & Mawardi, 2020). Research conducted by (Wardani & Firdaus, 2019) shows that the guided inquiry learning model based on blended learning can make students more active and provide learning motivation to understand and apply learning concepts. This guided inquiry learning model also provides more opportunities for students to present learning so that students can optimize cognitive and psychomotor abilities. This research is supported by previous research that explains that guided inquiry learning can make students actively speak. In practice, students must discuss in small groups to solve problems with guided inquiry learning steps (Wardani, Setiawan, & Supardi, 2016). The guided inquiry learning model in chemistry learning is effective in improving learning outcomes and student activity, this is evidenced by the increased activity of students at each meeting, the first meeting was 36.9% with the criteria of being less active, the second meeting increased to quite active by 60.5%, the third meeting in the active criteria was 78.2%, and the fourth meeting was 81.4% in the very active criteria(Fitriani, Widiyatmoko, & Khusniati, 2016).

Guided inquiry learning in its application showed positive results for several chemistry materials, including learning with the guided inquiry model integrated with the flipped classroom approach on the colligative properties of solutions showing that this learning model is valid and practical to use in learning (Waer & Mawardi, 2021), the development of a guided inquiry-based flipped classroom learning model on chemical equilibrium material can be appropriately developed and is valid and has a high practicality category to be used in learning (Ramadianti & Mawardi, 2021), the application of the guided inquiry-based flipped classroom learning system with the Edmodo learning management system on salt hydrolysis chemistry also shows that the guided inquiry learning system is valid and very practical to apply in learning (Nengsih & Mawardi, 2021). The combination of the guided inquiry learning model with the flipped classroom on chemical bonding material can increase student activity during learning and students can learn more flexibly according to the desired time so that learning objectives can be achieved (Anjelina & Mawardi, 2021). In improving students' cognitive achievement, guided inquiry teaching is significantly better than conventional teaching methods (Mmatthew & Kenneth, 2013).

The learning process with an online learning system can be implemented with a learning management system. Among the learning management systems that can be used for online learning is Moodle. Moodle is an application program that can convert learning media into a web form. This application program allows students to enter digital classrooms to access learning materials entered into their respective classrooms (Retnoningsih, 2017). From the results of research conducted by (Watrianthos, 2019) it

is known that in the atomic structure material, Moodle-based e-learning media is appropriate to be used to provide experiences to students in online learning.

Based on the problems that have been described, the learning system that can be used during the Covid-19 pandemic and is also expected to be used in other special conditions and to support the learning system in the industrial revolution 4.0 era is the Flipped Classroom Learning System Based Guided Inquiry Using Moodle on Salt Hydrolysis Material.

▪ METHOD

The research was conducted at SMAN 8 Padang from March to April 2022. This research is an Educational Design Research (EDR) research with the Plomp development model. According to (Sukmadinata, 2009), development research is a process or series of procedures to develop a new product or improve an existing product, which can be accounted for. Plomp development consists of several stages or phases, namely: (1) preliminary research, (2) prototyping phase, and (3) assessment phase. However, this research was only carried out until the prototyping phase. The next stage will be further research.

The preliminary research stage is the initial stage of developing a guided inquiry-based flipped classroom learning system using Moodle. At this preliminary research stage, what was done was identification and analysis of needs and context, literature review, and development of a conceptual framework. The needs analysis was conducted by interviewing three chemistry teachers from three different schools to find out the problems during online learning. The stages involved in developing the flipped classroom learning system based on guided inquiry using Moodle include: (1) making learning materials and installing Moodle, (2) designing Moodle display and managing Moodle page views which consist of setting menu layouts, navigation buttons, text selection, and selecting the appropriate theme for the Moodle background, (3) uploading learning materials to Moodle, (4) validation of the learning system by material experts and media experts, each consisting of six validators (5) revising the product based on the validation results, (6) conduct a one-on-one evaluation of three students, and (7) conduct small group trials to twenty students and three chemistry teachers to determine the practicality of the product developed.

The validation of the flipped classroom learning system based on guided inquiry using Moodle on salt hydrolysis material consists of content and media validation. Content validation was carried out by four chemistry lecturers and two chemistry teachers, content validation was carried out by giving a content validation questionnaire to the validator consisting of four indicators, namely content component indicators, presentation components, linguistic components, and graphic components. The content component indicator consists of four questions that describe the suitability of the material with the learning model used and the material provided is by essential competencies and suitability in decreasing competency achievement indicators. The presentation component indicator consists of 13 questions that describe the suitability of presenting the material with the steps of the guided inquiry learning model. The linguistic component indicator consists of four questions that describe the clarity of the language by the Indonesian Spelling (EBI) rules so that it is easy to understand. The graphic indicator consists of three questions that describe the clarity of the appearance of the material on Moodle.

Media validation was carried out by two electronics engineering lecturers and four chemistry lecturers. Media validation is done by providing a media validation questionnaire which consists of two indicators, namely visual indicators and indicators of convenience. The visual indicators consist of eight questions that describe the visual aspects of Moodle, namely the selection of letters, color composition, background selection, audio and video quality, as well as the arrangement of the material properly and neatly. The ease indicator consists of 10 questions that describe the ease of use of the features available on Moodle. Validated data were analyzed using the Aiken formula with the assessment categories: (1) valid ($V \geq 0.79$), (2) invalid ($V < 0.79$) (Aiken, 1985).

The practicality of the flipped classroom learning system based on guided inquiry using Moodle on salt hydrolysis material consists of practicality by twenty students and three chemistry teachers at SMAN 8 Padang. This practicality is carried out by providing a practicality questionnaire consisting of three indicators, namely indicators of ease of use, time efficiency, and benefits. The ease of use indicator consists of five questions that describe the ease of understanding the learning material by the steps of the guided inquiry learning model on Moodle. The time efficiency indicator consists of two questions that describe the suitability of students' learning speed in learning. Benefit indicators describe the benefits of using the guided inquiry learning model on Moodle for students in understanding learning materials. The data from the practicality results were analyzed using the percentage method with the assessment criteria: (1) very practical (86%-100%), (2) practical (76%-85%), (3) quite practical (60%-75%), (4) less practical (55%-59%), and (5) impractical (≤54%) (Purwanto, 2010).

▪ RESULT AND DISCUSSION

This research is based on the Plomp development limited to the prototyping stage. The plomp development stage consists of the preliminary research, prototyping phases, and assessment phases (Plomp & Nieveen, 2007). The development that has been carried out has resulted in a product in the form of a flipped classroom learning system in a learning management system Moodle structured according to the syntax of guided inquiry learning.

First stage, namely the initial investigation stage needs and context analysis is carried out, literature review (literature review), and the formation of a conceptual framework. Activities in the needs analysis are carried out by looking at the description of conditions related to problems during the chemistry learning process at school. This activity is in the form of interviews with several teachers in various schools and the results are that the learning process which is usually carried out face-to-face is now turning into online learning and there is a demand from the 2013 curriculum to carry out student-centered learning in increasing student activity throughout learning and the use of technology as an adjustment step to the development of the industrial revolution 4.0 in the world of education. Then for context analysis in the form of an analysis of the chemical salt hydrolysis which produces indicators of competency achievement by the essential competencies, namely analyzing the ion balance in a salt solution and calculating its pH. The indicators of competency achievement produced are students can analyze the concept of hydrolysis of salt, types of salt that are hydrolyzed with non-hydrolyzed salt, types of hydrolysis, and acid-base properties of and calculate the pH of hydrolyzed salt solutions.

In the literature review, the activities carried out were seeking and understanding information from sources related to the development carried out and it was concluded that learning that could be used during the Covid-19 pandemic was learning by applying flipped classroom learning. The flipped classroom is part of the blended learning submodel, namely the rotation model (Watson et al., 2020) which consists of learning outside the classroom and learning in the classroom (Syakdiyah, Wibawa, & Syahrial, 2020). (Lopes & Soares, 2018) also said that the flipped classroom can be more collaborative in the teaching and learning process. Another advantage of implementing the flipped classroom is that students can be more active in group discussions and class discussions. In addition, from the literature review, it is also known that guided inquiry learning can be transferred to online learning by using an appropriate learning management system in this case, namely Moodle.

Guided inquiry is a series of activities that allow students to search and investigate systematically, critically, logically, and analytically so that students can present their findings with confidence. Guided inquiry can improve student activity, motivation and learning outcomes (Mawardi, Asra, & Dj, 2016). Using this guided inquiry learning model, students are more oriented toward the guidance and instructions of the teacher so that students can understand the concepts of the lesson (Mmatthew & Kenneth, 2013). The stages of guided inquiry learning consist of orientation, exploration, concept formation, application, and closing (Hanson, 2005). From the preliminary research stage, the prototype I was produced in the form of a guided inquiry-based flipped classroom learning system on salt hydrolysis material that had been included in the Moodle learning management system.

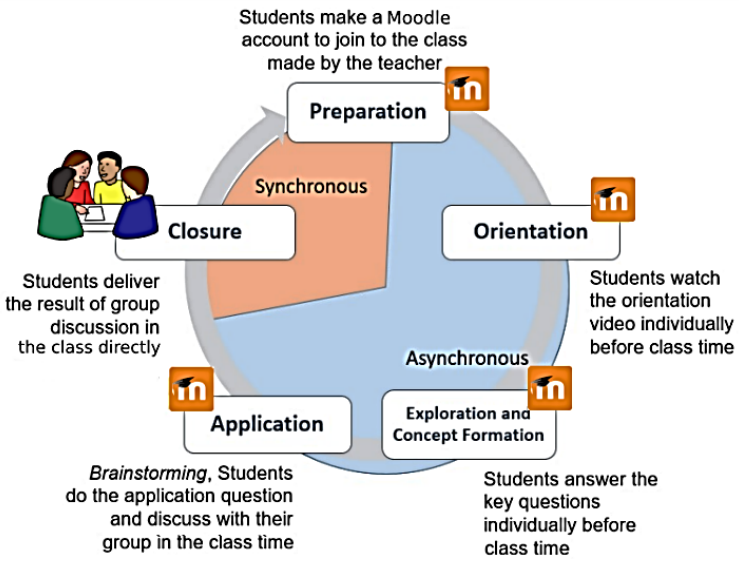

Figure 2. Flipped-guided inquiry learning model cycle (Ismail & Mawardi, 2021)

The orientation stage is carried out asynchronously in the form of a learning orientation video included in Moodle. Students are independently asked to watch the orientation video first. Then the learning stage is continued at the exploration stage and concept formation by providing a model in the form of an image of dissolving salt into the water which students will analyze to answer key questions that will lead students to get a concept from the learning carried out. The application stage is also conducted

asynchronously in a group (collaborative asynchronous) (Chaeruman & Maudiarti, 2018). Next is the application stage, at the application stage students are given practice questions that aim to strengthen and expand students understanding of the salt hydrolysis material and the last stage of the guided inquiry learning model is a cover where students will present the results they get in the form of answers to questions. Questions at the application stage then students from other groups will respond and after that the teacher will reconfirm the answers from students and provide reinforcement regarding the concepts being studied.

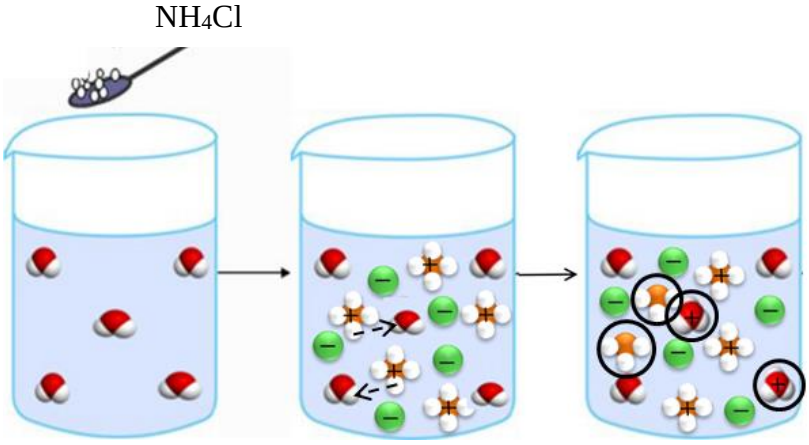

Figure 3. Sample molecular representations used in this study

The resulting prototype I was then evaluated with a checklist questionnaire in the form of a self-evaluation questionnaire and it was found that the prototype I produced had fulfilled the components that must exist in the flipped classroom learning system based on guided inquiry on salt hydrolysis material, so that prototype I immediately became prototype II. Then in prototype II an evaluation was carried out in the form of an expert review (expert assessment) from material experts and media experts using a product validity questionnaire developed and one to one evaluation of three students with different abilities. The selection of three students with different abilities is intended to represent students' opinions as a whole to produce prototype III. After Prototype III was produced was valid, it was re-evaluated with activities carried out as a form of small group testing of twenty students and three chemistry teachers, this activity was intended to gain practicality from the flipped classroom learning system based on guided inquiry on the material, developed salt hydrolysis.

The guided inquiry-based flipped classroom learning system developed on the salt hydrolysis material has been tested for validity and practicality. Validity test is one of the tests to determine the quality of a product being developed. The validity test consists of a content validity test, construct validity test, and media validity test. In the content validity test, the validator provides an assessment of the content component, in the construct validity test, the validator provides an assessment of the presentation component, linguistic component, and graphic component, while in the media validity test, the validator assesses the visual aspect and the ease of this guided inquiry-based flipped classroom learning system. In the product validity test developed, both content validity, construct validity and media validity were assessed by six validators each. According to Sugiyono (2013: 172) the instrument's validity can be carried out with the opinion of an expert (judgment expert) with a minimum number of three people, and

this is the basis for selecting six validators for each validity test. Assessment data from all validators were processed using Aiken's V formula.

The content validity test on the content component aspects of the guided inquiry-based flipped classroom learning system on salt hydrolysis material has an average validity value (V) of 0.86 with a valid category. This indicates that the material contained in the guided inquiry-based flipped classroom learning system on salt hydrolysis material is by the demands of essential competencies, the model used is by the material studied. Competency achievement indicators are formulated following essential competencies in salt hydrolysis material. The construct validity test on the component aspects of the presentation of the Flipped Classroom learning system based on guided inquiry on salt hydrolysis material was carried out on the suitability of the learning design presented and the suitability of learning activities with the guided inquiry stages. Based on the validator's assessment, the validity value (V) is 0.87 with a valid category.

The linguistic component of the guided inquiry-based flipped classroom learning system on salt hydrolysis material has a validity value (V) = 0.89 with a valid category. This shows that the guided inquiry-based flipped classroom learning system on salt hydrolysis material has used the appropriate language according to the indonesian spelling rules. The language used in the delivery of instructions or information is clear and communicative to be understood and not ambiguous (causing more than one meaning). The last is an assessment of the graphical component of the flipped classroom learning system based on guided inquiry on salt hydrolysis material which has a validity value (V) = 0.89. This means that the arrangement of learning activities in Moodle is used neatly arranged and the use of models in the form of images can be observed.

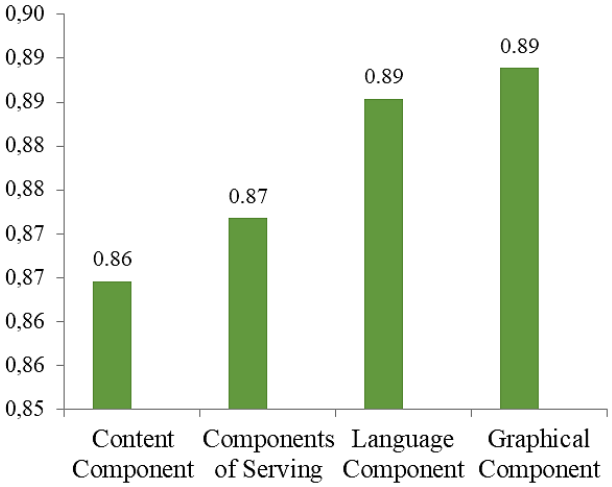

Figure 4. Validity Questionnaire Analysis Results

The validator assessed the media validity test from the visual aspect and the ease of use aspect of the Moodle learning management system. In the visual aspect of the guided inquiry-based flipped classroom learning system on salt hydrolysis material, an assessment of the appearance of the features contained in Moodle and obtained a validity value (V) of 0.92 with a valid category. Then, on the ease of use of the Moodle learning management system for guided inquiry-based flipped classroom learning on salt hydrolysis material, an assessment of the suitability of these features in the

implementation of learning was obtained and the validity value (V) = 0.92 with a valid category.

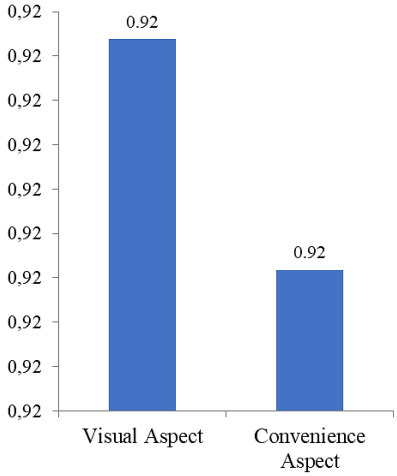

Figure 5. Results of media validity analysis

Practicality tests were carried out to find out whether in the implementation of learning with a guided inquiry-based flipped classroom learning system on salt hydrolysis material, errors or obstacles were still found in the products developed. Practicality tests on students are carried out in the small group stage. At this small group stage, students will try to use the product that was developed and then in the practical assessment, they are given a questionnaire in the form of a student response practicality questionnaire. The practicality questionnaire was filled out by twenty students (Tesmeer, 1997) which stated that small group evaluations were given to 5-20 students. For teacher practicality it was carried out by three chemistry teachers. Data from the results of the practicality assessment of students and teachers were analyzed using percentages.

From the aspect of ease of use of the guided inquiry-based flipped classroom learning system on the salt hydrolysis material, the percentage of practicality by students is 91% and by the teacher is 93% with a very practical category, this indicates that the inquiry-based flipped classroom learning steps guided on easy-to-understand salt hydrolysis material. The subject matter, models, key questions and language used are also easy to understand and understand both by students and teachers. From the aspect of time efficiency, the guided inquiry-based flipped classroom learning system on salt hydrolysis material has a practical percentage of 91% by students and 93% by the teacher with a very practical category, this means that guided inquiry-based flipped classroom learning on hydrolysis material salt can adjust the learning speed of students and the learning time becomes more efficient. This is because the implementation of learning with the flipped class system based on guided inquiry occurs in two learning conditions, namely asynchronously and synchronously so that when learning with the teacher, students can focus more on things that are not understood in learning and the teacher can also re-evaluate subject matter well.

From the benefit aspect of the guided inquiry-based flipped classroom learning system on salt hydrolysis material, the percentage of practicality by students is 93% and by teachers is 94% with a very practical category, this shows that the guided inquiry-based flipped classroom learning system can be helpful. In helping students understand

the material of salt hydrolysis, increasing student interest in learning and increasing student activity in learning.

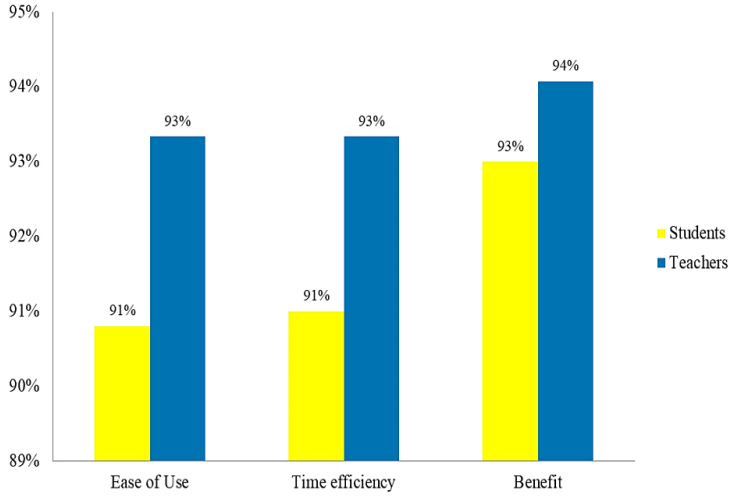

Figure 6. Result of practicality analysis

Based on the analysis of practicality data, the average percentage of the practicality of the guided inquiry-based flipped classroom learning system on salt hydrolysis material from students is 92% and from teachers is 94% with a very practical category. The average practicality obtained from both students and teachers shows that the guided inquiry-based flipped classroom learning system on salt hydrolysis material can be used and practiced in the implementation of learning.

The guided inquiry-based flipped classroom learning system effectively increases learning activities. Learning steps with the guided inquiry model can be carried out more efficiently with the flipped classroom. In contrast, students are asked to study independently to find concepts from learning starting from the orientation, exploration, concept formation, and application stages in asynchronous conditions. During synchronous learning (closing stage), students are more focused on discussions related to concepts that have been found previously. In other words, the existence of a guided inquiry-based online learning system involves students' activeness during the learning process. Research conducted by (Afifaha, 2021) also shows that the guided inquiry learning model based on blended learning is well implemented, with the percentage of active students in learning at 87.41% and the guided inquiry learning model based on blended learning is effective in improving students' metacognitive abilities. Not only that, the guided inquiry learning model with the experimental method is also effectively used in online learning on students' cognitive learning outcomes with an N-gain score of 0.514 (Nurdiana, Sunarno, & Wahyuningsih, 2021).

▪ CONCLUSION

The Flipped classroom learning system based on guided inquiry using the Moodle learning management system on salt hydrolysis material has been successfully developed. It is valid with a validity value (V) = 0.88 from material expert lecturers and a validity value (V) = 0.92 from a lecturer media experts. At the same time, the level of practicality is categorized as very practical with a percentage of 92% of student responses and 94% of teacher responses. There are shortcomings in using the video conferencing feature on Moodle. This is due to the weak internet network of students at

SMA N 8 Padang, making it challenging to access these features. However, this research is expected to be an alternative to online learning and support education in the 4.0 revolution era by finding other solutions that can be used for virtual face-to-face between teachers and students.

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