The preliminary study of learning interaction in physics concepts for developing e-learning to promote students’ critical thinking

H Safitri1,2*, I Hamidah1 and W Setiawan1
1Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
2Universitas Terbuka, Jl. Cabe Raya, Tangerang Selatan, 15418, Indonesia

*henis@student.upi.edu

Abstract. Interaction has become one of the important strategies in e-learning for teaching the students to think critically when they conveying their ideas and to make them become more proactive. This paper describe interaction in physics concept between student-student, student-teacher, and student-content. Data were collected through three times observed e-learning system in physics course. Data were analyzed by using quantitative descriptive technique. Based on the results of data analysis, it was concluded that generally interaction in physics concept can be categorized on low category, student-student 14 %, student-content 38% and student-teacher 25%. The interaction result will be used as a reference to develop e-learning design in the physics learning context and it will be used to promote students critical thinking.

1. Introduction
Widespread internet services make the learning process easier to access. This is a fundamental change of education in the 21st century. Learning can be done anytime and anywhere. As an educator must be at least responsive to these changes. Implementation of internet assisted learning, better known as online learning. Online learning has been promoted at various levels of education. Online learning itself is more cost effective and comfortable learning compared to the traditional learning environment [1]. Various places schools or formal education institutions of higher emphasize online learning names in the form of e-learning. E-learning is a learning process based on the use of facilities or digital material. in practice there online interaction between users in this case between lecturers students or among students themselves [2]. E-learning it self is more known to the public as a medium to apply distance learning. E-learning based learning is one alternative learning strategies that are expected to develop students' mastery of knowledge skills independently.

The implementation of e-learning system designed to contain material, question and answer, discussion, reflection, and assignments to the students. E-learning provide more comprehensive and flexible opportunities for students to develop their potential so that learning objectives can be met effectively. So that independence in learning is highly demanded in this study. Independence in learning is an effort that comes from within a person based on his own motivation to master certain materials that can be used to solve a problem. In addition, the ability of a must-have is the ability to think critically. Because in E-learning all information can be contained, so that every individual should have the ability to filter and critical of existing information. Through the use of e-learning to make students and teachers
create a more interactive, face-to-face online, can visualize and provide authentic regional [3]. This makes the process of continuous learning. Teachers can monitor the activities of learners through interaction in e-learning.

Interaction has become one of the important strategies in e-Learning to teach students to think critically when they express their ideas and make them more proactive. Interactions within the online learning allows teachers and students to communicate and respond to each other needs and interests of interaction is also known as one of the keys to change teaching methods teacher-directed traditional to learner-centered approach and the effects of interactivity may be better ensured by studying the types of interaction among the students [4]. Interactions can also be described in terms of the actors participating in the interaction. The three most common forms of interaction in distance education, student-student; student-teacher and student-content [5]. The interaction expanded to include teachers, teacher-content, and content-content interaction [6]. And then [7] developed the equalization theorem describes the capacity to replace one of the other forms of interaction, based on the cost and accessibility factors. Moore and Keasley identify three interactions occurring in distance education is the interaction between the learners with content, interaction between the learners with the instructor, and the interaction between the learners with other learner [8]. Explanation related to the interaction is as follows. The interaction of learners with content described as intellectual interaction between learners and learning topics. This interaction is important in online learning environments. In an online tutorial, student interaction with content goes one way and can be seen from the frequency of student involvement while opening the initiation material in the form of text/ppt, video or animation. Then the interaction of learners with the instructor occurs during learning where instructors are responsible for stimulating and sustaining learners to be interested in studying topics presented, motivate, support and encourage students to learn, and evaluate the achievement of learners.

Furthermore, the interaction between learners occurred between learners in an online environment with or without the presence of an instructor. This interaction serves the communication between a participant and another participant or group of participants either synchronous or asynchronous. The pattern of interactions that occur in online learning by the initiator of the two types of interactions initiated by the instructor, the interaction initiated by students [3]. Meanwhile, based on the direction of interaction consists of a one-way, two-way and multi-way interaction. First, patterns of interaction begins instructor, trainer sending material that message/discussion for all students to participate actively discuss/task. After receiving this message, the student will interact with the content (to find and answer discussion material). Some students will send a message to answer the discussion and sent to the instructor while several others due to various constraints do not send reply. Second, students begin interaction. This interaction occurs in a community discussion forum, in which learners act as initiator and commentator. Meanwhile, one-way interaction occurs when instructors impart information and no learners respond. Two-way interaction occurs when the learner and the instructor asked to respond. Multi-directional interactions occur when the instructor requested and responded to by many learners or when participants were asked, then taken up by other learners and instructors.

Based on the paper analyzed, generally the use of e-learning has great potential to be developed, for example in the context of studying physics at university, especially for physics student teachers. As a first step, researchers noticed that it is very important to observe the interaction in e-learning about the concepts of physics in the study population so that it can be used as reference to identify the characteristics of the material achievement of the weak and the planned development of the design of e-learning in the context of learning physics.

2. Method
This research is to describe the interaction of e-learning about the concepts of physics at the Open University in Indonesia. The study involved 105 students taking introductory physics courses. Data collected by observed interaction student-content, student-students and teacher-student with a given material, discussions and assignments about the sound, waves, reflection and refraction, interference,
diffraction, polarization, electrical and magnetic concepts. Technique data analysis was done by using a quantitative description.

3. Result and discussion

3.1. Student-content interactions

Student-content interaction has always been a major component of formal education, even in the form of literature or reading a textbook in advance with the instructions of the face. The interaction of learners with content described as intellectual interaction between learners and learning topics. This interaction is important in online learning environments. In an online tutorial, student interaction with content goes one way and can be seen from the frequency of student involvement while opening the initiation material in the form of text/ppt, video or animation. This site supports more passive forms of interaction student-content, but also provides a number of new opportunities, such as immersion in micro environments, exercises in virtual labs, and online computer aided learning tutorial. The development of interactive content that responds to student behaviour and attributes (often referred to as a model student) allows for customization of content in unprecedented ways to support the individual needs of each learner is unique. Participant interaction-content as a factor contributing to student success in online courses [9].

![Figure 1](image-url)

**Figure 1.** Profile interaction in physics concepts.

Figure 1 shows the concept of a magnetic field with the lowest interaction between the student and the content. This is to be expected because generally the matter of the magnetic field contains abstract concepts, involving students in complex physical phenomena, requiring observation and interacting with three-dimensional phenomena [10]. When selecting materials, you need tools to support the interaction, it is important to ensure that the tools are in line with the intended course objectives and learning outcomes. The following taxonomy can help you harmonize technological tools with the purpose of teaching and learning [11].

Strengthening the teaching of science especially physics and learning through digitally accessible content that has the potential to provide an active or constructive learning experience that enables learners to collect, analyse, and display data [12] and fully engage in simulation of real-world problem contexts; connecting learners - both students and science teachers - to an experience that mimics how science is practiced in the real world [13].
3.2. Student-student interaction
The interaction of students has traditionally been treated as a distance education requirement, due to obstacles to technological availability and earlier bias among distance education experts on individual learning [14]. Working on collaborative learning illustrates the potential benefits in cognitive learning tasks, as well as improving the degree of completion and acquisition of critical social skills in education. Work related to peer tutors describes the benefits that can be generated for both tutors [15] and learners of various forms of feedback [16]. Student-led teams can produce higher levels of cognitive, social, and even teaching attendance, than those led by teachers [17].

Student-to-student interaction is an important part of the learning experience. In classroom settings, these interactions occur naturally, as students listen to each other’s comments, ask each other, and build relationships through frequent contacts. Instructors can also encourage student-to-student interaction in online settings, but may require building formal and informal interaction opportunities in your course design [18].

Figure 1 shows, student interaction occurs only in discussion 2 in the concept of sound waves, only 18% of students from 52 students in the discussion responded when the other students asked questions about refraction waves. If the level for all discussions only one discussion has a response so that only 14% of student interactions occur in the course. This needs to be more attention if it will develop e-learning, therefore online courses with high student-to-student interaction levels have a positive impact on learning. Student-to-student interaction is essential for building communities in an online environment, which supports productive and satisfying learning, and helps students develop problem solving [19, 20] and critical thinking skills [21, 22, 23].

3.3. Student-teacher interaction
Teacher-student interactions are supported on online learning in a large number of variations and formats that include both direct and indirect communication in text, audio, and video communications. The volume of communication often dominates many new teachers. In addition, students often hold unrealistic expectations for immediate responses from their teachers. The emerging best practices now recognize the flow of communication in the online course to be more focused on the student than the teacher-centered; teachers do not have to respond immediately to any student questions and comments, and play a less dominant role in classroom discourse may actually support the emergence of greater learners’ commitment and participation.

Figure 1 shows two discussions on the concept of sound waves, teacher comments and feedback for questions or statements from students up to 87%. This is thought to be due to the fact that the content or prepared material is well designed, as well as the students and teachers are interested in the material and because it displays simulated waves in real life. Unfortunately, this does not continue in other discussions about the concept of light, interference, electricity and magnetism, so that if the average interaction between teacher-students is only about 25% of the total discussion given. Teachers are expected to have lesson plans to overcome this. Teachers should design discussion forums that invite interaction, provocative, open-ended questions that will stimulate different thoughts and reflections of students, and generate interest so students want to read. It is important for teachers to provide examples of support from different perspectives so that there is a sense of comfort involved in the discussion. Teachers can also promote student interaction by asking students to provide ideas for discussion in assigned tasks [18].

4. Conclusion
Based on the data analysis, it can be concluded interactions in physics concepts in the low category. Profile of interaction can be a reference for developing learning activities in e-learning. With the result that e-learning instruction can be more interesting, challenging and increasing participation in learning physics. On the other hand, critical thinking and problem solving is a skill that needs to be owned by the students of physics, can be built in e-learning.
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References
[1] Richardson J and Swan K 2003 JALN 7 1 68–88
[2] Widuri R 2013 Pemanfaatan E-Learning dalam Pembelajaran Bahasa Indonesia available at http://widuri.rahja.info/index.php?title=Pembelajaran_E-learning
[3] Nuangchalerm P, Samkumduang K, Uhwha S and Chansirisira P 2014 Asian Journal of Education and Elearning, 24 259–263
[4] Hirumi A 2002 International Journal on E-learning, 1 1 19–27
[5] Christenson L and Menzel K 1998 Communication Education 47 1 82–90
[6] Anderson T and Garrison D R 1998 Distance learners in higher education 97–112
[7] Anderson T 2003 Review of Research in Open and Distance Learning 4 2
[8] Moore M G and Kearsley G 2012 Distance education: A systems view of online learning (3rd Ed.) (Belmont, CA: Wadsworth Cengage Learning)
[9] Zimmerman T D 2012 The International Review of Research in Open and Distributed Learning 13 4 152-165
[10] Anderson J L and Barnett M 2013 Journal of Science Education and Technology 22 6 914–926
[11] Koszalka T A and Ganesan R 2004 Distance Education 25 2 243-256
[12] National Research Council (NRC) 2000 How people learn: Brain, mind, experience, and school. Committee on Developments in the Science of Learning. eds. John Bransford, Ann Brown, and Rodney Cocking. Commission on Behavioral and Social Sciences and Education (Washington, DC: The National Academies Press)
[13] National Research Council (NRC) 2012 A Framework for K–12 Science Education (Washington, DC: The National Academies Press)
[14] Andersen T, Norton J R and Nussbaum J 1981 Communication Education 30 377–392
[15] Kirby D and Boak C 1987 Journal of Distance Education 2 2 31–42
[16] Resnick M 1996 Proceedings of the International Conference on the Learning Sciences
[17] Rourke L and Anderson T 2002 Journal of Interactive Media in Education 1
[18] Rochester Institute of Technology 2014 Teaching Elements: Student-Student Interaction
[19] DeVore S, Marshman E and Singh C 2017 Physical Review Physics Education Research 13 1-18
[20] Stary C and Weichhart G 2012 Knowledge Management & E-Learning: An International Journal 4 2
[21] Pramudya D A P and Sudarti 2015 Jurnal Fisika Indonesia 19 55 45-48
[22] Kolloff M 2011 17th annual conference on distance teaching and learning
[23] Gharib M, Zolfaghari M, Mojtahedzadeh R, Mohammadi A and Gharib A 2016 Advances in Medical Education and Practice 7 271–279