Investigation of integrated science course process and the opportunities to implement CSCL learning environments

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Abstract. Integrated science learning should master the entire science study holistically and achieve it needs to be implemented collaboratively. This study aims to describe an integrated science course process and the possibility of implementing CSCL learning environments. Qualitative descriptive was used to analyze data. Data were collected using closed questionnaires with interviews added. The results revealed that there were no collaborative discussions during the course by students that lead affect misconceptions and difficulties to learn of integrated science, due to differences in scientific background. The opportunity to implementing CSCL learning environment is relatively wide due to the availability of technology facilities and skills, but it needs training in operating blogs, wikis, scripts, and interactive multimedia as a CSCL strategy.

1. Introduction
The effectiveness of integrated science learning is related to teacher knowledge in both content and pedagogy. Recommendations of science teachers at the primary and secondary levels should have an understanding of the thematic science in their interdisciplinary perspectives [1] and built on the practice of science and engineering, cross-cutting concept, and core ideas in scientific rules [2]. Nevertheless, the implementation of integrated science learning by teachers has not been well planned due to a lack of understanding of teacher content and pedagogy [3,4]. It is predicted that scientific background differences in physics, chemistry, biology that are fragmented, so an effective integrated science learning is necessary for students as prospective science teachers.

There are many ideas that emerged in support of the effective use of technology in learning [5,6] both to improve achievement [7,8] and motivation [8,9] toward higher order thinking skills [6,8–10]. The belief that knowledge development evolves in a collaborative learning environment through social interaction [11] and will be more effective when aided by the presence of technology [12], through computer-supported collaborative learning (CSCL) [8,13,14]. CSCL comes as part of blended learning in facilitating face to face learning through online learning to influence students' motivation, peer relationships, and of course the academic ability of students [8]. By creating an effective learning process based on Vygotsky's theory of social constructivism, CSCL provides interaction in the learning environment and gives students a central role in the process [15]. In addition, CSCL provides
an innovation in overcoming the limitations of space and time without reducing the benefits of traditional collaborative learning. With the many benefits that learning has with the CSCL environment, its core potential is to influence the social aspects that occur by creating a collaborative learning process in the group [16].

Implementing collaborative learning is certainly a challenge for every teacher. Common barriers can be caused by student literacy on technology, stakeholder policies, skills in collaborative learning [15]. Based on this, it is necessary to investigate the process of implementing integrated science course on the master program as the initial reference of the researcher to implements learning with CSCL environment.

2. Method
This research is a qualitative descriptive through techniques of documentation study, questionnaire, interview, and observation. This method is chosen to illustrate the process of implementing an integrated science course in the master program of a school of postgraduate studies in Bandung. The samples were obtained by purposive sampling consists of 37 students in 2 different classes in the 3rd semester, and 2 lecturers of integrated science course in each class. The analysis technique is done descriptively related information from lecturer and student.

3. Result and discussion

3.1. Implementation of integrated science course process
The implementation of integrated science course in Bandung consists of 2 classes taught by two different lecturers. Although different, students are directed to have conceptual competencies on integration models, so that they can choose and design learning tools containing integrated of physical, biological, chemical, and earth and space science content. This competence has been in line with the competencies required by science teachers [1,2]. The course run sequentially every meeting in distinctive ways. First half meeting in A class, students discuss the concept of each integrated model in heterogenous group in different science background, then develop lesson plan in the rest of meetings. While, students in B class comprehend the concept of each integrated model that is directly followed by develop its lesson plan in the first half semester. In addition, they also discuss learning model and develop its lesson plan in the rest of meetings. All course tasks in B class were done individually.

All students in both class then make presentation as the results in front of the class. During courses, presenters deliver the material directly by using Microsoft Power Point media. After the delivery of the material, participants propose questions or give suggestions to the presenter. On this occasion, generally the question is limited because there will be a review of lecturers related tasks presented.

Course activities are mostly dominated by presenter and communication activities on one side only. Discussion activities are short because at each meeting there are 2-3 presenters. The limited time of discussion causes the students to feel that they have the limitation to build their knowledge. In addition, the assessment criteria for discussion activities reached 20%, but not a highlight of the course. Student motivation is not maximally obtained due to lack of discussion opportunities. The discussion is actually very important in the process of constructing knowledge [8,9,13,17,18]. Limited opportunities to construct knowledge through discussion activities will potentially tendency of students misconception [3,19,20].

The results also mention that students have difficulty and misconception when reviewing materials in integrated science because of differences in their scientific background and high number of students who not pass the course (29,73%). Students who are un-known of the concepts of integrated science because of differences in their scientific background are in high category (81,08%). Students admitted when preparing lesson plans are concepts that need to be re-examined in depth because of ignorance. Excerpts of the interview mention that when some students with the biological background studying physics materials such as electricity and magnetism, need to re-study the material in order to be linked.
Inadequate knowledge of the content on other subjects or the inability to combine contents from different disciplines in teaching is an obstacle to creating science learning [3].

![Figure 1](image)

**Figure 1.** Percentage of students' difficulties.

A: un-known concept of integrated science, B: have misconceptions in integrated science, C: scientific background affects integrated science misconceptions; D: Difficulty in arranging integrated science materials.

Figure 1 shows a high percentage (70.27%) occurs when students realize that they have misconceptions in integrated science course. Differences in scientific backgrounds contribute a high percentage to the occurrence of these misconceptions (75.68%). Students are aware of misconceptions when given feedback by lecturer and participants. The emergence of misconceptions is identified because of the lack of discussion and collaboration and is an individual task. Lecture said that the misconceptions occurred by students tend to be more in physics because the concept is abstract such as energy, electric and magnetism, and optics, then biology like genetics. Misconceptions occurs frequently even on basic topics like energy [21] electric and magnetism [22,23] and modern physics [23].

The difficulties of students in arranging and connecting integrated science because of differences in their scientific backgrounds reach a high percentage (81.08%). When students make lesson plans on certain models, it is very difficult to integrate the subject matter each other. It is summarized by the students' answers that the most difficult topics are in the integrated, immersed, and network models. The difficulty occurs in connecting the subject matter and skills of physics, chemical, and biological disciplines of the models. As prospective and in-service science teachers they have difficulties in connecting subject matter outside his or her background of science, more inclined to specific science area, and inadequately to arrange and teach science curriculum [24]. For example, when connecting the concept of energy to biological context, students have difficulty in explaining the changes of energy conditions in the body of living things, but more easily in understanding the forms and sources of energy [23,25].

In addition, the obstacles that occur in the integrated science course make students achievement is quite low. We assumed that limitation of group discussions causes to this low achievement. In the class that make all course task individually contribute to all the students' who not pass the course. When students work alone, they do not have opportunity to develop ideas or to explore more knowledge from their peer. Discussion in group meeting must be add as effective dialogue in covering different science backgrounds to share, construct, and create knowledge in collaborative way [17].

### 3.2. Opportunities to implement CSCL’s learning environment

Implementing CSCL’s learning environment covers the availability and utilization of ICT in the form of smart-phones and computers, as well as connections to the internet. Ownership of the device shows that almost all students have smart-phones (94.50%), while the rest are feature-phones (2.75%) and
hand-phones (2.75%). The smart-phone operating system is generally based on iOS (22.80%) and Android (77.20%). The internet used by students varies on: less than 3 Gb (8.10%), 3-5 Gb (18.90%), 5-7 Gb (35.10%), 7-9 Gb (24.30%) and more than 9 Gb (13.50%). Generally, the source of the internet connection of students comes from the data package (81.10%), campus WIFI (35.10%), home WIFI (27.00%), and others (18.90%). The use of data package more than 9 GB is estimated in use more on campus or homes WIFI with bundling system. Frequency of utilization of internet connection on smart-phone more used for call and SMS (81.10%), access social media (89.20%), streaming (67, 60%), and accessing lecture information (48.60%). This general description is enough to provide information literacy on the use of smart-phone technology in everyday life is already high, although to access the course information such as searching for material resources in the form of articles, students’ worksheet, and course content material, and also other information just half of population done.

All students (100.00%) own ownership of computers in the form of laptops. The ability of students in using the computer is presented in figure 2.

![Figure 2. Students’ ability in using computers.](image)

**Figure 2. Students’ ability in using computers.**
A: using Microsoft Word; B: using Microsoft PowerPoint; C: using Microsoft Excel; D: using search engine; E: using Blogger and as though; F: using interactive multimedia (Adobe flash and Shockwave)

Most students already have good skills in using Microsoft Office such as Microsoft Word, Microsoft PowerPoint, and Microsoft Excel. Similarly, using search engines such as Internet Explorer, Google Chrome, and Mozilla Firefox. However, most students have low ability in using Blogger, Word Press, and as though and more cannot use interactive multimedia especially Adobe flash and Shockwave. The use of technology by students and lecturers has fundamentally been sufficient, but it needs further training to be able to operate web blogs and interactive multimedia, to implement CSCL learning environment. Skills in operating web blogs like composing wikis, scripts, and interactive multimedia are strategies of CSCL [7,8,13,16,26].

Utilization of learning with technology requires creativity of teachers in creating innovations that can facilitate students through discussion activities, solve problems, and seek information collaboratively through CSCL. Several studies have shown a positive impact on the use of CSCL in science learning to solving abstract concepts [26], improving motivation and peer relationships [8,14], generating trans-active memory system [27]. Relationship in script discussion transitively in CSCL and also online learning environment, very effective to produce argumentation [13,18,27,28] that use to remediate misconception [20,29]. Overcoming difficulties and limitations in discussions on the
course by space and time is important to improving student interaction, so using CSCL learning environment it will be conduct the discussion in a trans-active way. Argumentation in trans-active discussion very effective to produce critical thinking [6,9,30] and collaboration [31,32] as 21st century skills.

4. Conclusion
Based on the analysis of the information obtained, it was concluded that integrated science course has not enough on student activities to collaborate through discussion activities both when preparing integrated subject matter and lesson plan. The number of students who realize the misconceptions and difficulties occurs in learning integrated science because of differences in scientific background. The opportunity to implement CSCL learning environments is available, but further training is required in compiling web blogs, wikis, scripts, and using interactive multimedia as a strategy for implementing CSCL.

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References
[1] NSTA [National Science Teacher Association] 2003 Standards for Science Teacher Preparation
[2] NGSS Lead State 2013 Next Generation Science Standards: For States, by States (Washington, DC: The National Academies Press) p 534
[3] Sun D, Wang Z H, Xie W T and Boon C C 2014 International Journal of Science Education 36 p 808–838
[4] Wilujeng I, Setiawan A and Liliarsari 2010 Cakrawala Pendidik 29 p 353–364
[5] Nelson R F and Webb L S 2015 International Journal on Education 2 p 27–30
[6] Karagöl I and Bekmezci S 2015 Journal of Education and Training Studies 3 p 86–92
[7] McKnight K, O’Malley K, Ruzic R, Horsley M K, Franey J J and Bassett K 2016 Journal of Research on Technology in Education 48 p 194–211
[8] Peterson A T and Roseth C J 2015 International Journal of Education Research 76 p 147–61
[9] deNoyelles A and Reyes-Foster B 2015 Online Learning 19
[10] Sun N, Yuan C W, Rosson M B, Wu Y and Carroll J M 2017 Proc-IEEE 17th Int. Conf. Adv. Learning Technology ICALT 2017 (United State of America: College of Information Sciences and Technology) p 410
[11] Dilshad M N 2017 Archives of Business Research 5 195–198
[12] Magaña S and Marzano R J 2014 Enhancing the Art & Science of Teaching with Technology the Classroom Strategies Serie (United State of America: Marzano Research) p 195
[13] Noroozi O, Weinberger A, Biemans H J A, Mulder M and Chizari M 2013 Computers and Education 61 p 59–76
[14] Wang X, Kollar I and Stegmann K 2017 International Journal of Computer-Supported Collaborative Learning 12 p 153–172
[15] Roberts T S 2009 Computer-Supported Collaborative Learning in Higher Education (Australia: Idea Group Publishing) p 322
[16] Cress U, Stahl G, Ludvigsen S and Law N 2015 International Journal of Computer-Supported Collaborative Learning 10 p 109–116
[17] So K 2013 Teaching and Teacher Education 29 p 188–196
[18] Özçinar H 2015 Journal of Moral Education 44 p 232–251
[19] Yilmaz A and Bayrakçeken S 2015 Procedia - Social and Behavioral Sciences 174 p 2831–2838
[20] Acar Ö 2014 *Learning and Individual Differences* **30** p 148–154
[21] Lancor R 2015 *International Journal of Science Education* **37** p 876–902
[22] Lemmer M, Kriek J, and Erasmus B 2018 *Research in Science Education* p 1-18
[23] Park M and Liu X 2016 *Science Education* **100** p 483–516
[24] Mak Y, Yip D Y and Chung C M 1999 *Journal of Science Education and Technology* **8** p 161–170
[25] Opitz S T, Blankenstein A and Harms U 2017 *Journal of Biological Education* **51** p 427–440
[26] Namdar B and Shen J 2017 *Interactive Learning Environment* p 1–16
[27] Noroozi O, Biemans H J A, Weinberger A, Mulder M and Chizari M 2013 *Learning and instruction* **25** p 1–12
[28] Mayweg-Paus E, Macagno F and Kuhn D 2016 *Discourse Processes* **53** p 280–297
[29] Acar Ö, Patton B R and White A L 2015 *Australian Journal of Teacher Education* **40** p 132–156
[30] Memiş E K 2016 *International Journal of Progressive Education* **12** p 62–77
[31] Golanics J D and Nussbaum E M 2008 *Journal of Computer Assisted Learning* **24** p 167–180
[32] Ibrahim SNKA and Harun J 2015 *Innovative Teaching and Learning Journal* **1** p 13–28