The development of web based inquiry as online science inquiry environment

A I Yasin¹, D Rochintaniawati², and E C Prima³*

¹Program Studi Magister Pendidikan IPA, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
²Departemen Pendidikan Biologi, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
³Department of Science Education, Faculty of Mathematics and Science Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

*ekacahyaprima@upi.edu

Abstract. This paper studies a research in the design and development of web based inquiry as online science inquiry environment. The web based inquiry is constructed to help junior high school students in understanding everyday science phenomena with guided inquiry framework and various sources of scaffolding. Furthermore, it is aimed to support teacher in designing their inquiry virtual class for new normal studying era. This study used 4-D development consisting define, design, develop, and disseminate as research method. At the beginning, it is stated about inquiry theoretical framework and online science inquiry environment underpinning for designing the web based inquiry, describe the features and components of the system, and explain workflow of web based inquiry’s instruction. Web based inquiry went through expert judgement with positive feedback. Afterwards, web evaluation questionnaire is distributed to science junior high school teacher to underline their perception regarding web based inquiry. The result of web evaluation questionnaire gained over 80% positive response. Therefore, web based inquiry can be used for both teacher and students in learning science with appropriate content navigation and layout.

1. Introduction

Inquiry is the important aims and nature of scientific learning. Generally, inquiry focuses on students' analytical skills to understand scientific concepts and processes through direct investigative activities [1,2]. Nevertheless, there are obstacles in implementing of learning science causing inquiry learning can’t be achieved optimally. A few teachers routinely use inquiry based instruction due to constraints to prepare exam students, low self-confidence or insufficient academic background to teach certain disciplines through inquiry, or understanding limited to inquiry-based instruction that impacts the knowledge transfer process [3,4].

Currently, learning science through inquiry methods incorporating ICT is desired as 21st century pedagogical approach. In recent years, a number of computer-supported science learning environments have been developed, studied and evaluated [5]. Moreover, some research shows web-based technology supports a more collaborative inquiry pedagogy in scientific inquiry to build and communicate students' scientific understanding [6,7,8]. The use of the web in learning improved 21st century skills and problem-solving abilities [9]. In addition, Kahoot's web-based learning in colloidal material can develop...
students’ digital literacy in categories both in the aspects of information, communication, content-creation, safety and problem-solving [10].

The Online Science Inquiry Environment is intended to support concept understanding, integration of knowledge, critical thinking and stimulating communication skills. Instructions and facilities in the Online Science Inquiry Environment are created virtually to support students’ metacognitive processes in understanding day-to-day science phenomena and reflecting on the progress of their problem solving process [11]. Web-based inquiry is one of the online inquiry environments to help students engage in inquiry learning about scientific phenomena that are difficult to teach using only textbooks and showing science experiments. Online Science Inquiry Learning has the following characteristics; increased authenticity, guided but flexible learning; improving student communication capabilities; data based assessment; teacher adaptation to the learning environment [5,11].

The aim of this research is to develop web based inquiry for appropriate online science inquiry environment through research and development method. The expected result is web based inquiry learning with appropriate content, navigation and layout to implement ICT based learning for both teacher and students. Probably, students experienced failure because of certain bias in the real experiment. Therefore, web based inquiry retrieve and strengthen students’ scientific thinking. Moreover, due to this pandemic period, teacher can still develop their professionalism in designing online science class and students is facilitated IT based scaffolding guiding their learning from home.

2. Methods
The method used in this research is research and development The model used in this study was the development of a 4-D model for learning tools. The 4D development model had four main stages: Define, Design, Develop and Disseminate [12]. This method and model was chosen to produce web-based inquiry products. In the early stage of this research, students characteristic, science topic and scientific inquiry steps were analyzed. Afterwards, the design, layout and flow chart of web based inquiry were arranged and developed. In the final stage, the web based inquiry went through trial and error and validated by expert from computer department expert and lecturer. Web based inquiry was disseminated to science junior high school teacher through Web Evaluation Questionnaire to check whether it has appropriate feature and workflow.

The respondent of web evaluation questionnaire was junior high school science teacher. The researcher gave both teacher’s and student’s account to access and explore the web based inquiry. They were allowed to design a class, upload a proper video and link, and explore students’ mark database, or even following the steps and answering the questions with students account. Afterwards, the participants gave their opinion about web based inquiry through web evaluation questionnaire.

Web Evaluation Questionnaire was given to the teacher to see teacher’s perception and first impression through web based inquiry. Web evaluation questionnaire consists of fourteen statement explaining dimension of connection, quality of information, layout, and language as explained in Table 1 [13]. Web evaluation questionnaire gained respondent’s opinion through rating scale consist of Strongly Agree, Agree, Neither Agree or Disagree, Disagree and Strongly Disagree. The researcher gave web evaluation questionnaire by online facilitated by google form.
### Table 1. Web Evaluation Questionnaire

| Dimension   | Aspect          | statements                                                                 |
|-------------|-----------------|-----------------------------------------------------------------------------|
| Content     | Relevance       | The information in this website is of little use to me.                     |
|             |                 | This website offers information that I find useful.                         |
|             | Comprehensiveness | The language used in this website is easy to me.                            |
|             |                 | I find many words in this website difficult to understand.                  |
| Navigation  | Ease of use     | I consider this website user friendly                                         |
|             |                 | I had difficulty using this website.                                         |
| Structure   | The convenient set-up of the website helps me find the information I am looking for |
|             |                 | I find the structure of this website clear                                 |
| Hyperlink   |                 | The homepage clearly directs me towards the information I need.             |
|             |                 | Under the hyperlinks, I found the information I expected to find there.      |
| Speed       |                 | I think it takes a long time to download a new web page from this site.      |
|             |                 | I think this is a fast website                                              |
| Layout      | Web page appearance | I like the way this website looks.                                           |
|             |                 | I find the design of this website appealing.                                |

### 3. Result and Discussion

The web-based inquiry learning had advanced design and workflow. It will cover many classes, teachers, topics and virtual lab for appropriate ICT-based science learning. Teachers have the ability to control and set specific class and learning material independently, while students can access several classes and topics in one website. It was more advanced than the previous study about the development web-based learning using interactive media for science learning that covered only one topic and subject [8]. Moreover, the specific components of the web such as content, navigation, and layout from the result of web evaluation questionnaire would be described in the following explanation.

#### 3.1 Content

The dimension of content is related to the information that is found in the website. Content dimension has two aspects underlining the quality of information. The first content dimension aspect is **Relevance**. More than half of the participants didn’t agree with the first statement “The information in this website is of little use to me”. 20% of participants stated that the web-based inquiry didn’t have any benefit, while 10% of them didn’t know whether it gave any benefit or not. The second statement “This website offers information that I find useful” was designed to test the consistency of participants’ opinions regarding web-based inquiry. 80% and 20% of participants agreed that web-based inquiry gave benefit for them. It means that web-based inquiry have positive relevancy to information needed. Figure 1 below explained the result percentage of relevance aspect.

![Figure 1](image1.png)  
**Figure 1.** The result percentage of relevance aspect

While for **Comprehensiveness** aspect, 60% and 40% of participants agreed the third statement “The language used in this website is easy to me”. In line with the previous statement, over 80% rejected the statement “I find many words in this website difficult to understand”, the rest of them didn’t find any difficulties to understand the language using in the web. From those sentences above, the respondents
gave their positive thought to information existing in the web based inquiry as explained in Figure 2. Therefore, web based inquiry learning fulfilled the requirement of web information technology in education practice to have readable and relevance content for suitable online learning within desktop device [14,15].

3.2 navigation

The dimension of Navigation is related to the process of looking for information and its connection in the website. The navigations dimension has 4 aspects. The first aspect was Ease of use which mainly about the user’s thought after exploring all of menu from web based inquiry. The statement “I consider this website user friendly” was approved by almost participant with 72.7% of absolutely agree and 27.3% agree. The next statement “I had difficulty using this website” was neglected by almost participants with 63.6% a bit disagreement and 36.4% disagree. From the percentage in Figure 3, those two statements delivered that the navigation of web based inquiry can be used easily.

Figure 2. The result percentage of comprehensiveness aspect

The second aspect is Structure and discussed about the arrangement system of web based inquiry. The structure of this web was asked through statement number seventh and eighth. The seventh statement “I find the structure of this website clear” was accepted by almost participants with 81.8% agree and 18.2% absolutely. In accordance with the previous statement, the eighth statements “I find the

Figure 3. The result percentage of ease of use aspect

Figure 4. The result percentage of structure aspect
structure of this website clear “was approved by 81.8% of them agree, while the rest 27.3% absolutely agree.

The percentage result from those statements shown in Figure 4 and concluded that web based inquiry was well structured. Hyperlink is the third aspect discussing the extended link feature in the web based inquiry. The ninth and tenth statement asked the respondent how well the provided hyperlink worked. The statement “The homepage clearly directs me towards the information I need” was admitted by almost 91%, while the rest 9% questioned whether there is hyperlink in the web. The next statement “Under the hyperlinks, I found the information I expected to find there” was approved by 72.7% and 18.2% participants. Although, the rest of 9% of them questioned whether the hyperlink can provide the information needed. The participants’ opinion summarizing in Figure 5 proved that hyperlink related the information needed.

Speed is the last aspect of navigation dimension. It is about how long the web based inquiry process and load the web page. The statement “I think it takes a long time to download a new web page from this site” was neglected by almost participants with 63.6% and 18.2% percentage. The other 18.2% participants doubted whether the web is fast to access and jump to next page. The statement “I think this is a fast website” was accepted by almost participant with the percentage 81.8% absolutely agree and 18.2% agree. Those responses from the participants positively were summarized as Figure 6. It is proved that web based inquiry has enough speed to access. Navigation aspect’s result above explained that web based inquiry learning followed former semantic web technology with friendly navigation feature to present learning material at computer desktop properly [16,17].

![Figure 5. The result percentage of hyperlink aspect](image5.png)

![Figure 6. The result percentage of speed aspect](image6.png)
3.3 Layout
The third dimension of web evaluation is Layout with Web appearance as its aspect. It is mainly discussed about the aesthetic quality of website’s appearance in the classical notion. The last two questions is about the layout and the interface design of web page. The statement “I like the way this website looks” was admitted by almost participants with the percentage 81.8% agree and 9.1% absolutely agree. The rest 9.1% participants doubt to decide whether the web is attractive. The last statement “I find the design of this website appealing” have the same result as the previous statement. Those statements were summarized in Figure 7 and explained that the web was interesting enough to attract participant. In line with the research of semantic web technology, web based inquiry consisted appropriate layout design such as unity of content appearance, page layout and colour theme to pleasant the users when interacting within the website in every desktop resolution [16,17].

![Figure 7. The result percentage of layout aspect](image)

4. Conclusion
Web evaluation questionnaire gave insight about the content, navigation and layout of web based inquiry from the participant’s responses. From the result above, it can be concluded that web based inquiry which have been developed has enough and appropriate content and navigation and layout. Although the web achieved over 80% positive responses from participants, it has some disadvantages such as the web still cannot accommodate the big file, the web server deficiency and there is no time limitation, exam, learning material feature in this web. For further development, it will be repaired to convenience the user.

5. References
[1] McNew-Birren J and Kieboom L A 2017 Exploring the development of core teaching practices in the context of inquiry-based science instruction: an interpretive case study Teaching and Teacher Education 66 74-87
[2] Kumdang P, Kijkuakul S and Chaiyasith W C 2018 An action research on enhancing grade 10 student creative thinking skills using argument-driven inquiry model in the topic of chemical environment Journal of Science Learning 2 9-13
[3] Chichekian T, Shore B M and Tabatabai D 2016 First-year teachers’ uphill struggle to implement inquiry instruction: exploring the interplay among self-efficacy, conceptualizations, and classroom observations of inquiry enactment Sage Open 6 1-16
[4] Fitzgerald M, Danaia L and McKinnon D H 2017 Barriers inhibiting inquiry-based science teaching and potential solutions: perceptions of positively inclined early adopters Research in Science Education 49 543–66
[5] Williams P J, Nguyen N and Mangan J 2017 Using technology to support science inquiry learning Journal of Technology and Science Education 7 26-57
[6] Putri A S and Aznam N 2019 The effect of the science web module integrated on batik’s local potential towards students’ critical thinking and problem solving (thinking skill) Journal of Science Learning 2 92-6
[7] Vania P F, Setiawan W and Wijaya A F C 2018 Edmodo as web-based learning to improve student's cognitive and motivation in learning thermal physics Journal of Science Learning 1 110-15
[8] Astuti L, Wihardi Y and Rochintaniawati D 2020 The development of web-based learning using interactive media for science learning on levers in human body topic Journal of Science Learning 3 89-98
[9] Haseski H I, Ilic U and Tugtekin U 2018 Defining a new 21st century skill-computational thinking: concepts and trends International Education Studies 11 29-42
[10] Jumila J, Parisitowati M, Zulhipri Z and Allanas E 2018 Analisis literasi digital (ict) peserta didik melalui pemanfaatan web kahoot dalam pembelajaran koloid Jurnal Riset Pendidikan Kimia 8 95-100
[11] Kyza E A 2015 Online inquiry environments Encyclopaedia of Science Education ed R Gunstone (Netherlands: Springer) pp 715-18
[12] Thiagarajan S, Semmel D S and Semmel M I 1974 Instructional Development for Training Teachers of Exceptional Children; A Sourcebook (Bloomington: Eric Publishing)
[13] Elling S, Lentz L and De Jong M 2007 Website Evaluation Questionnaire: Development of A Research-Based Tool for Evaluating Informational Websites (Berlin Heidelberg: Springer)
[14] Mkrtchian V, Krevskiy I, Bershadsky A, Glotova T, Gamidullaeva L and Vasin S 2019 Web-based learning and development of university’s electronic informational educational environment International Journal of Web-Based Learning and Teaching Technologies 54 32-53
[15] Potocki M, Scharrer L, Ros C, Stadtler M, Salmerón L and Rouet J F 2019 How good is this page? benefits and limits of prompting on adolescents’ evaluation of web information quality Reading Research Quarterly 14 299-321
[16] Vesin B, Klašnja-Miličević A and Ivanović M 2016 Application of semantic web technologies to facilitate use of e-learning system on mobile devices Smart Education and E-learning ed V L Uskov, R J Howlett and L C Jain (Switzerland: Springer) pp 473-84
[17] Wang S, Zhang J, Yang F, and Ye J 2013 A method of e-government website services quality evaluation based on web log analysis Proceedings of 3rd International Conference on Logistics ed Runzong Zhang, Zhenji Zhang, Kecheng Liu, Juliang Zhang (Heidelberg: Springer) pp 1157-162