



A narrative inquiry of socio-scientific issues-based e-learning development in biology to promote student health literacy

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ABSTRACT

Study on e-learning implementation has been growing as a great interest particularly in biology education research and practice. Whilst a number of research has shown various modes of e-learning, however, there is still a lack of understanding on how e-learning can be applied for health literacy orientation in biology instruction. This research aimed to develop a conceptual framework of SSI-based e-learning in biology to promote student health literacy. This research was conducted in narrative inquiry design. Nine people including five biology teachers, two experts in health education and two science teachers who are practitioners in e-learning implementation were voluntarily participated in this research. Data of this research are experiences, knowledge, or perspectives that were expressed by participants and were collected through semi-structured interviews. Thematic analysis approach was employed to analyse the data in three stages with trustworthiness and authenticity were applied for quality standard. Research findings show that there are three main aspects that need to be considered in developing an intended framework. These are: 1) e-learning platform could be used, 2) SSI-based learning pathways arranged in e-learning mode, and 3) additional e-learning elements need to be provided. Hence, these three aspects play essential roles in underpinning the framework of SSI-based e-learning in biology to promote student health literacy.

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INTRODUCTION

Nowadays health issues presence as one of big and challenging problems in our society (NRC, 2009). Despite of an advanced development of medical knowledge and technology as well as health services, many diseases occur and potentially threat our quality of life. As a contemporary instance, covid-19 pandemic which caused by SARS Co-2 virus has been has a significant impact to all of us globally, not only for health condition, but also toward life aspects we live in, such as economics and education activity (Atabey, 2021). It is an interesting to view that dealing with health issues caused such by covid-19, some people may apply their scientific knowledge and have a well-informed perspective as well as decision to respond it. However, it is also represented that many individuals in society may stand on different points of view, where socio-cultural dimension may play an important role for the way undertaken by society in dealing with the issue (Pietrocola et al., 2021). For example, although public policy and health procedures have been admitted in handling of the corpses of covid-19, a few groups of society force to manage the funeral without considering the procedures and rather carried out of it in conservative way by which cultural and religiosity believe underpinned their decision. Thus, it implies on a high risk of SARS Co-2 virus spreading since people who involved in the funeral did not take care of themselves in safety ways.

Considering the state of health issue related to covid-19 above described, it is clearly viewed that the issue can be defined as one of socio-scientific issues (SSI) (Atabey, 2021; Grace & Bay, 2011). SSI represent issues where scientific knowledge and socio-cultural dimensions are interrelated and presenting conflicts or dilemma faced by society and lead to multi-perspectives confrontation amongst individuals (Sadler, 2011; Zeidler & Nichols, 2009). Just like other issues shown by previous studies such as genetic modified organisms (GMOs), global warming and climate change, nuclear-based electricity (Dawson & Venville, 2013; Lederman et al., 2014; Lee et al., 2013; Lee & Grace, 2010), some others health-related issues are also considerably defined as SSI (e.g Albe, 2008; Lundström et al., 2012). Furthermore, in science education practice, SSI has been implemented in a large number of studies and evident in providing better learning process and also supporting students to develop important skills (Chowning et al., 2012; Dawson & Venville, 2013; Lenz & Willcox, 2012; Ottander & Ekborg, 2012; Robottom, 2012; Rudsberg et al., 2017; Subiantoro et al., 2013; Subiantoro, 2019).

The emergence health related issues in society consequently requires individuals who have adequate knowledge and enable to critically select, evaluate and use relevant information in order to respond to those health-related issues wisely. As exemplified by NRC (2009), health issue currently is one of essential contemporary problems for the 21st century biology that requires individuals who have health literacy. According to the World Health Organization (WHO) (WHO, 2008), health literacy represents cognitive and social skills which underlies someone's motivation and capability to understand and use health information towards sustainable health state. Nutbeam (2000), moreover, defines health literacy onto three different categories, namely: 1) basic/functional literacy, including reading and writing about health issues, 2) communicative/interactive literacy, by which cognitive and social skills to select, interpret, and use health-related information, and 3) critical literacy, expressed when individual critically reason and analyse information to make a decision about health problem. Hence, preparing students who have such capabilities and to become literate-community members then being a part of responsibility of biology education practice.

Although it is not literally stated as 'health literacy', nevertheless, the call of health literacy orientation is considerably reflected in the Indonesian national curriculum (i.e 2013 Curriculum). According to the Ministry of Education and Culture Act no. 24/2016 (Permendikbud, 2016), some basic competencies in biology curriculum for senior high school particularly in Grade 11 consist the orientation. Basic competency number 3.7, for example,

states: *“Analysing the relationship between the structure of tissues that compound of digestive system and their relation to nutrition, bioprocesses, and malfunction. In pair, basic competency number 4.7 mentions: “Presenting report about nutrient test and its relation to individual energy demand, and food processing technology and food safety products. Moreover, there are ten-out-of-fourteen (71%) basic competencies which have similar content to those for Grade 11, or over all fifteen-out-of-thirty-five (43%) basic competencies for all grades in the curriculum that consist health-related context or discourse.*

Carefully review to those basic competencies’ construction especially those for Grade 11 reveals that learning achievements expected by those basic competencies considerably reflect a number of skills that can be defined as health literacy as above referred. These include knowledge on biological structure and functions, skills of investigation toward issues or problems related to bioprocesses as well as physiological malfunction or diseases, and communication skill to express idea, knowledge or argument related to health problems being learnt. Generally viewed, therefore, health literacy is strongly relevant to national curriculum need for biology education practice (Grace & Bay, 2011).

It is viewed that health literacy has a strong relevance and needs to be involved in science classrooms as an important skill to be developed (Bruselius-Jensen et al., 2017; Lamanauskas & Augiene, 2019) for preparing students as responsible citizen to overcome communal health problems in their society (Vamos et al., 2020). Hence, as exemplify by previous studies in other countries (e.g Jacque, et al., 2016; Sakamaki, et al., 2005; van der Heide, et al., 2013) this means that a call of health literacy orientation must also be a great interest for contemporary biology education practices. However, since covid-19 pandemic has been forcing global education system, including in Indonesia, to adopt a different approach by which the teaching and learning process is no longer can be arranged in a direct face-to-face occasion in classes as an alternative strategy of instruction is required.

Toward that challenge, many studies show that online learning is likely the best way to accommodate the alternative strategy required. Online learning basically represents an approach that is applied for distance learning system (Rhode et al., 2017) that applies advanced information and communication technology (ICT) including internet and also commonly known as e-learning (Han & Shin, 2016). It is shown that a distinct application or strategies of e-learning had been developed and employed in science education practices (Mikropoulos et al., 2003; Seribulan et al., 2018; Wicaksana et al., 2020). Nevertheless, considerations are needed to take into account in designing e-learning in/for science education practices, including in fostering health literacy orientation (NSTA, 2016).

Although many researches have contributed to a various frameworks on SSI-based instruction implementation (e.g Feierabend & Eilks, 2010; Presley et al., 2013; Subiantoro & Treagust, 2020), however, there is still a lack number of studies which provide a theoretical framework as well as practical features of suitable strategy in implementing SSI-based instruction particularly for fostering student health literacy through online learning. This implies on a need of empirical study about a conceptual framework as a basis of how SSI in health context can be arranged and managed in an e-learning design of biology instruction.

SSI and health issue in science education (especially biology) represent an epistemological view in which a rising of consideration to uncertainty as well as unpredictability of those field of studies in science emerged (Lee, 2012). Hence, towards its implementation in science instruction needs an insightful understanding about a concept or framework on pedagogy, curriculum, and teaching and learning dimensions. According to Hwang (2011), this requires not only theoretical basis, but also by taking into account the teachers’ (and other parties’) experiences and reflections that may support to transform and reconstruct their knowledge, thinking, idea, as well as perspectives. Therefore, this research is

basically aimed to fulfill the need and carried out in a view of meaning-making process within the specific context of curriculum topic (i.e health issue in high school biology instruction) to develop a conceptual framework of SSI-based e-learning in biology to promote student health literacy. The research question led this study was: what aspects are considered to developed a conceptual framework of SSI-based e-learning in biology to promote student health literacy?

METHODS

Research Design

As this research intend to develop a conceptual framework of SSI-based e-learning in biology to promote student health literacy which emphasizes on the experience-based critical construction and meaning-making from related parties or participants (i.e teachers, experts, practitioners), hence this research is framed and conducted in/as narrative inquiry design. According to Webster and Mertova (2007), narrative inquiry “provides researchers with a rich framework through which they can investigate the ways humans experience the world depicted through their stories” (p. 3). Moreover, Josselson (2011) accentuated that generally the objective of narrative research is to bring framework that can be figured out or depicted from exploration and conceptualisation of human experience as well as perspectives contextually about a field of study.

Research Participant

Nine people whom including five biology teachers (four females and one male), two experts in health education (both females) and two science teachers who are practitioners in e-learning implementation (both males) were voluntarily participated in this research. Following Webster & Mertova (2007), there were no specific requirements or conditions such as age or gender assigned to the teacher as well as expert-participants despite of they decided to be involved in this study after an invitation provided by researchers toward biology teacher association as well as health educators. However, researchers priorly ensured that each participant’s background is met with the research context and need based on everyone’s profile collected by researchers. For biology teachers, for instance, it was ensured that each of them has been teaching in senior high school. Likewise, researchers also have known that two practitioner-teachers have experience in e-learning practice in their teaching duties. Five biology teachers and two practitioner-teachers are from different public high schools in Yogyakarta province, while two health educators are lecturers as well as researchers from a reputable state university in Yogyakarta province, Indonesia.

Instrument

The main data of this research are experiences, knowledge, or perspectives that were expressed by participants considering the problem of the research (Webster & Mertova, 2007). Therefore, the data of this research is qualitative in nature. As suggested by few studies regarding main method in narrative study (e.g Savin-Baden & van Niekerk, 2007), a semi-structured interview was administered to collect the data in this research. Semi-structured interview characterised by its interview-protocol as the research instrument where the questions are not constructed in detail for every aspect of data or problem dimension, instead of lies on some key points prepared or arranged as foundations for researcher to ask the participants in a dynamic and insightful conversation (Josselson, 2011). The sample of questions given to the participants as instances: *“How do you understand about health literacy?”*; *“How is your idea or opinion about the relevance of health literacy to biology learning?”*; *“How important is health literacy in/for our biology education?”*

Procedure

This research was conducted in three stages of procedure. *Firstly*, focus group discussions were carried out by researchers to analyse and define the key points of interview protocol based on literature reviews. At this stage, researchers also sent an invitation of research interview-conversation to local high school biology teachers association, teacher-practitioners, and health educators for data collections. *Secondly*, based on schedules arranged, interviews were carried out with research participants in three different occasions. There were: 1) conversation with biology teachers that was talked about SSI and health literacy in biology instruction, 2) with teacher-practitioners on e-learning implementation in science instruction, and 3) with health educators where discussion about health education practice was undertaken. *Lastly*, data analysis was administered to obtained data from interviews.

Data Analysis Techniques

Since narrative study could be defined as one of research methods in interpretive paradigm family (Treagust et al., 2014), qualitative analysis is suitable and underpinned to current research. Moreover, narrative analysis emphasizes content and its meaning which are revealed in structural forms and put its focus on the pattern of relationship amongst experience, knowledge and values to create 'a meaning' by which reflected as 'conceptual framework' in this study (Josselson, 2011; Webster & Mertova, 2007). Hence, thematic analysis (Josselson, 2011) was applied in order to find patterned relationship in the flow of experiences-narrated by participants. Practically, the analysis technique carried out by the following stages: 1) defining the unit of analysis (i.e participants' statements), 2) organizing the data in chronological as well as topical classification, 3) defining and interpreting the pattern of the data, and 4) representing the data in order to figure out the 'meaning' (i.e intended conceptual framework) with examples. For quality standard which is generally termed as validity in interpretive study, this research applied trustworthiness and authenticity of the data considerations through member checking by the following steps. *First* is translation to all participants' expression into textual data that written by first author. *Secondly*, participants were asked to check the validity of data translations and were also pleased to give adjustment notes, if necessary, for any inappropriate translation provided. *Third*, based on participants views, researchers then did a group discussion to cross-check the data back to their source and reach agreement in aligning the data interpretation (Creswell & Miller, 2000).

RESULTS AND DISCUSSION

The main objective of this research is a developed conceptual framework of e-learning for SSI-based instruction in biology for promoting student health literacy. According to data analysis, the findings of this research are represented and supported by quotes or summarised narration expressed by participants whom coded by number toward essential dimensions emerged from interviews in accordance to intended framework as follows.

There are essential aspects that can be figured out based on the interview data with teacher participants. For the first aspect of potential biological topics, it is suggested that most of biological topics in national curriculum are suitable and in align with health context problems, either for grade 10, 11 or 12. Participant #1 stated that all topics for grade 11 are appropriate, as she provided her class experience in learning about circulatory system as an example. Other participants (#2 and #5) added that besides topics for grade 11 which mostly discuss about human physiology, other topics in grade 10 (such as virus) or for grade 12 (for example: genetic and hereditary disease) are also possibly applicable. Following the discussion about the potentiality of the topics, teacher participants also provided their views about the relevance of the topics for health literacy orientation. Participant #3, for instance, stated:

“this [study] is interesting, because biology learning should promote student health literacy, and this can be stimulated by contextual issue. Contemporary issue about Covid-19, for example, is strongly related to virus topic in grade 10” (excerpt #1).

However, the potential of biological topic for promoting health literacy is possibly to apply as many topics are likely suitable, but it may be challenging to achieve the health literacy since teachers may not have been recognise as well as understand the concept of the skill, particularly regarding the way students shall use information on health contexts. Participant #2 reflected this view based on her experience as she stated:

“In my class, students mostly learn how to receive [biological] information and knowledge, but they have less experience to use it in the decision-making activity. I think it is complicated to carry out the assessment on it. Students need guidance to do the decision-making activity” (excerpt #2).

Following this reflection, the discussion continued about the way socio-scientific issues (SSI) may support in fulfilling the above stated challenge. Participant #5 stated that according to the national curriculum, one of important competency needs to be achieved is social skills and this most likely relevant to SSI implementation. Participants #1 and #2 argued that SSI emphasize the issues in society that might be advantaged in biology learning. Thus, in designing the SSI-based learning, a strong stimulation is required whereby students could define the problem being learnt and further will also be attracted to find relevant information to resolve the problem. Moreover, participant #4 also accentuated two important considerations regarding the instructional design. *First*, students’ beliefs about their learning orientation that mainly focuses on knowledge mastery. To gain different dimension of learning objectives (such as health literacy) may really complicated for teachers. *Second*, student intrinsic motivation may strongly influence to lead student in doing expected learning activities as well as gaining the targeted learning achievement. Additionally, participant #4 viewed that it is strongly suggested for teachers to understand appropriate instructional strategy in contextualising the biological topic by, for example, providing social-based issues that represent scientific problems because students tend to less motivated if they do not find any relationship between biological knowledge and life experience, including health context.

Based on interview with two health education experts, there are some considerations can be summarised about health education dan health literacy. *First*, according to expert #1, related to public health education, socio-scientific issues (SSI) can be defined as biomedical and social issues. One thing should be noted that based on personal, social, health and education principle, the issues do not imply only to personal interest and involvement, but to solve the issues requires participations from groups of society. *Second*, refers to expert #2, there are two main orientations on public health education, including promotive and preventive frameworks. Either one is implemented, the usefulness of strategy in resolving health problems need to be considered. In other words, understanding the advantages of health knowledge as well as values to resolve health problems is an important dimension to a meaningful health education which can be perceived either by individual or group of society. *Third*, both experts reminded that the basic framework of health literacy which comprises of three skills, including: understanding the health knowledge, communicating and writing argumentation as well as decision toward health problems.

Regarding biology teaching and learning practice, both experts assert that SSI can play an important role in contextualising health problems which can be learnt in biology. However, expert #1 asserted that it is important to ensure the relevance of SSI to curriculum need

particularly to the topic that further be developed as learning materials, instructional media and assessment strategy. Particularly about instructional media, social media are suggested by the experts to be potentially useful since many health issues can be found in, and students are familiar to such media contemporary in their daily life. Furthermore, related to learning objectives, both experts accentuated that it would be sufficient to put the preventive framework in biology instruction developed by which teachers and students can take the health risk into account in their teaching and learning process.

Concerning e-learning development that underpinned this study, teacher-practitioners pointed out two essential factors that need to be concerned. *First*, fostering health literacy skills in e-learning environment could be really challenging as arranging learning activities in an online mode is not easy. Moreover, teachers also argued that they will not be able to well supervise students in doing essential activities related to SSI-based learning, such as role-play or class discussion, since there is limited occasion to have face-to-face meeting in online learning. *Second*, related to online learning implementation, regardless the specific learning strategies implemented, basically teachers have been having experience in applying various online instruction during covid-19 pandemic. Besides on the basis of learning management system (LMS) which has been managed by a few schools, teachers also informed that they have been applying other modes, such as personal blog (e.g using Google classroom), digital modules or worksheets, online source (such source as biology learning website or YouTube), or videos. Related to these e-learning modes, web-based resource and social media were suggested as appropriate platform to use, as participant #6, for example, argued:

“In my perspective, web-based form of learning resource is interesting and might useful. Students can have one complete resource as well as instructional arrangement for one topic. Social media is also interesting since to date social media have been a trend and a lot of students use those in their daily life” (excerpt #3)

In align with e-learning practises view above, the two practitioners added that accessibility for teachers and students is the main factor which need to be taken into account since e-learning platform will be the main ‘space’ to meet and manage the teaching and learning process together between teachers and students. Thus, defining an appropriate application that can be embedded and applied in e-learning platform is required for facilitate students in doing online activities in SSI-based learning framework.

Toward the expected conceptual framework aimed by this research, it can be highlighted that one important aspect reflected by teacher-participants as shown in excerpt #1, for instance, that it is a critical consideration about the role of biology instruction to promote student health literacy. Although there were no more arguments supporting their view especially on what way the role could be represented in teaching and learning practice, nevertheless, their experiences on the relevance of some biological topics to health context discourse accentuated the view, and this is considerably in align with a number of studies (Bruselius-Jensen et al., 2017; Lamanauskas & Augiene, 2019; Vamos et al., 2020) who explained that science instruction (including biology) could have an important role to promote health literacy. Supporting this view of relevancy, it is important to understand how biology instruction could foster student health literacy in teaching and learning process. Although it may still to be a big challenge for teachers, as such represented by excerpt #2, health literacy needs to be priorly defined and derived as learning objectives in the instructional design, particularly in the preventive orientation of health education.

Related to this health literacy orientation, two considerations reflected from data obtained. *First*, about the way health literacy could be defined. As reminded by health

educators, it is reflected that health literacy covers skills including knowledge, information processing skill, reasoning and decision-making toward health issues (Nutbeam, 2000; WHO, 2008). *Second*, socio-scientific issues (SSI)-based instruction in health context is believed to have an important role in providing appropriate learning environment to the expected objectives. It should be noted that besides to contextualise scientific knowledge (Feierabend & Eilks, 2010; Lenz & Willcox, 2012), SSI-based learning also evident its role in improving as well as fostering students' scientific knowledge, information processing skill, reasoning and argumentation (Chowning et al., 2012; Dawson & Venville, 2013; Lundström et al., 2012). It means that students' health literacy could potentially be developed through SSI-based learning.

In dealing with SSI-based instruction, many studies have provided various models of implementation that described aspects, principles, as well as learning pathways need to be considered (Feierabend & Eilks, 2010; Saunders & Rennie, 2013). According to Subiantoro & Treagust (2020), in particular, there are four dimensions that involved in the SSI learning environment, including: 1) contextualisation of SSI, 2) student involvement, 3 student dispositions, and 4) SSI learning objectives. These key aspects considerably could be adopted to overcome teachers' concerns on the way implementing the SSI instruction pathways. Concerning e-learning implementation, based on data gathered, basic platform of e-learning and supporting applications which could be embedded in the platform applied are two important aspects need to take into account. As suggested by teacher-practitioners (excerpt #3), web-based mode is most likely suitable platform to be developed as it provides "*one complete resource as well as instructional arrangement for one topic*" and relevant to theoretical recommendation of e-learning in science education (NSTA, 2016). Additionally, applications such as virtual live-meeting (e.g Google meeting, zoom cloud meeting), online chat forum, or any digital learning material management, may potentially be used in facilitating teacher and students to have a face-to-face occasion for discussion, debate or role-play since these activities are recommended in SSI-based instruction. Therefore, based on all those views and considerations, this research offers the conceptual framework of e-learning for SSI-based instruction in biology for promoting student health literacy as represented by Figure 1.

As represented by Figure 1, the conceptual framework of e-learning for SSI-based instruction for promoting students health literacy can be described as follows:

1. e-learning platform developed and applied is web-based mode, as it is most suggested as has been discussed above.
2. SSI-based instruction constructed comprises of six phases. These are: 1) Orientation, 2) Activity #1, 3) Discourse #1, 4) Activity #2, 5) Discourse #2, and 6) Reflection and Evaluation. These phases are basically derived from SSI-based learning framework developed by previous studies (Feierabend & Eilks, 2010; Presley, Sickel, Muslu, Merle-Johnson, et al., 2013; Saunders & Rennie, 2013)
3. Various elements are provided as such represented applications to support teaching and learning activity management in web-based platform developed.

Roles/function	Learning Phases	Web elements
To engage students to contextual issue and biological topic will be learnt	1. Orientation	Videos, text, news
Facilitating students to explore their prior knowledge and argument toward the issue	2. Activity 1	Digital student worksheet
To discuss essential biological knowledge related to the topic	3. Discourse 1	Videos, digital books, virtual meeting
An inquiry-based activity to develop an insightful argument & decision	4. Activity 2	Digital student worksheet
To confirm and reflect biological knowledge, social aspects and decision being made	5. Discourse 2	Videos, digital books, virtual meeting
Examining students' achievements: knowledge, reasoning & argumentation (health literacy)	6. Evaluation	Online tests, assignments

Figure 1. A Representation of Developed Conceptual Framework of E-Learning for SSI-based Instruction in Biology for Promoting Student Health Literacy

CONCLUSION

According to the findings, it is shown that there are three main aspects that need to be considered in developing a conceptual framework of SSI-based e-learning in biology to promote student health literacy. These aspects are: 1) web-based mode as the preferred e-learning platform to be used since it most likely to provide comprehensive learning materials as well as an online learning environment, 2) SSI-based learning is arranged in six stages in order to facilitate students learning SSI in health context and achieve health literacy, and 3) in dealing with providing more interactive representations of learning material, various e-learning elements are required to support instruction process. Since this research is limited to its effort in developing an intended conceptual framework based on research method employed, perhaps more studies are required to re-examine the developed framework based on more theoretical basis as well as philosophical points of views. Moreover, research on implementation the framework in a real SSI-based online teaching and learning is likely the most important thing to be carried out in revealing the degree of the framework's role in practical dimension for biology education practice.

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