Exploration of student's social presence in a web-based discussion for conceptual learning of organic chemistry

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Abstract

The current paper reports social presence in web-based discussion for their conceptual learning of organic chemistry class. The study examined students-students, students-instructor, and students-learning materials interactions via the designed web-based discussion. We developed an online forum nicknamed "Universal Chemistry Network" to enhance communication among students and teachers in organic chemistry class. A sample of 138 senior five students was purposively selected from two secondary schools located in Kicukiro district, Eastern province in Rwanda. A questionnaire composed of multiple-choice and open-ended questions was used to collect data. Descriptive statistics and interpretive analysis were used to analyze data. The results revealed that the use of web-based discussion is the potential and effective teaching method for enhancing students' -student's and student's- teacher's interaction in organic chemistry class also students appreciated this teaching and learning method as it helped them to search for additional information, exchange their ideas, knowledge, and experiences. A web-based discussion was also found to provide the students with the potential confidence and motivation to express freely their ideas. The challenges faced by students during web-based discussion while learning organic chemistry were also examined

Introduction

Social presence refers to the way people interact with each other in an online environment (Lowenthal, 2011). People learn from each other in the community. Based on Vygotsky's idea social-cultural learning leads to learner-centered and constructivist learning (Yu et al., 2013). Furthermore, teacher-students and students- student's interactions are key aspects for creating and assisting new ideas.

Social-cultural learning theory combines the social world and cognitive development. The web-based discussion offers interactions between students-students, students-teachers, and the exploration of resources and practice. Thus, knowledge construction is enhanced. The interaction in web-based discussion increases students' confidence in organic chemistry class (Poole & Glaser, 1999). Web-based discussion is important in the teaching and learning process as it supports a paradigm shift from teacher-centered to learner-centered education engages students to learn at their own pace and supports the connection of learners with others.

It was found that the use of traditional group discussion does not allow efficient resources for students to get full of information needed in their learning and some students are inactive during traditional group discussion (Bin, 2014). The use of a traditional method of teaching like lecturing where a teacher is considered as the master of the learning content affects the students' development of cognitive presence due to time constraint, the inefficient guide for all learners, lack of interactive content, and students' misconception (Ferdous & Karim, 2019). The utilization of web-based discussion was found to be the best solution to those challenges due to its added value of allowing the students to express and exchange their ideas and discover the learning concepts.

It has been reported that constructivism in web-based discussion is valuable in teaching and learning. Thus, it is an area that necessitates research continuity (Lefoe, 1998). Via web-based discussion in organic chemistry, interaction is more effective and helps students to understand difficult concepts in organic chemistry including nucleophilic substitution and nucleophilic substitution reactions involving new carbon-carbon bonds (Rodríguez et al., 2016).

Using web-based content is more interesting and encourage students to understand a topic in organic chemistry including alkanes, alkenes, alkynes, stereochemistry, aromatic compounds, alkyl halides, alcohols, phenols, ethers, aldehydes and ketones, carboxylic acids and their derivatives, amines, heterocyclic compounds, carbohydrates, lipids, amino acids and proteins, and nucleic acids (Al-Salihi & Alobaidi, 2018). It was found that students have a high positive perception towards the utilization of web-based discussion in organic chemistry (Romero, Vidal Espinoza, and Ramírez Hernández, 2018). Thus, the current research aimed to explore student's social presence and perception via web-based discussion for their conceptual learning of organic chemistry in secondary school in Rwanda

Research questions

How do students interact with themselves, the instructor, and the teaching material in web-based discussion in organic chemistry?

What are students' opinions towards web-based discussion in organic chemistry class?

Methodology

In this study, questionnaires composed of multiple-choice and open-ended questions were administered to the students to explore students' opinions, their interaction with each other, the teacher, and teaching materials via web-based discussion. We designed a web-based discussion nicknamed "Universal Chemistry Network (UCN)" available at www.universalchemistrynetwork.com a total of 138 students comprised of 83 males and 55 females from two selected schools in the Kicukiro district were registered to the forum. Those schools were selected due to the purpose of the study and the availability of computer labs and internet connection in those schools. Web-based discussions were done for one month. 10 organic chemistry topics via designed web-based discussion. The discussions were done via UCN where the account of each participant has been created, and each participant has been logged in by using his/her username and password. Figure 1 below shows the home page of the designed web-based discussion.

The discussed topics were based on alkanes, alkene, alkyne, alcohols, aldehyde, ketone, ethers, esters, carboxylic acids, and amines. The content discussed was mainly based on nomenclature, physical properties, chemical properties, and preparation of organic compounds. Figure 2 below shows the login status of the designed web-based discussion

After login, every participant got access to the forum. Students and teachers discussed together organic chemistry topics via UCN, the figure 3 below shows the discussion chat during the study.

Questionnaires were analyzed in two ways, Likert scale questions were analyzed by using descriptive statistics such as mean ($\bar{x}$) and standard deviation (SD) while open-ended questions were analyzed by using interpretive analysis. To ensure the content validity of the research instruments, the interview was checked and approved by a team of experts in research and chemistry education from the college of education, University of Rwanda (UR- CE). The recommendations and comments provided were very helpful and constructive to improve the final research instruments. To ensure the reliability of this study before the intervention, the research was piloted in one school (different from the schools involved in this study) with the same characteristics of the schools under the study. The reliability coefficient was calculated by using Cronbach's and was found to be 0.88. Researchers were obtained ethical approval from the University of Rwanda, the College of Education from the research and innovation department, research permission from Kigali city and Kicukiro district. The participants have explained the aim of the study, before signing the consent forms to participate in the study willingly. All students have ages ranging between 16 years and above. Researchers received permission from the parents whose children are below 18 years. We have ensured that the principle of anonymity was respected to guarantee the confidentiality of the collected information. All data collected were available and stored secretly in the email of the researcher.

Result And Discussion

4.1 Student's opinions towards the utilization of web-based discussion in organic chemistry

To explore students' view a Likert scale questionnaire composed of 14 statements were used whereby each statement has four levels of agreement which are 1= strongly disagree, 2= disagree, 3=agree, and 4= strongly agree. Table 1, below shows, represent the mean score and standard deviation on students' views toward the utilization of web-based discussion in organic chemistry class.

Table 1
student's views towards the utilization of web-based discussion in teaching and learning organic chemistry.

Statements	Mean	Std. Deviation
It was easy to collaborate with other via web-based discussion	3.9783	.92387
I like to interact with other students via web-based Discussion In organic chemistry class.	4.2029	.89736
Web-based discussion is a powerful collaborative tool in teaching organic chemistry class.	3.8551	1.15607
Web-based discussion helps me to visualize organic chemistry concepts	3.6594	1.05676
Web-based discussion helps me to share my views and resources with other students and teacher required in organic chemistry	4.0725	.76069
Using web-based discussion in organic chemistry is enjoyment	3.6594	1.05676
Teacher encouraged learners to explore new concepts through web-based discussion	4.0725	.76069
Web-based is an excellent collaborative tool in learning organic chemistry than traditional discussion	3.7681	.85683
I felt comfortable while discussing organic chemistry with other students via Web-based discussion.	3.6594	.88372
Via web-based discussion brainstorming and searching relevant information was increased.	3.6594	1.05676
I can recommend administrators and other schools to web-based discussion in teaching and learning of organic chemistry.	4.0725	.76069

During the analysis, we combine strongly agree and agree, and strongly disagree and disagree. The result above indicated most students are familiar with using web-based discussion in their learning with the $\bar{x}$ of 3.9783 and SD 0.92387. Those are agreement with (Janssen et al., 2009) found that students have the experience to collaborate with others via web-based discussion. It was also confirmed by (Yang & Cornelius, 2004) found that students have a positive experience towards web-based discussion in their learning. With the $\bar{x}$ of 4.2029 and SD of 0.89736 responded that they liked their interaction via web-based discussion. It was also confirmed by (Serhan, 2019) found that the use of web-based discussion enhances students interaction. In addition, found that web-based discussion increases social interaction.

Web-based discussion is powerful collaborative tool at $\bar{x}$ of 3.8551 and SD of 1.15607. According to (Grover, 2007) indicated that a web-based discussion is a powerful tool that stimulates student's thinking and sharing of information. Students reported that use of web-based discussion is enjoyable with the $\bar{x}$ of 3.6594 and SD of 1.05676. As it was also confirmed by (Mitchell, Chen, and Macredie, 2005) found that students enjoy more web-based discussions and have positive view's to this kind of discussion. Web-based discussions helps students to visualize organic chemistry concept with the $\bar{x}$ of 3.6594 and SD of

1.05676. use of web-based discussion encourages students to explore new organic chemistry concept with the $\bar{x}$ 4.0725 and SD of 0.76069. It is in agreement with (Onyema et al., 2019) indicated that web-based discussion encourages students to explore and share ideas.

Students confirmed that web-based discussion is an excellent collaboration tool than the use of traditional discussion with the $\bar{x}$ of 3.7681 and SD of 0.85683. This is in agreement with (Helic et al., 2004; Nguyen, 2015; Shana, 2009) all of them in their research found that web-based discussion is an excellent collaborative tool than using traditional discussion. Students felt comfortable while discussing via web-based discussion with the $\bar{x}$ of and 3.6594 and SD of 0.88372. It was also confirmed by (Richards-Babb et al., 2015; Salame and Hanna, 2020; Tekane, Pilcher, and Potgieter, 2020) found that students have positive opinions about the quality of using web-based discussion in organic chemistry class. Via web-based discussion brainstorming of searching new information was increased with the $\bar{x}$ of 3.6594 and SD of 0.88372. According to (Kurt & Emiroğlu, 2017; Tsai & Tsai, 2003) also found that use web-based discussion encourages student's search for new information. Student's appreciated and recommended educator use of web-based discussion tools with the $\bar{x}$ of 4.0725 and SD of 0.76069. This result is in consistent with (Khan et al., 2021) recommended educational institutions and policy makers to take this online-learning process to the next level in a better way. In addition, (Abel et al., 2010) recommend educators and educational stake holders to promote use of web-based discussion forum as it promote communication and motivate learners.

4.2 Social presence in web-based discussion for conceptual learning of organic chemistry.

To explore the interaction of among students themselves, teacher and learning materials incorporation of students idea from open ended questionnaires were used. Students were given number from S 001 to S 138. Students reported that web-based discussion is interactive and unjoyful. One student wrote that "*through web-based discussion, it was easier to reflect on ideas of my colleague, and it was also easier to get to know idea of the another's*"(S120). Students also reported that web-based discussion improve their communication and interaction. All students 100% were satisfied with on quality of communication and interaction of web-based discussion. One student wrote "*We got opportunity to share our own ideas, experience and understand other views on a given topic*"(S132). Another student reported that "*through web-based, our interaction became easier because it was easy to react and share ideas more easily*" (S 084).

It was found that web-based discussion helps students to search other resources. One student wrote "*using this platform is good because as we are connected to the internet it was easy to search related information when you uncouneted with difficulties during discussion*".(S 018). Participants pointed that the web-based discussion forum gave them a platform to learn from each other through social interaction. In addition web-based discussion encourage all student to participate in the discussion, one student pointed that "*during traditional discussion, I refused to answer even though I knew the answer because I'm shy but through this mode of collaboration helps me to collaborate with my colleague without fear*" (S 062).

The above statements suggest that web-based discussion forum is a powerful collaborative tool that enhances social learning where learners share their ideas and experiences for a given topic. From the above results we found that social interaction in web-based discussion is useful in three ways: sharing ideas and experience, increase interaction and problem solving. The Table 2 below shows sample of student's response on their views about social presence in web-based discussion

Table 2
Student's response on social presence in web-based discussion

Areas	Students number	Response
Sharing ideas and experience	- S120	- <i>Through web-based discussion, it was easier to reflect on ideas of my colleague, and it was also easier to get to know idea of the another's</i>
	- S 132	- <i>We got opportunity to share our own ideas, experience and understand other views on a given topic</i>
	- S 014	- <i>Sharing and discussing with other in web-based discussion is enjoyment and interactive.</i>
Interactions	- S 084	- <i>Through web-based, our interaction became easier because it was easy to react and share ideas more easily"</i>
	- S 062	- <i>During traditional discussion, I refused to answer even though I knew the answer because I'm shy but through this mode of collaboration helps me to collaborate with my colleague without fear</i>
	- S 007	- <i>I really like the participation of my colleagues and teacher during discussion.</i>
Problem solving	- S 018	- <i>Using this platform is good because as we are connected to the internet it was easy to search related information when you uncounted with difficulties during discussion</i>
	- S 094	- <i>My colleagues give their views often and inputs on the content given topic.</i>
	- S 017	- <i>My colleagues and teacher gave me support where necessary.</i>

The above results shows that use of web-based discussion, enhance interaction, encourage student's participation, motivate them, encourage them to share knowledge and experience, and help them for searching additional information in organic chemistry class. They are in agreement with others authors for example the study conducted by (Dai et al., 2021) found that use of online discussion forum enhance communication, motivate and encourage students to participate during discussion of carboxylic acid sub-topic. According to (Poole & Glaser, 1999) found that organic chemistry online forum helps students to know each other and encourage participation. These results are consistent also with (Romero et al., 2019) found that web-based tool is useful collaborative tool in organic chemistry that enhance interaction.

4.3 Challenges of using web-based discussion in teaching and learning organic chemistry.

Regardless of the usefulness of using web-based discussion in organic chemistry class, some challenges are identified. They include reported poor internet connection, lack of own computer and smart phone, delay of feedback from teacher, classroom time table, writing formula and drawing compounds, loose of concentration and technical support. The Table 3 below shows the samples of students response on their challenges while discussing organic chemistry topics via web-based discussion.

Table 3
Challenges faced by student while discuss organic chemistry topic via web-based discussion.

Student's number	Challenges
- S 002	<i>- Poor internet connection - Expensive - Waste of time</i>
- S 101	<i>- Classroom time table - Availability of computer - Internet connection</i>
- S 027	<i>- Internet connection - Technical support - Loose of concentration</i>
- S 078	<i>- Lack of own computer and smart phone - Delay of feedback from the teacher - Insufficient time</i>
- S 124	<i>- Technical support - Writing compounds and formula - Poor internet connection - Waste of time.</i>

According to (Coman et al., 2020) found that low technical skills affect effective collaboration in a web-based discussion. This was also in agreement with (Crossley & McNamara, 2016) showed that low technical skills in web-based discussion hinder effective communication. This was also confirmed by (Elida et al., 2012), (Aljeraisy et al., 2015), and (Bartley & Golek, 2004).

4.4 Challenging organic chemistry topics difficult to discuss via Web-based discussion.

To identify challenging topics difficult to discuss via web-based discussion a Likert scale questionnaire used where by Students were requested to rate organic chemistry topic with four levels of agreement, those levels are: very difficult=1, difficult=2, Easy=3, very easy =4. The following figure 4 below shows how students rate difficulty of organic chemistry topics via web-based discussion..

During analysis we combined very difficult and difficult as difficult and very easy and easy as easy. All students 138 (100%) reported that it was difficult to draw organic compounds, 110 (79.71%) responded it was difficult to discuss isomerism in web-based discussion, however only 28 (20.29%) of them indicated it was easy to easy. All students 138 (100%) reported that it was easy to discuss nomenclature of organic compounds via web-based discussion. 99 students about 71.73% pointed that it was difficult to discuss reaction mechanism via web-based discussion while 39 students about 28.27% showed that it was easy to discuss reaction mechanism. 90 students about 65.22% pointed that it was difficult to discuss chemical properties of organic compounds while 48 students about 34.78% showed that it was easy for them. All students 138(100%) highlighted that it was difficult to discuss reaction synthesis of organic compounds via web-based discussion. On the other hand all 138 (100%) students pointed that it was easy to discuss the classification and physical properties of organic compounds via web-based discussion. From the above results identified some challenge organic chemistry topics that are difficult to discuss via web-based discussion include drawing organic compounds, reaction synthesis, isomerism, reaction mechanism, and chemical properties of organic compounds.

Conclusion And Recommendations.

The current study intended to explore student's social presence in web-based discussion for conceptual understanding of organic chemistry. The study also investigated the challenging topic difficult to discuss via web-based discussion, in addition challenges faced by students while discussing via web-based discussion. The finding revealed that web-based discussion is powerful collaborative tool that enhance interaction among students and teacher, it also found that web-based discussion encourage students to share idea and experience, help them to search additional information on a given topic. The study also highlighted challenging topic difficult to discuss via web-based discussion including reaction mechanism, drawing and writing organic compounds, chemical properties and isomerism. In addition challenges faced by student while discussing via web-based discussion were identified such poor internet connection, lack of own computer and smart phone, and technical support. Use of web-based discussion important in teaching and learning process, however we need future direction to continue this success, education policy maker need to formulate policies that regarding to the usage of web-based discussion in secondary schools. Future work will focus on how web-based discussion enhance student's higher level of thinking.

Declarations

Acknowledgment

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Conflict of interest

There is no conflict of interest between authors.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Figures

The forum

The UNC aim is online discussion group. Any user can post the doubts topics and can reply for the other user doubts. This is useful for a researcher who is interested to correct data and idea from particular people. Facility to share the resource and post topic that can be viewed by registered user. User also be able to share his/her though on given topic.

Figure 1

Home page of designed web-based discussion

Figure 2

Login status of designed web-based discussion

UCN Create a topic View topics Aloys IYAMUREMYE Logout

All available topics

Search keyword...

- what are potential of natural product in our every day life?**
IYAMUREMYE 4:44:43 12 2021
- What are natural product? A natural product is a chemical compound or substance produced by a living organism or found in nature**
IYAMUREMYE 4:4:41 12 2021
- Carboxylic acid in our every day life: Carboxylic acids and their derivatives are used in the production of polymers, bioalymers, coatings.**

Differentiate electrophilic and nucleophilic substitution

Aloys IYAMUREMYE 5:47:28 16 2021 31

- In Electrophilic substitution, electrophiles replace another electrophile attached to a compound whereas in Nucleophilic substitution an electron-rich compound attacks another compound and replaces it
NDIKUMWENAYO Alain 5:0:29 24 2021
- difference between electrophile and nucleophile is that electrophiles are atoms or molecules that can accept electron pairs whereas nucleophiles are atoms or molecules that can donate electron pairs.
blenda Batakariza 0:25:25 26 2021
- Electrophiles are electron acceptors while nucleophiles are electron donors
ESPERANCE CYUZUZO 0:44:6 26 2021

Aloys IYAMUREMYE Comment Comment

Figure 3

discussion room

Figure 4

challenging topic difficult to discuss via web-based discussion