Data in Brief 56 (2024) 110803

Contents lists available at ScienceDirect

Data in Brief

journal homepage: www.elsevier.com/locate/dib

Data Article

Examining the utilization of web-based discussion tools in teaching organic chemistry: A dataset collected from secondary schools of Gasabo and Kamonyi districts in Rwanda

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ARTICLE INFO

Article history:
Received 21 June 2024
Revised 30 July 2024
Accepted 31 July 2024
Available online 6 August 2024

Dataset link: Dataset collected to evaluate the usage of web-based discussion in teaching and learning organic chemistry in the selected Rwandan secondary schools (Original data)

Keywords:
Dataset
Utilization
Web-based discussion
Teaching and learning
and Organic chemistry

ABSTRACT

In recent years, teaching and learning organic chemistry have been troubled by limited engagement, and active participation among learners. As a result, there has been a growing need to develop innovative teaching methods that can address these educational challenges. Web-based discussion tools have emerged as a promising means of promoting engagement and critical thinking skills among learners. Web-based discussion tools are platforms or apps that help communication and collaboration among users over the internet. These tools allow individuals or groups to engage in conversations, share information, and exchange ideas in a digital learning environment. Therefore, this dataset delves into the current usage of web-based discussion in teaching and learning organic chemistry in Gasabo and Kamonyi districts secondary schools. The study's objectives encompass evaluating usage levels of web-based discussion tools, comparing levels of usage, identifying integration possibilities, and informing policymakers and researchers for future practices. The dataset consists of data from 133 secondary school chemistry teachers obtained through an online sur-

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https://doi.org/10.1016/j.dib.2024.110803

vey. The survey gathered information on the current usage, teachers' perceptions and skills of using web-based discussion tools in teaching organic chemistry. The data were categorized into seven sheets. The dataset allows for in-depth exploration across various demographic variables, including gender, location, school ownership, working experience, and age. The data are raw, filtered, analyzed and are available freely to explore and reuse. Researchers in related fields can use this dataset to measure the existing use of web-based discussion in teaching and learning organic chemistry, identify gaps, and foresee potential solutions to the difficulties associated with the use of this approach in Rwandan secondary schools. Moreover, the presented data can aid teachers, policymakers, and curriculum designers in developing effective strategies for integrating web-based discussion into organic chemistry instruction.

Specifications Table

Subject	Chemistry
Specific subject area	Chemistry education
Type of data	Tables Figures
How the data were acquired	Data were collected via an online survey consisting of two sections. The first section gathered demographic information such as name, gender, location, school type, school ownership, age, and experience from participants. The second section examined the current usage of web-based discussion for teaching and learning organic chemistry. Kobo Toolbox was used to collect the data. The recording and management of the information were carried out in Excel 2016.
Data format	Raw Filtered Analyzed
Description of data collection	Data were gathered from 133 secondary school chemistry teachers from Gasabo and Kamonyi districts in Rwanda. The survey was completed by 147 chemistry teachers. However, we only looked at the data from 133 of them because they answered all of the questions. The sample was drawn at random and included all teachers. All teachers from boarding, day, public, government, and government-aided schools were given an equal opportunity to participate in the data collection method.
Data source location	Two districts (Gasabo and Kamonyi), Rwanda.
Data accessibility	**Data are available freely to explore and reuse** Repository name: Mendeley Data identification number: https://data.mendeley.com/datasets/m6pbpkk3sw/1 Direct URL to data: 10.17632/m6pbpkk3sw.1

1. Value of the Data

- The provided data are advantageous to chemistry education, particularly organic chemistry education in Gasabo and Kamonyi districts as they clarify the status of employing web-based discussion tools in teaching organic chemistry.
- The data presented in this study hold significant importance as they provide valuable insights into the utilization of web-based discussion as a novel approach to teaching and learning organic chemistry in Gasabo and Kamonyi districts secondary schools. Therefore, they inform

the development of effective strategies for integrating web-based discussion tools into organic chemistry instruction, ultimately improving the quality of education in the field.
- Researchers in related fields can use this data to measure the existing use of online discussion in teaching and learning organic chemistry, as well as to pinpoint any gap and foresee potential solutions to the difficulties associated with using online discussion in Gasabo and Kamonyi districts secondary schools. Accordingly, data can be re-analyzed based on several factors, such as school location and ownership, district, gender, instructors' experience, and qualification, depending on the researcher's interests.
- This information is crucial for policymakers and curriculum designers as it can assist in conducting relevant reviews of teacher competencies, promoting the implementation of novel teaching techniques that utilize web-based discussion tools in various schools, and ensuring the successful adoption of a competency-based curriculum.

2. Background

Education is a cornerstone for societal development and access to quality education is essential for the growth and progress of any nation. Rwanda, many other countries emphasize improving the quality of education, particularly in science and technology fields [1]. The study has shown that the majority of secondary school curricula in developing nations emphasize memorization [2]. Rwanda as a developing country, traditionally has relied on conventional teaching methods which may not provide active participation [3]. In this sense, different studies demonstrated that traditional pedagogical approaches of teaching organic chemistry in Rwandan secondary schools often rely on rote memorization [4–9].

Nowadays, Rwanda is implementing ambitious education reforms from a Knowledge-Based Curriculum (KBC) to a Competence-Based Curriculum (CBC). The major reason for changing KBC to CBC was done to promotes active learning and skills that enable graduates to acquire the competence needed for the job market and become problem solvers [10]. Thus, for the effective implementation of CBC, the adoption of modern technologies offers innovative solutions to enhance the teaching and learning experience [11]. Thus, this dataset aimed to evaluate the current utilization of web-based discussion tools for teaching and learning organic chemistry in secondary schools across Gasabo and Kamonyi districts.

3. Data Description

To evaluate the current usage of web-based discussion tools in teaching and learning organic chemistry in Gasabo and Kamonyi districts Secondary schools, we collected and analyzed the dataset in seven sheets. The data collected were categorized into three categories in all sheets. The first category is concerned with teachers' perception of the use of web-based discussion in teaching and learning organic chemistry. The data in in this sheet were given the following codes strongly agree = 4, agree = 3, disagree = 2, and strongly disagree = 1. The second category was concerned with teachers' skills in using web-based discussion in teaching organic chemistry. In this category, these data were given the following codes excellent = 4, very good = 3, good = 2, poor = 1. Lastly, the third category is about the extent of using web-based discussion in organic chemistry class with the following codes. more than three per week = 5, three times per week = 4, two times per week = 2, once per week = 2, and none = 1. The Table 1 shows the categories of statements used during data collection

During the designing the survey, the researchers connected the with connectivism theory of learning. Connectivism emphasizes the role of technology and networks in learning, suggesting that learning is not solely situated within the individual but is distributed across networks of people and resources [12]. In the context of our study, web-based discussion tools serve as a central component of connectivism learning. These discussions create an environment where

Table 1
Categories of question.

Teachers' perceptions towards the use of web-based discussion tools in teaching organic chemistry	Teachers' Skills of using web-based discussion tools in teaching organic chemistry	Extent of using web-based discussion tools in teaching organic chemistry
1. How effective do you believe web-based discussion tools are in facilitating interactive learning among secondary school students studying organic chemistry? 2. How important do you believe web-based discussions are for promoting the conceptual understanding of organic chemistry among secondary school students? 3. I feel confident in my ability to use the computer 4. My students have knowledge and skills of using web-based discussion tools 5. I have received adequate training and support to use web-based discussion tools effectively 6. There is a need for increasing investment in technological infrastructure to improve the utilization of web-based discussion tools 7. Lack of access to reliable internet connectivity is a barrier hindering the use of web-based discussion tools effectively 8. Do you find teaching organic chemistry via web-based discussion is possible in your school?	1. Rate your overall skills on the of web-based discussion tools (Excellent = 4, Very Good = 3, Good = 2, and Poor = 1)." 2. I can complete group assignment by using web-based discussion tools 3. I have knowledge of searching for information on the website	1. How often do you use web-based discussion tools in your teaching? 2. How often do you use web-based assessment tools in your teaching? 3. How often do you incorporate web-based discussion and assessment tools into your teaching?

students can actively engage with course materials, each other, and external resources, fostering knowledge creation through the connections they form. In addition, the connectivism theory asserts that learners are not passive receivers of knowledge but active participants who construct knowledge through interactions with the learning environment [13]. In this study, web-based discussions are a tool for promoting social collaboration and knowledge co-construction among learners, which aligns with the tenets of the connectivism theory. The interactive nature of web-based discussions also promotes self-directed learning and learner autonomy, which is consistent with the connectivism theory's emphasis on learners' active participation in the learning process [14]. Thus, by participating in web-based discussions, students can connect with peers, teachers, and external experts, expanding their networks and access to diverse perspectives and knowledge sources.

It is widely admitted that the success, acceptance, and effective implementation of online teaching and e-education through technologies depend on various factors internal and external to the teacher [15]. As identified in the literature, there are several teacher-related factors that have a significant impact on the adoption and utilization of technologies and online discussion tools. These factors include gender, technological literacy, technological pedagogical content knowledge (TPACK), location, attitudes, beliefs, motivation, habit, self-efficacy, performance expectation, as well as computer experience and proficiency [16]. Research has also shown that external factors, such as institutional structure, working culture, available resources, social conditions, value of technology, feasibility of technology use, competitive advantage, and institutional preparedness all play a significant role in determining the implementation and integration of online education [17]. Moreover, the provision of professional development courses for teachers and their expected online resources and infrastructures influence their technology integration in

their teaching [18]. In case these factors are considered and effectively dealt with, many positive outcomes may emerge in education, particularly organic chemistry.

The first sheet named "Raw data" contains anonymous information and filtered data of the participants. Columns A to P contain the teacher's identifications. Column B contains the anonymous information of teachers from teacher 1 up to 133. The data on the current utilization of usage of web-based discussion started from column Q to AD. Sheet number two named "Analysis one" contains the overall analysis of data collected which shows the overall usage of web-based discussion in the teaching and learning of organic chemistry in Gasabo and Kamonyi districts secondary schools. The data in this sheet come from sheet one where COUNTIF, Sum, and percentage functions were used to analyze the collected data. Thus, the figures in this sheet were drawn based on percentages.

The data in sheet 3 named "Analysis two" displays the extent of using web-based discussion according to gender. The data related to teachers' perception of the use of web-based discussion are found from columns Z to AM while the data related to teachers' skills on the use of web-based discussion in organic chemistry were found from columns AX to BF. Furthermore, data related to the extent of using web-based discussion were found from BK to BX. During analysis, the graphs were drawn from sum and percentages functions.

The data found in sheet four nicknamed "Analysis three" were related to the geographical locations (per-urban, urban, and rural) of the participants. Likewise, those data were categorized into three categories. The data relating to teachers' perceptions were found in columns A to T. According to the classification of the data in this sheet, the data related to teachers' skills on the use of web-based discussion were found in columns W and X. Lastly, the data related to the extent of using web-based discussion based on geographical location are found from the column AB to AU. Like in analysis 3, the graphs were drawn by using sum and percentages functions.

The data in sheet five, named "4" are related to the school ownership (Government aided, public or government schools, and private). Columns A to N are concerned with teachers' perception on the use of web-based discussion in organic chemistry learning according to the owner of the school while data concerned with skills on the use of web-based discussion were found in the Q to S. Finally, the data related to the extent of using web-based discussion per type of school were located from Y to AZ. Sheet six named "Analysis five" contains data related to teachers' working experience. In this context, data concerned with teachers' perceptions are drawn from columns A to O while information on the skills of teachers on the utilization of web-based discussion was found from columns Y to AE. The last categories of information on this sheet data related to the extent of using web-based discussion were found from columns AH to AS.

The last sheet of data called "Analysis six" is concerned with the usage of web-based discussion according to age. Columns A to O are related to the information about teachers' perceptions. On the other side, columns T to Z are concerned with data on skills of using web-based discussion per age. Lastly, columns AA to AL contain data related to the extent of using web-based discussion in organic chemistry per age Table 2 shows demographic variables analyzed in this dataset.

4. Experimental Design, Materials, and Methods

The purpose of gathering the data for this data collection was to evaluate the way that organic chemistry is now taught and learned in Gasabo and Kamonyi districts secondary schools, specifically concerning the use of web-based discussion tools. The study used a census sampling technique. The census uses the entire population as a sample [19]. In this sense, a total of 133 secondary chemistry teachers in Kamonyi and Gasabo districts of Rwanda have participated in this study. The census sampling method ensures that the entire population of interest is accounted for and provides accurate and precise information about the frequency and nature of the phenomena being studied [20].

Table 2
Demographic information of the respondents.

N^0	Demographic item	Code	Category	Frequency (n = 133)
1	Gender	1	Female	30
		2	Male	103
2	Location	1	Per-urban	4
		2	Rural	102
		3	Urban	27
3	School ownership	1	Government aided school	67
		2	Public	60
		3	Private school	6
4	Working experience	1	Less than one year	7
		2	1-3 years	44
		3	4-6 years	26
		4	7-9 years	17
		5	Above 10 years	39
5	Age	1	18-25 years	3
		2	26-32 years	63
		3	33-40 years	57
		4	above 40 years	10

The data were categorized according to the five main variables analyzed such as gender, location, school ownership, working experience, and age. The collection of data employed a survey research design [21]. During data collection, the participants were requested to fill online survey generated via the Kobo Toolbox. This survey questionnaire was developed by a team of four researchers from the University of Rwanda-College of Education. It aimed to show how often and how long chemistry teachers used web-based discussion in their teaching. In addition, a survey was used to identify organic chemistry concepts that can be taught via web-based discussion. Furthermore, this tool was used to explore types of web-based discussion platforms used by chemistry teachers while teaching organic chemistry concepts. Hence, this survey-based descriptive study approach aimed to see a complete picture of the breadth of the use of web-based discussion in teaching and learning organic chemistry in Gasabo and Kamonyi secondary schools.

We took validity and reliability into account [22] defined validity as measuring what is expected to be measured and what is being measured. To ensure the content validity of the research instrument, the researchers from the University of Rwanda's College of Education reviewed and approved the research instrument. During validation, a team of six researchers with different expertise were used. These include one Associate Professor in Biochemistry, one senior lecturer in ICT in education, one lecturer in English education, one lecturer in Chemistry education,and two PhD students in Chemistry education. The content Validity Ratio (CVR) proposed by [23] of each test item was also tested. CVR is a linear transformation of a proportional level of agreement on how many "experts" within a panel rate an item "essential."

$$\mathrm{CVR} = \frac{n_e - \left(\frac{N}{2}\right)}{\frac{N}{2}}$$

where CVR is the content validity ratio, n_e is the number of panel members indicating "essential," and N is the total number of panel members. The final evaluation to retain the item based on the CVR depends on the number of panels. The CVR of the research instrument was calculated and found to be 0.87 Hence, the obtained CVR is greater than the minimum value of CVR, P = .05. In this line, the used research instrument is valid.

To ensure the reliability, the questionnaire was piloted to 60 chemistry teachers which have same characteristics to the teachers under the study. Afterward, Cronbach's alpha was used to calculate the reliability coefficient for the questionnaire and was found to be 0.72. Thus, the instrument was found reliable to be used in data collection.

4.1. Method of Data Analysis

Ms Excel 2026 was used to analyse the collected data. During data analysis, COUNTIF, SUM, and Percentage functions were used to analyze data. In addition, data were descriptively analyzed in terms of percentages, histograms, and bar charts. During analysis, we analyzed data based on five variables such as gender, location, school ownership, working experience, and age. In this context, the following codes Female =1 and Male = 2 were given to gender. In addition, per-urban = 1, rural =2, and urban = 3 to also given to location. On the other hand, government-aided = 1, government = 2, and private = 3 were coded to the school ownership. Furthermore, according to working experience data were coded as follows: less than one year = 1, 1-3 years = 2, 4-6 years = 3, 7-9 years = 4, and above 10 years = 5. In addition, 18-25 years = 1, 26-32 years = 2, 33-40 years = 3, and above 40 years = 4 were given based on the age of the participants.

Limitations and Future Consideration

They are different limitations related to the collection of this data set. Firstly, the sample size of 133 chemistry teachers may not be sufficient to represent the entire population of secondary school chemistry teachers in Rwanda, which could limit the generalizability of the results. As data were collected through an online survey tool, there might be some potential biases related to self-reported data and technological limitations faced by respondents during data collection. Additionally, the data were limited to the current usage of web-based discussions and did not account for other factors that could affect teaching and learning outcomes in organic chemistry. Furthermore, the quality of the data set could be limited by participants' comprehension of the survey questions, potential misinterpretation, and errors in data entry or recording. These limitations should be taken into account when considering the scope and reliability of the data set.

Future research in this area could address several avenues to build upon our findings and address the identified limitations. Firstly, conducting longitudinal studies could provide insights into the sustained impact of web-based discussion tools on learning outcomes and student engagement over time. Additionally, expanding the study to include a more diverse range of schools across different regions of Rwanda would enhance the generalizability of findings and allow for comparisons between urban and rural settings or between public and private schools. Furthermore, incorporating qualitative methods such as focus groups or interviews with teachers and students could offer deeper insights into the specific mechanisms through which web-based tools influence teaching practices and student learning experiences. Lastly, exploring the role of teacher training and support in effectively integrating these tools into the curriculum could provide valuable guidance for educational policymakers and school administrators seeking to enhance technology-enhanced learning environments in Rwandan secondary schools and similar contexts globally.

Ethics Statement

Our dataset involved human beings. Therefore, the researchers obtained approval ethical clearance letter from the ethical committee of the University of Rwanda College of Education with ref number RC/ET/01/04/2024. We certify that the necessary informed consent was received from the participants. All participants agreed voluntarily to participate in the collection of data. The study adhered to ethical principles such as respect for human dignity, informed consent, and confidentiality of the information collected.

Data Availability

Dataset collected to evaluate the usage of web-based discussion in teaching and learning organic chemistry in the selected Rwandan secondary schools (Original data) (Mendeley Data).

CRediT Author Statement

Aloys Iyamuremye: Methodology, Writing – review & editing; **Innocent Twagirimana:** Methodology, Writing – review & editing, Visualization, Supervision; **Francois Niyongabo Niyonzima:** Methodology, Writing – review & editing, Visualization, Supervision.

Acknowledgments

We acknowledge the contribution of chemistry teachers who agreed to participate in this study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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