

INNOVATIVE LEARNING AND APPLICATION OF SOCIAL MEDIA TECHNOLOGIES IN ENGINEERING EDUCATION: *FINDINGS FROM A SYSTEMATIC STUDY OF BOTSWANA TOP ACHIEVERS IN STEM AND LITERATURE REVIEWS*

Katso Larona Golekanye, Mohamed Toufiq Asifbeg Mirza

HB Botswana; katsolaronagolekanye@gmail.com;
mirzamohammedtoufiq@gmail.com

Abstract: Social media is an interactive forum where people may exchange ideas, viewpoints, and information to discuss various topics and express their perspectives. In engineering education, social media is becoming more widely acknowledged and used, and studies have shown that it can involvement, learning, and engagement of the students. To develop policies for the efficient application of social media platforms in engineering education, the main topic of this theory paper is evaluating the numerous field research investigations by compiling the diverse research subjects, social media components that are employed, and analysis methods, among other things. The pieces for this study were obtained from a number of sources, such as Scopus, Science Direct, and Web of References: Science, Wiley Online Library, Google Scholar, IEEE Xplore Library, ERIC. As a component of this literature search, the search phrases used to retrieve articles from these databases are Snap chat + engineering + memes + pages; Youtube + engineering + stem Facebook + Engineering, Instagram + Engineering, and X(Twitter) + Engineering. The review process involved these distinct steps. In the first part a interview in the form of questionnaire were given on Instagram Polls feature to 10 Selected Top achiever programme students. The findings indicate that Facebook, Instagram, and X (Twitter) have been used as a learning environment in a few engineering disciplines, including software engineering, civil engineering, mechanical engineering, and electronics engineering. More than half of the sampled articles used quantitative research designs and descriptive statistics for data analysis, and META Facebook emerged as the most preferred choice of researchers among the sampled articles. Initially, all articles from various databases were gathered and compared to eliminate any duplicates, 10 articles that met the exclusion criteria as articles not focused on engineering, articles in languages other than English, articles with a focus other than Facebook, Instagram, and Twitter, and work-in-progress articles, were removed from the final list. In the second step, these 10 articles were screened based on their titles and abstracts to assess their relevance and applicability to the study. Out of these, 2 articles were selected for further consideration. Articles not meeting the relevance and applicability criteria were excluded from the study. In the third step articles that remained were critically reviewed to extract the relevant information necessary for the analysis.

Information such as research questions, research design, data collection, and data analysis, among others, were retrieved from the articles and consolidated in a separate file. Finally, this consolidated information was further analyzed and synthesized to generate observations and trends.

1. INTRODUCTION

The increasing prevalence of social media platforms (SMP), like X(Twitter), Facebook, Instagram, etc., in students' daily routines has prompted research into the tangible effects of SMPs use in an academic context. Scholars have been collecting evidence to determine whether SMPs can be utilized as a teaching tool [1]. Although many educators are optimistic about SMP's educational potential, researchers are still conducting experiments to ascertain whether students' learning habits have changed due to SMP and the connection between SMP usage and academic performance [2]. Depending on the type of SMP, users can interact with it by adding friends, publishing interesting links, tagging other users in their posts or status updates, leaving comments, use of hashtags liking other users' posts, privately messaging their connections, and in a variety of different ways. Within these SMPs, user interactions aid in developing a user relationship network that represents ties of direct social impact. More than 100 million students use social media, a technology that encompasses various social networking sites like Snapchat, Threads, Facebook, X(Twitter), LinkedIn, Instagram, etc. Recent research has demonstrated how to use network science concepts and data-driven methodologies to quantify social influences in social media [3]. Due to the ease and ubiquity of Social Media tools and ease of accessibility via a laptop, smartphone, or tablet, an increasing number of students are using them [4]. Students can interact with current and previous peers through social media, which also makes it easier to access emotional support and suggests creative activities [5]. This is crucial because, for minority students, making connections is one of the essential components of a fulfilling academic experience. Due to communication barriers or other reasons, minority students are typically less comfortable discussing their thoughts and experiences, so integrating social media platforms encourages the exchange of perspectives more effectively and without discomfort [6]. Despite these advantages, social media integration in education is hampered by several technical challenges, a lack of interest, and privacy concerns. As a result, efficient strategies for integrating social media into STEM disciplines must be developed to improve students' learning and engagement [7].

The use of social media in engineering education has also been on the rise in recent years, and it has become a popular tool for students and instructors to connect, collaborate, and share information [9]. While some researchers argue that social media can enhance student engagement and learning, others suggest that its use may

International Conference on Engineering Education and Management (IC2EM'24), September 23-25th, 2024, BIUST, Botswana

negatively impact learning outcomes[10]. Studies have investigated the impact of social media on engineering education and have found mixed results. A study conducted by [11] showed that social media platforms such as Twitter and Facebook improve student engagement, as students were more likely to participate in class discussions and share course-related information on these platforms. teaching practices, it will be essential to continue exploring the impact of social media on student learning and engagement and to identify strategies to maximize the benefits and minimize the risks.

We also took a look at the use of SMP in education concerns about its potential adverse effects, such as distraction, privacy issues, and cyberbullying This research paper aims to examine the current state of social media use in engineering education, including the benefits, challenges, and potential risks associated with its use. It will also address the primary research question, " current trends of social media platforms usage in engineering education?"

The research aims to answer the questions listed below to explore and classify the articles being reviewed. This study will also explore the ways in which educators can leverage social media to enhance student learning outcomes and provide recommendations for future research in this field.

- Q1. Which type of SMP has the most innovative interface for Engineering students?
- Q2. Which engineering discipline does Batswana students learn about through SMP?
- Q3. Which SMP offers the best ease of use for conducting research work?
- Q4. Which sampling methods/ size were used in selecting the Students for the interviews?
- Q5. What method of communication was used to conduct the study?
- Q6. Which engineering discipline used social media as an educational tool within the context of engineering education?
- Q7. Which types of research designs were used in the sampled articles?
- Q8. Which topics/concepts were explored in the articles on social media in the sampled articles?
- Q9. What methodologies/tools/formats were used in the articles for data collection on social media?
- Q10. What sampling methods and sample sizes were used in the sampled articles?
- Q11. Which social media platforms were used in the sampled articles?
- Q12. Which data analysis methods were used in the sampled articles?

2. LITERATURE REVIEW BACKGROUND AND RELATED WORK

Social media activism campaigns to increase gender diversity in the engineering field have been examined using social media applications, such as hashtags on Twitter [11]. Other benefits of incorporating social media include the adaptability of following courses at any time and in any location, as well as the optimum engagement with course materials through peer discussion and opinion exchange [12]. Despite the potential benefits of using social media, several challenges have been identified in incorporating social media into engineering education. One of the main concerns is the potential distraction that social media can cause during the class time [13]. Students may be tempted to use social media for personal reasons during class time, which could negatively impact their learning outcomes. Additionally, some students may be hesitant to participate in discussions on social media due to concerns about privacy and security [14]. Several best practices have been proposed to address the challenges associated with using social media in engineering education. According to [8], instructors should establish clear guidelines and expectations for using social media in their courses and provide training and support to help students use social media tools effectively. Additionally, instructors should monitor social media discussions to ensure they are relevant to course objectives and address inappropriate behavior [15].

The social media learning environment is a digital space where individuals can access educational content, engage in learning activities, and connect with other learners and educators (16). With the rise of social media platforms such as Facebook, Instagram, and Twitter, the social media learning environment has become a crucial component of modern education [17]. This is due to the widespread availability of these platforms, their accessibility through mobile phones, and their ability to connect people from all over the world. [11]. A recent study found that 94% of university students, including those in developing countries, use Facebook. Students believe Facebook can be effectively used as an online learning environment [7]. Instagram: Instagram has over 1BILLION users, with one-third being students, making it a suitable platform for learning [10]. It offers a visually stimulating platform for sharing and discovering content, engaging students' attention, and promoting their creativity. Students can showcase their work, share ideas, and connect with professionals in their field. Instagram features live videos, stories, and hashtags, which can be used to host live events, tutorials, and discussions around specific topics or interests. Studies show that Instagram can enhance students' learning process through visual aids, improve writing skills, aid in project reminders, and promote group work. Overall, Instagram is a promising platform for creating a dynamic and engaging learning environment. X(Twitter): X(Twitter's) fast-paced and concise nature makes it a suitable learning environment for students. With a character limit of 280, X(Twitter) encourages

International Conference on Engineering Education and Management (IC2EM'24), September 23-25th, 2024, BIUST, Botswana

clear and effective communication, while providing access to a vast amount of information from various sources. A recent study shows that architecture, engineering, and construction (AEC) university students utilize Twitter to follow subject matter experts, stay updated on relevant topics, and participate in discussions through hashtags or Tweet deck. Twitter has several advantages in higher education, including access to experiential learning, rigorous discussions, and improved grades

3. METHODOLOGY

The methodology for conducting a systematic study involves several steps to ensure rigor and comprehensiveness in the review process.

The first step involves defining the research question and developing inclusion and exclusion criteria for the articles to be reviewed. This helps to narrow the focus of the review and ensure that only relevant articles are included. Next, keywords related to the research question are used to do a full search of relevant databases like Research gate, Science Direct, PubMed, Web of Science, and Google Scholar. The selected articles / are then critically evaluated for their quality and relevance to the research questions. Finally, a synthesis of the findings from the eligible articles is conducted, and the results are organized and presented in a clear and concise manner.

3.1. Data collection and simulations

We used Xplore and Google Scholar databases, specifically targeting articles with the terms 'Facebook AND Engineering', 'Instagram AND Engineering' and 'Twitter AND Engineering' in the article's title, abstract, or keywords. In this study, a total of 48 articles [7, 8,] were initially reviewed for full text, and after careful consideration and evaluation.

For the second part of interviews we selected 10 Students from the Top achiever Programme, The specific of their courses as well as field of study was provided by DTEF / Ministry of education the sample size was initial of 300 but due to lack of communication and poor responses it was cut down to 10, the second part of this analysis was done through an Instagram Polling through which the students answered the questions as stated in the research,

4. RESULTS AND DISCUSSION OF FINDINGS

Here are the results from the poll and interview run on Instagram and questions to Botswana Top achiever students

Q1. Which type of SMP has the most innovative interface for Engineering students?

- 80% of the sampled students agreed with the option of Facebook
- 10% selected twitter (X)
- 5% chose Snapchat
- 5% chose Instagram

Q2. Which engineering discipline does Batswana students learn about through SMP?

- 50% Not STEM related
- 20% Mining engineering
- 20% Civil engineering
- 10% Mechanical Engineering

Q3. Which SMP offers the best ease of use for conducting research work?

- 60% Instagram
- 20% Facebook
- 5% X(twitter)
- 5% Snapchat

From the above questions we then conducted and further interviews with select Students, we learnt that students prefer Instagram as this is a picture sharing app with many video facility, unlike the other platforms it is well altered the quality of upload is 4k while other apps downsize the uploads to 1080p resolution, we also learnt that students Mainly use the Polls and questions Tag feature to run Interviews and questions to their Audience on Instagram stories this feature disappears in 24 hrs unlike other apps its more interactive in Instagram. Although the audience size is limited to the followers of the individual conducting the poll it is a very interactive option.

What method of communication was used to conduct the study? We used social media to reach out to the students and those who agreed to interviews were then referred to out Instagram pages where we used the video call feature and tags option on live and it was a more interactive session.

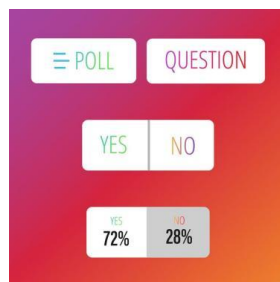


Figure 1. Here is an example of the poll feature in use.

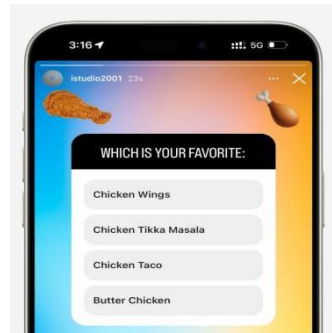


Figure 2. Polls can be yes and no or more detailed.

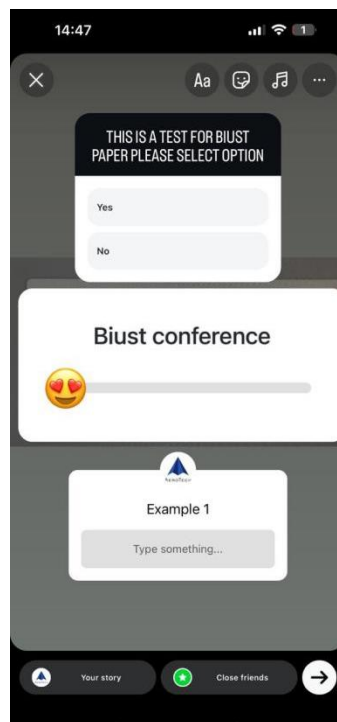


Figure 3. This is a showcase of other features.

We present the findings of the Literature review in this section research questions. The data presented in this section is from the 10 articles that made it to the final synthesis phase.

Which engineering disciplines in the articles used social media as an educational tool within the context of engineering education? in the sample of 10 reviewed articles. Among these, six articles (60%) focused on software engineering. Mechanical engineering and general first-year engineering were the subjects of 20% and 10% of the articles, respectively, while civil and electronics engineering accounted for 10% each. These findings suggest that social media is relevant and applicable in diverse engineering fields, as indicated

Which types of research designs were used in the sampled articles? Table 2 represents the distribution of research designs employed among the sampled articles. Most of the articles (60%) utilized a quantitative research design, and 20% used a qualitative design to investigate the effect of social media usage in engineering education. A few articles (20%) used a mixed design that combined quantitative and qualitative methods.

Table 1. Research Design Number Percentage (%)

Quantitative design	6	60%
Qualitative design	2	20%
Mixed design	2	20%

Which topics/concepts were explored in the articles on social media in the sampled articles?

- Electronics Engineering
 - Energy Policy
 - Fundamental Electronics
- Mining oil and gas Engineering
- Software Engineering
- Freshman Programming Courses
- Introductory Programming
- Civil Engineering
 - Flood Management
 - Structural Engineering Course
 - Construction Engineering Course
- First-Year Engineering - General Science Course
- Mechanical Engineering
 - Computer-Aided Design (CAD) Solid works
 - Mechanics of Materials

What methodologies/tools/formats were used in the articles for data collection on social media? Research Design Data Collection Method Frequency Percentage (%)

- Quantitative design 40%
 - Questionnaire
 - Feedback
- Qualitative design 20%
- Mixed design 30%
 - Questionnaire
 - Focus groups
 - Analytical

What sampling methods and sample sizes were used in the sampled articles?

Table 2. Sampling Methods Frequency Percentage (%).

Random sampling	6	60%
Convenience sampling	4	40%

Table 3. Sample Size Percentage (%).

1-100	4	40%
101-1000	6	60%

Which social media platforms were used in the sampled articles? Most of the studies used 50 %Facebook as their social media platform, indicating the popularity of this platform. 20% (2 articles) of the articles used two or more platforms, while none of the articles used Instagram as the sole communication medium. Among those five articles, one study used Facebook and Instagram, one study used Facebook and Twitter together, and another study used Facebook and WhatsApp together. Two articles considered YouTube,

Which data analysis methods were used in the sampled articles? along with the frequencies and percentages of their use. The research articles that employed descriptive analyses as their research methods primarily utilized means, variance, and graphs as their data analysis methods. Among inferential analysis methods,

5. DISCUSSION

This study's initial goal was to provide a survey of the literature on social media in engineering education, encompassing works written, Seven research issues were examined, the first of which was concerned with the engineering specialties that employed social media to teach engineering. The findings showed that software engineering, general engineering, and mechanical engineering were the top three engineering specialties using social media. The various research designs for social media in engineering education were identified by the second research question. The most popular study design for most publications (61.90%) was the use of quantitative methodologies. The analysis showed that each article examined a different and distinct issue, with no themes covered in more than one. Future research has the chance to carry out comparable investigations on the same subject or area. It is important to do multiple research studies on the same subject or area for a number of reasons. It first aids in proving the findings' validity and dependability. Confidence in the validity and generalizability of the findings rises when several studies consistently present comparable findings. It also aids in pointing out any disparities or

contradictions in the data, which may inspire more research to account for the variations. Second, a more thorough grasp of the phenomenon being studied is made possible by numerous investigations on the same subject. Together, the studies offer a comprehensive picture of the research issue, even though they may concentrate on various factors or topics. This may result in the creation of more complex and nuanced ideas or models. Third, carrying out several studies can assist in identifying areas that require additional research as well as gaps in the current body of knowledge. These holes might be filled by fresh research, which could result in novel findings or uses.

Most research publications concluded that Facebook was a beneficial learning environment for a variety of reasons. It is the most widely used social networking site, which gives students the chance to interact and work together with others who are located around the globe. It has elements that encourage academic communication, knowledge exchange, and resource use, like private groups, pages, and conversations. Second, teachers can easily incorporate Facebook into their lesson plans thanks to its familiarity and accessibility, which increases student participation and engagement. Due to its social aspects, students can help one another and exchange knowledge and experiences through peer-to-peer learning and cooperation. Last but not least, teachers can use Facebook as a venue to publish announcements, assignments, and reminders to keep students informed and current on their studies. It also gives professors the opportunity to interact with their students outside of the classroom, respond to inquiries, and give comments on their assignments.

The examined papers' data analysis highlights the value of network data analysis in the context of social media learning. In order to gain a deeper knowledge of the intricate dynamics of social media interactions, more research in this area is required that employs network data analysis to extract specific insights from participant interaction data. Having been students in the Government institution from Psle to Bgcse most students do not have access to Social media however in University the Exposure to social media is being used by the surveyed students to connect with their peers and conduct research as well as share data in a format that is easy to understand and more accessible,

6. CONCLUSIONS, LIMITATIONS AND CHALLENGES

In summary, the integration of social media into the classroom has the potential to raise student interest, expand their access to resources, and help them communicate with their teachers. Studies have indicated that incorporating social media into the classroom can yield favorable results in terms of student involvement and academic performance. An outline of the research on social media use in engineering education is given in this report. The results show that a few engineering students of Top achiever

International Conference on Engineering Education and Management (IC2EM'24), September 23-25th, 2024, BIUST, Botswana

programme in the field such as software engineering, civil engineering, mechanical engineering, and electrical engineering, have used Facebook, Instagram, and Twitter. Facebook was the favored social media platform, descriptive statistics were used for data analysis, and quantitative research techniques were employed in over half of the sampled publications.

This research study has several limitations, just like any other. First off, this study only looked at Facebook, Instagram, and Twitter. However, there are additional social media sites like WhatsApp, Reddit, YouTube, LinkedIn, TikTok, and WeChat that could have a big impact on engineering education. Subsequent studies could examine alternative social media channels, their use, and their influence on the involvement and education of engineering students. Second, by concentrating solely on these three platforms, the publications that were obtained from various databases using the search terms "Facebook AND Engineering," "Instagram AND Engineering," and "Twitter AND Engineering" may have influenced our findings. Also the Due to small sample size of 10 students and 10 Articles the research conducted was very limited. We could have expanded our search even further by adding more search terms, such "social media AND engineering," in addition to these ones also increasing participants. The third restriction of this study is that it only included articles published between 2019 and 2022. This means that certain significant studies released earlier in the year may have been overlooked, which would have added even more relevant context to the analysis. Investigating the use of all social media platforms in engineering and its effect on student learning is one possible avenue for future research. We had a challenge of submitting this paper online as one author was in Moscow, when trying the email of University we failed to get any response for 3 months however in the comment section of the BIUST Facebook page we managed to reach a member and get their contact and were able to submit, this shows how social media can help in communication even in official capacity when traditional means fail.

ACKNOWLEDGEMENT

We would like to give our Thanks to Botswana International University of Science And Technology for allowing us to submit our paper, we are grateful to professor / chairman Professor M Tunde Oladiran of This conference and the entire committee for Hosting Botswana first Engineering conference, for giving a platform to The youth of Botswana in the field of engineering. We are great for to Department of tertiary education funding and ministry of education as well as statistics Botswana, we would also like to thank Professor Thapelo J Otlogetswe Of university of Botswana for his Advice.

DECLARATION OF INTEREST

Our goal is to further the involvement of Botswana into STEM and engineering, the use of social media can be a game changer we plan to conduct further studies with bigger sample size in order to understand how best we can utilize social media as a tool for engineering education. So far Africa is the youngest continent and has majority youth users who mainly focus on meme culture news and entertainment however we wish to turn it into educational content like China has with its Baidu and in-house apps

REFERENCES

1. C. F. Goh, A. Rasli, O. K. Tan, and S. L. Choi, "Determinants and academic achievement effect of Facebook use in educational communication among university students," *Aslib Journal of Information Management*, vol. 71, no. 1, pp. 105-123, 2019, doi: 10.1108/ajim-05-2018-0116.
2. J. K. Ngo, H. J. I. P. Del Rosario, D. M. B. Pangan, and M. M. A. Villadelrey, "An Analysis On The Effects Of Social Media On Students' Academic Performance: The Case Of Selected Students Of The Faculty Of Engineering Of The University Of Santo Tomas," in *Journal of Physics: Conference Series*, 2020, vol. 1529, no. 3: IOP Publishing, p. 032051.
3. I. C. Drivas, D. Kouis, D. Kyriaki-Manessi, and F. Giannakopoulou, "Social Media Analytics and Metrics for Improving Users Engagement," *Knowledge*, vol. 2, no. 2, pp. 225-242, 2022.
4. S. Azhar and J. M. Abeln, "Investigating social media applications for the construction industry," *Procedia Engineering*, vol. 85, pp. 42-51, 2014.
5. C. C. Cheston, T. E. Flickinger, and M. S. Chisolm, "Social media use in medical education: a systematic review," *Academic Medicine*, vol. 88, no. 6, pp. 893-901, 2013.
6. S. M. Ovink and B. D. Veazey, "More than 'getting us through:' A case study in cultural capital enrichment of underrepresented minority undergraduates," *Research in higher education*, vol. 52, pp. 370-394, 2011.
7. E. Ivala and D. Gachago, "Social media for enhancing student engagement: The use of Facebook and blogs at a University of Technology," *South African Journal of Higher Education*, vol. 26, no. 1, pp. 152-167, 2012.
8. S. Ainin, M. M. Naqshbandi, S. Moghavvemi, and N. I. Jaafar, "Facebook usage, socialization and academic performance," *Computers & Education*, vol. 83, pp. 64-73, 2015.
9. M. Michikyan, K. Subrahmanyam, and J. Dennis, "Facebook use and academic performance among college students: A mixed-methods study with a multi-ethnic sample," *Computers in Human Behavior*, vol. 45, pp. 265-272, 2015.
10. B. Dyson, K. Vickers, J. Turtle, S. Cowan, and A. Tassone, "Evaluating the use of Facebook to increase student engagement and understanding in lecture-based classes," *Higher Education*, vol. 69, pp. 303-313, 2015.
11. A. Johri, H. Karbasian, A. Malik, R. Handa, and H. Purohit, "How diverse users and activities trigger connective action via social media: Lessons from the twitter hashtag campaign #ilooklikeanengineer," *arXiv preprint arXiv:1804.09226*, 2018.

International Conference on Engineering Education and Management (IC2EM'24), September 23-25th, 2024, BIUST, Botswana

12. H. Vanwysberghe and P. Verdegem, "Integrating social media in education," *CICWeb-Comparative Literature and Culture*, vol. 15, no. 3, 2013.
13. R. Junco, "The relationship between frequency of Facebook use, participation in Facebook activities, and student engagement," *Computers & education*, vol. 58, no. 1, pp. 162-171, 2012.
14. P. A. Kirschner and A. C. Karpinski, "Facebook® and academic performance," *Computers in human behavior*, vol. 26, no. 6, pp. 1237-1245, 2010.
15. N. Gambo, I. Musonda, and A. N. Zadawa, "Effects of Social Media Learning Environments on AEC Learning Process among University Students in Nigeria," *International Journal of Construction Education and Research*, pp. 1-29, 2021.
16. S. Jacques, A. Ouahabi, and T. Lequeu, "Synchronous E-learning in Higher Education during the COVID-19 Pandemic," in *2021 IEEE Global Engineering Education Conference (EDUCON)*, 2021: IEEE, pp. 1102-1109.
17. P. Bajpai, "Analyzing Effect of Social Media on Academic Performance of University Graduates," in *Proceedings of the 3rd International Conference on Information and Education Innovations*, 2018, pp. 40-44.