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A MODEL FOR USING SOCIAL MEDIA CONTENT TO PROMOTE 3D THINKING ON SUSTAINABILITY AMONG STUDENTS IN INTEGRATED MATHEMATICS, LANGUAGE, ARTS, AND TECHNOLOGY

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ABSTRACT

Aim/Purpose	This study aimed to develop a model for using social media content to promote 3D thinking of sustainability among students in integrated Mathematics, Language, Arts, and Technology (MLAT) classrooms.
Background	Social media is one of the most relevant platforms among students of the 21st century to the extent that connecting it to classroom learning becomes interesting to the learners. Education for Sustainable Development (ESD) requires teachers to implement an interdisciplinary teaching approach while promoting skills for dealing with sustainability issues. ESD enables students to think about three aspects (economics, environment, and society) of sustainability. In this paper, the ability to think about the environment, society, and economics simultaneously was termed “3D thinking of sustainability.” Social media content can be a catalyst for promoting students’ application of 3D thinking of sustainability if integrated into the classroom. However, teachers fail to use social media content in their classrooms because they lack the know-how to integrate them. Therefore, providing teachers with a model for using social media content in their teaching can help them integrate it into their classes.
Methodology	Design-based research was adopted by the researchers (two mathematics teachers and one curriculum expert) who were selected through purposive sampling,

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	and twenty students who were selected through convenience sampling. Data were collected from the teachers' interviews with twenty students through observation and reflective journals and from students' assignments through document analysis.
Contribution	The major contribution of the study is the development of the model for facilitating students' application of skills from the domains of mathematics, language, arts, and technology to understand sustainability issues. Furthermore, the study shows the value of social media in learning from the point of view of using them as context for applying interdisciplinary skills rather than media for teacher-student interaction.
Findings	The model with eight interactive phases was developed. The proposed model requires the teachers to be knowledgeable content-wise in various disciplines or to collaborate with teachers from other disciplines.
Recommendations for Practitioners	Practitioners are encouraged to adopt this model in the implementation of ESD.
Recommendations for Researchers	Researchers may test the application of this model in other integrated subjects and levels of education.
Impact on Society	The standard of living of any society is related to people's awareness of threats to sustainability. Therefore, the more education promotes 3D thinking of sustainability, the more the standard of living is guaranteed in our societies.
Future Research	To evaluate the applicability of the model in various educational contexts.
Keywords	education for sustainable development, social media, social media content, sustainability, inter/transdisciplinary teaching approach

INTRODUCTION

In this article, the model developed for using social media content to promote 3D thinking on sustainability among students in integrated Mathematics, Language, Arts, and Technology (MLAT) classrooms is discussed. Education in sustainable development requires teachers to integrate sustainability issues in the classroom to enhance learners' skills and knowledge of sustainability (Nousheen et al., 2020; UNESCO, 2017, 2020). According to Taylor et al. (2015), sustainability entails the existence of a balance among three dimensions: society, environment, and economy. This means for students to develop skills, knowledge, and attitudes to support sustainability, they need to be able to consider the three dimensions simultaneously. For instance, when students engage in/observes economic activities such as mining, they should be able to reflect on the activities from the economic, social, and environmental points of view to determine if such activities facilitate sustainability. As a result, the term '3D thinking' in this paper is confined only to thinking about the three dimensions of sustainability.

However, research shows that the concept of sustainability is complex in a way that cannot be understood by learners unless it is presented in a more concrete manner (Renert, 2011; Taylor et al., 2015). As Taylor et al. (2015, p. 25) posit, "The complexity of the interrelationships between these abstract concepts can be difficult to understand, including by primary students, but it is important that we, as teachers, have an overview and a sense of this web of connections of which we are a part." This implies the need for teachers to present the concept of sustainability in a way that can be understood by students. In response to this need, some scholars suggested the use of mathematical, linguistic, artistic, and technological presentations as the perfect way to make the abstract concept of sustainability more concrete among learners (Jenkins, 2015; Jodoin, 2020; Martins et al., 2006; Rosman et al., 2019). As Murdoch and Hornsby (1997, p. 14, as cited in Jenkins, 2015) posit, "English, other languages, mathematics, the arts (visual, music, drama, dance), technology and physical education (PE,

dance and movement) provide ways for students to explore, research, imagine, re-formulate, perform, communicate and evaluate rich concept.” This illustrates not only the importance of MLAT in understanding sustainability but also the need to teach these subjects in an integrated manner to enable students to apply skills and knowledge from these subjects simultaneously. However, teachers do not integrate the concept of sustainability in teaching MLAT or teach these subjects in an integrated manner (Jenkins, 2015; Renert, 2011; Taylor et al., 2015). Therefore, this attracts research attention to supporting teachers in integrating sustainability in MLAT and teaching these subjects as inter/trans-disciplinary rather than isolated disciplines.

While MLAT skills and knowledge help students understand sustainability, social media platforms such as YouTube, Facebook, Instagram, and TikTok, among others, are considered to be crucial in learning for their ability to contextualize learning experiences. This is because students of the 21st century spend much of their time on social media in such a way that these platforms have become their real world (Casey, 2013; Greenhow & Askari, 2017; Hidayatullah & Suprapti, 2020). As the Pew Research Center (2018, p. 2) reported, “YouTube, Instagram and Snapchat are the most popular online platforms among teens. Fully 95% of teens have access to a smartphone, and 45% say they are online almost constantly.” This implies that teaching MLAT to promote 3D can be even more authentic if social media content is incorporated into the classroom. Nevertheless, there is little evidence showing the use of social media content in MLAT classrooms, which could be caused by various factors, including teachers’ lack of know-how. As Bai et al. (2021, p. 529) argue, “Many teachers may cease using ICT [social media content] in teaching after some failures or when they think their ICT [social media content] adoption presents challenges.” Moreover, studies from Tanzania show that teachers lack the skills to use smartphones for educational purposes (Joyce-Gibbons et al., 2018; Msuya, 2015).

As a result, the current study aimed to develop a model for using social media content to promote 3D thinking of sustainability among learners in MLAT classrooms. The researchers believe that the model developed from this study will guide teachers to employ social media content in the MLAT classroom, thus catering for the need for skills by providing the reference (the model) for their social media content adoption.

GENERAL OBJECTIVE

To develop a model for using social media content to promote 3D thinking of sustainability among learners in MLAT classrooms.

SPECIFIC OBJECTIVES

- A. Assess the current practices of using social media content to promote 3D thinking of sustainability among learners in MLAT classrooms.
- B. To develop a model for using social media content to promote 3D thinking of sustainability among learners in MLAT classrooms.

THEORETICAL FRAMEWORK

This study is guided by the Transformative Learning Theory (TLT) developed by Mezirow in 1978. The main tenet of the theory is that learning involves changes in problematic frames of reference (mindsets, habits of mind, meaning perspectives) (Mezirow, 1997, 2008). According to TLT, learners who engage in Transformative Learning (TL) go through a series of phases: (1) a disorienting dilemma; (2) self-examination with feelings of fear, anger, guilt, or shame; (3) a critical assessment of assumptions; (4) recognition that one’s discontent and the process of transformation are shared; (5) exploration of options for new roles, relationships, and action; (6) planning a course of action; (6) acquiring knowledge and skills for implementing one’s plans; (7) provisional trying of new roles; (8) building competence and self-confidence in new roles and relationships; and (9) a reintegration into

one's life on the basis of conditions dictated by one's new perspective (Mezirow, 2008, p. 94). To apply TLT in the classroom, teachers need to ensure that they provide opportunities for students to reflect on their assumptions and those of others and participate fully in deciding the best points of view to guide their actions in the future (Mezirow, 1997, 2008). Classroom teaching practices for enhancing TL include discovery learning through project-based work, such as case study, simulation, and role play; problem posing and a learner-centered approach; frequent involvement in challenging and redefining assumptions (critical reflective-based education); and self-directed learning where the teacher is a facilitator (Mezirow, 1997)

As mentioned above, 3D thinking of sustainability requires one to be critically reflective of the balance among economic, social, and environmental aspects in every action or event of one's or others' engagements. This makes TLT a relevant theory for the present study, especially based on its aspect that requires teachers to enhance critical reflection among students about their own or others' assumptions. The question of students' full participation in deciding the best points of view for action resonates with the present study since, in this study, social media content is meant to increase the relevance of the concept of sustainability. Therefore, TLT is relevant to the present study because this study focuses on supporting students to change their assumptions on sustainability by using familiar practices from social media platforms.

RELATED STUDIES

Studies show that the use of social media in teaching and learning various subjects, including MLAT, cannot be overemphasized. Dhiwangkara et al. (2020) reported that the use of Instagram in teaching derivatives was viewed as useful among students of Class XI in Indonesia. Likewise, Abirin and Obra (2019) developed an instructional model for using social media to teach mathematics that resulted in improved learning among students. Based on these studies, it can be argued that social media can facilitate the teaching and learning of mathematics if they are utilized effectively in the classroom.

Also, Anwas et al. (2020) observed that students with intensive use of social media have a higher development of language skills (listening, reading, and speaking) compared to those with moderate use of social media. In addition, Xodabande (2017) revealed that the use of social media enhanced language learning among English learners in Japan through learning how to pronounce English language words correctly. Additionally, social media enhances learners' development of digital literacy, such as the ability to produce digital text (Al-Qallaf & Al-Mutairi, 2016; Greenhow & Askari, 2017) and creativity in arts (Greenhow & Askari, 2017). Against this backdrop, social media can facilitate teaching and learning MLAT.

However, the use of social media in the reported studies is based on a single-subject teaching approach. In other words, social media has been used to facilitate teaching MLAT as an isolated discipline rather than an integrated one. This is contrary to the ESD teaching approaches in which MLAT is best taught as interdisciplinary. Arguably, studies on the use of social media in teaching MLAT have not offered insights to support teachers in using social media with a suitable teaching approach for ESD. Based on this, the present study fills a gap by illustrating how social media can be used to teach MLAT in an interdisciplinary manner in the implementation of ESD.

Moreover, there is no explicit association between the use of social media in teaching MLAT and the integration of sustainability issues in these subjects. Recall that ESD requires teachers to integrate sustainability issues across all subjects to help students use skills and knowledge from relevant subjects in dealing with sustainability. Since these studies have not linked the use of social media in teaching MLAT with sustainability issues, it follows that there is a need for studies that link the use of social media in teaching MLAT with sustainability issues. That is why the researchers link the use of social media in MLAT with sustainability in the present study.

Furthermore, the major role of social media in teaching MLAT, as reported in the literature, is more of an interactive tool that links students to students or students to the teachers and the students to

content created by the teacher. There is little or no evidence that students use social media as a place to apply their skills and knowledge from MLAT as they interact with non-educational content such as news or music. Since non-educational content is what students engage with most of the time they visit social media platforms, non-educational content can stimulate learning if it is used in the classroom. Also, non-educational content makes learning more authentic as students can test the application of knowledge and skills from classrooms in real-life contexts. Therefore, in the present study, social media content has been put into consideration to ensure that social media plays the role of a laboratory in which students can apply and/or test the knowledge and skills they acquired from learning MLAT.

CONCEPTUAL FRAMEWORK

Based on the reviewed literature, it can be conceived that using social media content can promote 3D thinking of sustainability among learners in MLAT classrooms only if teachers are provided with the model for implementing the use of social media in their classrooms. This conceptual framework can be represented diagrammatically, as shown in Figure 1.

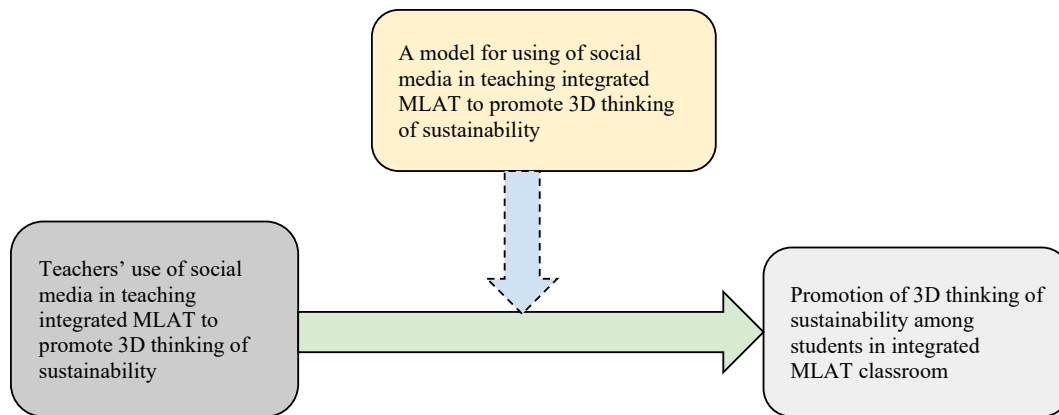


Figure 1. A conceptual framework

METHODOLOGY

RESEARCH DESIGN

The present study adopted Design-Based Research (DBR). DBR is focused on developing a solution to real-life situations through collaboration among people from various fields of expertise (Herrington et al., 2007; McKenney & Reeves, 2012; Vaezi et al., 2019). There are three main phases involved in DBR: Analysis and Exploration, Design and Construction, and Evaluation and Reflection, as shown in Figure 2 (Armstrong et al., 2022; McKenney & Reeves, 2012). As Vaezi et al. (2019, p. 29) argued, "It [DBR] involves identifying, evaluating, applying changes and modifications, and intervening in the program design process and other steps that are performed periodically with the participation of all stakeholders involved in the study, including instructors, learners, teachers, designers, and researchers." The iterative nature of DBR and the involvement of various stakeholders make it useful for developing solutions to complex issues such as those related to classroom contexts. This is because various stakeholders could lead to solutions that are developed from various points of view, and iterative testing cycles could lead to the most useful solution. Thus, comprehensive and sustainable solutions were developed. Therefore, DBR was chosen as the most relevant approach to the problem addressed in this study.

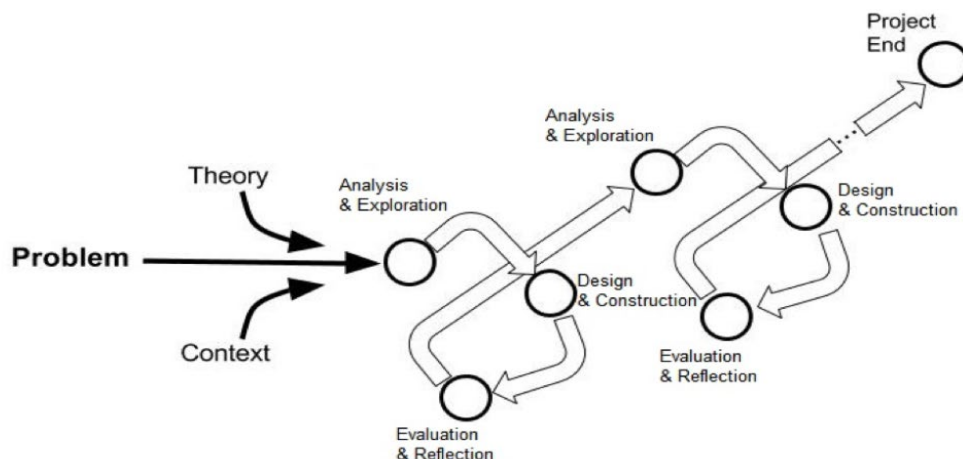


Figure 2. Phases of DBR
(Adopted from Armstrong et al., 2022, p. 108)

The analysis and exploration phase requires the researcher to review the literature and reflect on the current practices to understand and clearly define the problem in collaboration with various stakeholders (Armstrong et al., 2022; McKenney & Reeves, 2012). In the design and construction phase, the researchers are required to brainstorm various ideas, critique them, and map them to help the researcher to create a feasible solution (McKenney & Reeves, 2012). Moreover, the phase for evaluation and reflection involves testing the created solution (Armstrong et al., 2022; McKenney & Reeves, 2012). The solution can be in terms of physical objects such as teachers' guides or advice (McKenney & Reeves, 2012). However, these phases are interactive in the sense that by the time one design and construct could be evaluating and reflecting on the constructed artefact (McKenney & Reeves, 2012).

Context of the study

The study was conducted in a Basics of Communication Skills course in one of the colleges in Tanzania. The class has a total of 200 students. The project was limited to only five (5) weeks, in which there were eight contact hours per week. Although officially, this was a class for Basics of Communication Skills, students of this class had been oriented to learning interdisciplinary skills from MLAT before the commencement of this project. Therefore, the class qualifies to be termed as an integrated MLAT rather than a single-subject Communication Skills (Language) class.

Participants and sampling techniques

The study involved 2 college tutors, and 20 college students selected through a convenience sampling technique. Convenience sampling involves selecting participants based on their accessibility during the data collection (Berg & Lune, 2017; Creswell & Creswell, 2018). One of the tutors was selected because he had a mathematics teaching background, while another one had a pedagogy background serving as a teacher educator. The presence of tutors with this expertise was necessary because researchers were experts in communication skills and interdisciplinary teaching approaches. On the other hand, all students from the class of 200 students had a chance to participate in the study because they attended the learning sessions. However, given their busy study schedules, it was important that they were involved voluntarily in the data collection process. Initially, 30 students volunteered; however, 5 of them could not attend the entire session in the first session, and 5 of them could not complete the assignment. This forced the researchers to exclude these two groups, which made a total of 10 students, and hence remaining with 20. The main reason to exclude them was to ensure the consistency of the sample that the researchers involved in the study.

Data collection methods and analysis

In the present study, qualitative data was collected from students through document analysis, observation, and reflective journals, and interviews were used to collect data from college tutors. Data was analyzed thematically by adopting the framework of Miles et al. (2014) and Miles and Huberman (1994). Based on this framework, thematic analysis follows these steps: coding transcribed data, sorting and consolidating codes, developing themes, and verifying themes.

IMPLEMENTATION OF ITERATIVE CYCLES 1 AND 2 OF DBR

The development of the model for using social media to promote 3D thinking among students in the integrated MLAT classroom was done through two iterative cycles of DBR (shown in Figure 3).

Iterative Cycle 1

Phase One: Analysis and Exploration of the Problem. The main concern of this study was the infrequent or rare application of MLAT skills in reflecting on sustainability issues in social media content that students frequently engage with on social media platforms. To the researchers, this was like students' failure to apply MLAT skills in solving real-life problems as the researchers contextualized social media as a new world for the young generation. The researchers attributed the failure of students to the teacher's poor classroom facilitation. In this phase, the researchers conducted a literature review, reflection, and observation on the use of social media content in teaching MLAT for sustainability in Tanzania's colleges. The researchers noted that teachers do not use social media content as a resource for learning despite students' access to social media. Students were observed using WhatsApp to share tutors' notes or assignments. Others were using YouTube to listen to lectures related to Mathematics and Communication Skills courses. Also, it was noted that these subjects are taught as separate disciplines with little integration of sustainability issues. In other words, the researchers learned that the prevailing situation is the result of various factors, such as teachers' lack of "know-how" of the use of social media content as the context of using skills, teachers' lack of knowledge to facilitate interdisciplinary teaching approach, and the nature of the dominance of discipline-based curriculum. However, students' access to smartphones, basic knowledge of MLAT, interest in social media content such as music, and familiarity with various social media platforms were a few opportunities identified in this phase. Therefore, the pedagogical question was how social media content can be used in the integrated MLAT to promote 3D thinking of sustainability among students. In other words, the question was how the teacher can integrate social media content in an integrated MLAT classroom to enhance the application of MLAT skills to reflect on sustainability issues among students.

Phase Two: Design and Construction of the Model. Having analyzed the situation, the researchers developed a conceptual model that can serve as a guide for the teacher in integrating social media content in the MLAT classroom. The researchers' teaching-learning model was guided by the ESD teaching approach; that is, student-centred and trans/interdisciplinary. The model was not designed to capture all domains from MLAT but only the ones the researchers thought were relevant to understanding sustainability and that students have already been taught about. The researchers chose music song videos as the researchers' social media content. These songs were "Matozo" (Too Much Taxes) by Lady Jay Dee Ft Rama D (<https://www.youtube.com/watch?v=NO-B-CV2hms>) and "Sasa Hivi" (Just Now) by Vijana Barubaru (<https://www.youtube.com/watch?v=O5MyE-b9tPw>). These songs were chosen because of their popularity. At the time of the project, these two songs were released within the month and were available on various social media platforms, which convinced the researchers that many students would be interested in these songs. However, the model allows students to bring in any other social media content as they demonstrate their 3D thinking practices on social media content. Before the researchers implemented their plan, they shared it with the mathematics tutor and the curriculum tutor. They both agreed with the researchers' plan, and thus, they implemented it.

Phase Three: Evaluation and Reflection of the Model. This involved piloting the model in the classroom for two weeks with 8 class meeting hours. The teaching role in the piloting session was done by one researcher. Some of the data was collected during the teaching session through observation and document analysis. It was possible to observe students' interaction with the social media content presented in the classroom. Also, it was possible to analyze documents (students' exercise books or whiteboards) as they were applying MLAT skills on presented social media content to reflect on the sustainability concept. Data that was collected outside the classroom included those from students' assignments that were to be submitted on the next day and those from two experts based on their classroom observation and analysis of students' assignments.

After reflecting on iterative cycle 1, the researchers realized that there were some mathematical contents, such as relations and sequences, that they excluded in their planning but that were worth adding to the list of relevant domains for illustrating the concept of sustainability. Also, some nonverbal cues such as colours and objects were added to the list of useful domains to illustrate sustainability from the field of language. Furthermore, it was noted that students needed more time for feedback on their assignments. Also, it was found that there were contradictions in the presentation/illustrations using mathematical knowledge. This necessitated the full involvement of a mathematics tutor in the class during implementation. Furthermore, some students did not clearly understand how to approach the assignment, which forced the researchers to design a rubric.

Iterative Cycle 2

Phase One: Analysis and Exploration of the Problem. In this phase, the main focus was to deal with the constraints that the researchers identified in applying the conceptual model successfully. Factors that compromised the successful application of the model were limited mathematics domains, an unclear approach to how students should tackle the assignment involving social media content, and the absence of a mathematics expert during piloting to clarify some contradictions. Therefore, the guiding question was how to refine the model to accommodate the identified needs.

Phase Two: Design and Construction of the Model. The conceptual mode that was developed in the iterative Cycle 1 was refined to cater to the needs that were identified during the piloting session. For instance, when the researchers realized that students had suggested relevant mathematics content that was not considered in their previous plan, they added a phase of involving students in identifying relevant content. Also, they added the phase of modeling how to apply MLAT skills on 3D thinking of sustainability on social media content to resolve the issues of clarity on how students can approach the assignments.

Phase Three: Evaluation and Reflection of the Model. The timeframe covered in this phase is like the one covered in the similar phase of iterative cycle 1 (2 weeks with 8 hours of classroom meetings). Also, there was no change in the selected social media content (the two song videos). The teaching session was conducted by one researcher (the same researcher as in the first session) and mathematics experts. Mathematics experts helped clarify some mathematical contradictions that could not be resolved by the researcher, who had little knowledge of mathematics. At the end of the session, students were given a task to find social media content of their choice and reflect on the 3D sustainability concept from the content. The assignment was to be submitted the next day. Data collected in the classroom and outside the classroom from students' submitted assignments were analyzed, and reflection was done based on the findings. The researchers' reflections from this phase are presented as part of the findings from all phases of the project.

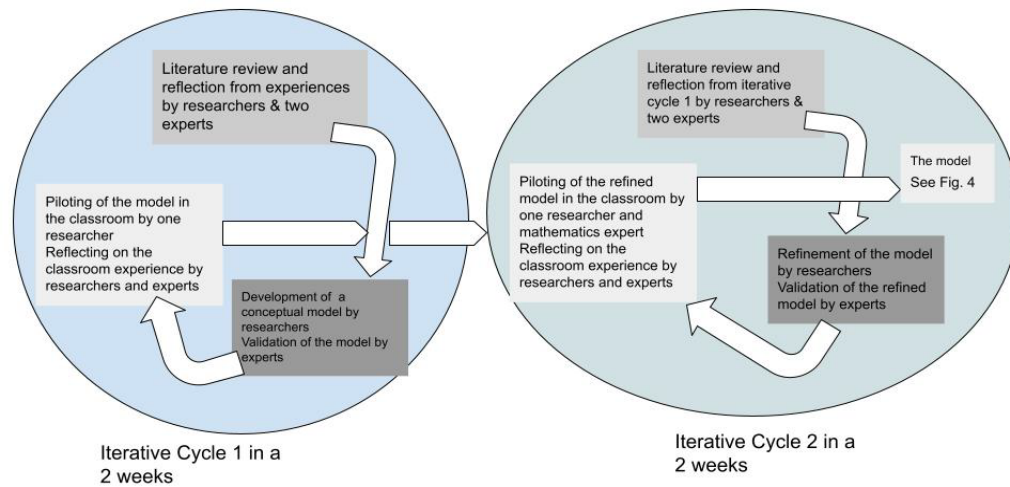


Figure 3. Iterative Cycles in a period of four weeks

FINDINGS AND DISCUSSION

In this section, we present findings based on themes drawn from the specific objectives that guided this study.

CURRENT PRACTICES OF USING SOCIAL MEDIA CONTENT

Data analysis indicates that social media is not used to promote 3D thinking of sustainability among learners in MLAT classrooms. The reflection and literature review show that teachers use social media mainly as a channel of communication between students and teachers or students. In instances where teachers encourage students to use social media, they want them to use it to search for learning content, such as lectures from YouTube.

These findings imply that the promotion of 3D thinking of sustainability among learners through social media content is limited. In this way, students lack the opportunity to learn actively and authentically. Hidayatullah and Suprati (2020, p. 9) posit, “The existence of YouTube, Instagram, Facebook and other popular social media makes students more active in learning at all times.” This implies that limiting students to learning through social media content could compromise student engagement with the subject and their learning continuity beyond classrooms. Therefore, it is imperative to consider the use of social media content if educators are to improve students’ active learning and long-life learning.

The findings on the current practice of the use of social media content are similar to those reported by Dhiwangkara et al. (2020), in which teachers used Instagram as an interactive tool for teaching mathematics. The similarities could be caused by teachers’ similar tendencies to transfer the core function of the technology to classroom contexts. Based on this, it is arguable that teachers need to be supported in using technology creatively in the classroom.

A MODEL FOR USING SOCIAL MEDIA CONTENT

The developed model for using social media content to promote 3D thinking of sustainability in the MLAT classroom that the researchers developed in this study comprises eight phases (see Figure 4). These phases are: (1) identify relevant subject content; (2) choose and analyze the social media content; (3) match social media content with subject and content and pedagogical aspects; (4) familiarize students with the concept of sustainability; (5) ask students to identify subject content relevant to the

Sustainability concept; (6) model the application of subject content on the sustainability concept from social media content; (7) guide students to apply subject content on the sustainability concept from social media content of their choice; and (8) reflect with students.

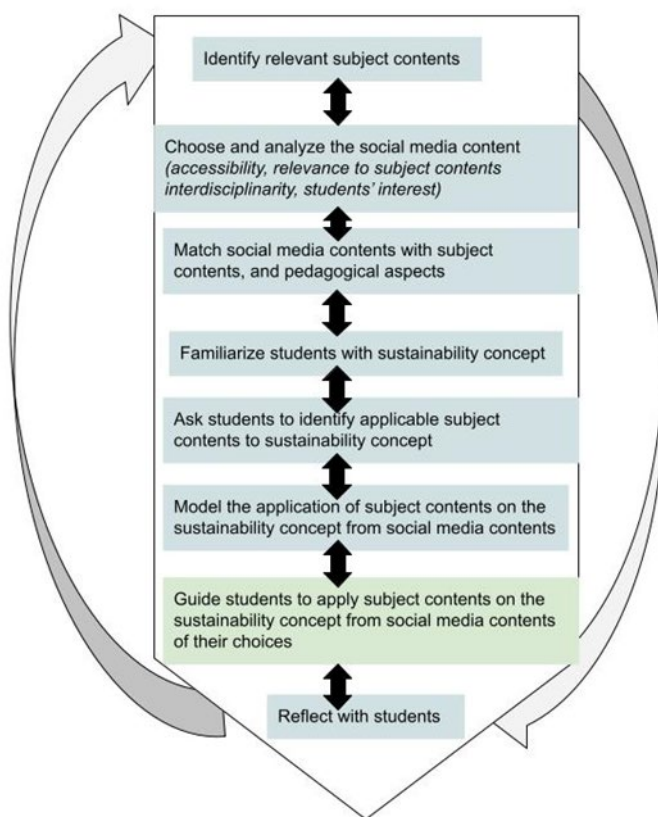


Figure 4. The model for using social media content to promote 3D thinking on sustainability

In the first phase, the teacher should identify the content from MLAT that is relevant to explaining the sustainability concept. This is important because not all teaching content from the four subjects (MLAT) is relevant to sustainability content. In the second phase, the teacher must decide on which media content is to be used; for instance, whether it is news, movies, or music. In the third phase, the teacher should match the social media content with the subject content and pedagogical aspects. In other words, the teacher should find how the selected social media content can be linked to the subject content without compromising the appropriate teaching and learning strategies. The fourth phase requires the teacher to familiarize students with the concept of sustainability. Familiarizing students with the concept of sustainability enables students to assess sustainability practices depicted in social media content and to identify subject content relevant to sustainability. Phase five involves asking students to identify subject content that they think is relevant to illustrating the sustainability concept. This helps teachers know whether students have clearly understood the concept of sustainability and if they are able to link contents from their learning subjects to sustainability. In the sixth phase, the teacher should model how various content from subjects such as probability and mathematics can be applied in explaining the concept of sustainability. In this phase, the teacher should allow students to interact (read/watch) with the social media content in the classroom and ask them to apply skills from the subject to think about the 3D of sustainability. For instance, in this study, students watched two song videos (“Sasa Hivi” and “Matozo”) in the classroom. The seventh phase requires the teacher to guide students to apply the subject contents on the sustainability concept from

the social media content of their choices. Students are free to choose any social media content for which they will apply skills from relevant subjects to practice the 3D thinking of sustainability. This phase helps the teacher assess students' level of development in applying skills from relevant subjects to think about the 3D of sustainability based on the content from social media. In the eighth phase, the teacher reflects with students on the use of social media content to promote 3D thinking in the MLAT classrooms. The reflection should be focused on how students applied skills from relevant subjects to practice 3D thinking of sustainability based on the social media content of their choices. Reflecting with students could help the teacher to clarify some misconceptions identified by students or provide general solutions to various difficulties that students encountered during the exercise.

One of the important points to be noted is that this model is cyclic in the sense that the teacher can go back and refine phase one despite being at phase five or six. This means the teachers' plan should be flexible enough to accommodate any modifications that emerge during the process of teaching and learning. Also, since teaching MLAT is drawn from the STEAM education approach, teachers should ensure that the model is employed based on a student-centered teaching approach.

Through this model, students could use social media content such as music videos and news to analyze this content from a sustainability perspective. The researchers observed that students were able to notice the interlink between the economy, society, and the environment from the social media content. Data from document analysis also showed that students were able to analyze the connection between economic, social, and environmental aspects of the social media content that they watched. For instance, Figure 5 illustrates one of the students' analyses of the sustainability concept in the song video of "My Vow" by Rwandese musician Meddy.

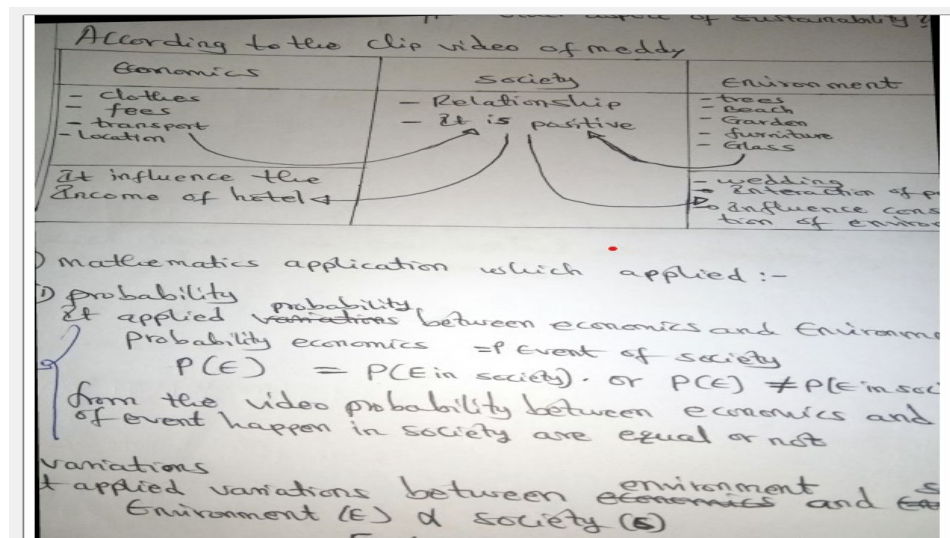


Figure 5. Illustrations of students' 3D thinking of sustainability from the video song (My Vow)
(Created by Student VII)

In Figure 5, the student shows that although the song is about love (a social event), there are economic and environmental aspects that are not discussed by the artist in an explicit way but influence the nature of how this social event is being practiced. Arrows from the columns representing the environment and economy show how the two aspects influence society. On the other hand, the arrows from the column representing the society show how the social event presented in the video song influences both the environment and the economy. The students' ability to apply 3D thinking of sustainability was evident from their reflections. For instance, student IV wrote in his/her reflective journal:

Kwa kuchambua mahusiano ya uchumi, mazingira na jamii kwenye video kunasaidia uelewa wangu Kwa sababu tukiangalia kwenye jamii lazima mazingira yawe safi na salama Kwa watumiaji na kiuchumi inasaidia Kwa kiwango kikubwa juu ya mapato Kwa maana hii sasa itasaidia kuhakikisha usawa wa mazingira katika maisha ya Kila siku.

This can be loosely translated as follows:

Analyzing the relationship between the economy, environment, and society from the video helps my understanding because if we look from the societal, it is a must the environment is clean and safe for users, and economically, it can help to a large extent on revenue. This means it will help to ensure the balance in daily life.

Therefore, the model for using social media content can promote 3D thinking among students if well utilized by teachers.

Also, there were students who chose to use media content that differed from the one the teacher used in the classroom (music video songs). For instance, some students used football matches and drama video clips, as illustrated in Figure 6. Therefore, this shows the extent to which the developed model has the potential to promote 3D thinking of sustainability among students when they engage with different social media content.

Reflective Journal IX (Swahili version)

Mimi binafsi nilijaribu kutumia video za maigizo kuangalia usawa Kati ya Mazingira na jamii na kiuchumi kiujumla pia njia ya hesabu mfano statistics.

Translated version

Personally, I tried to use video clips for drama to analyze the balance between environment, society and economy in general through applying mathematics such as statistics.

Reflective Journal XV (Swahili version)

Nimetumia vipande vya video za mchezo wa soka kwa mabara ya ulaya, amerika na afrika kuangalia usawa wa mazingira, uchumi na jamii.

Translated version

I used video clip of football matches from Europe, America and Africa to analyze the balance between environment, economy and society.

Reflective Journal XX (Swahili version)

Video ya mpira wa miguu goli lililofungwa na mchezaji wa kigeni osman sakho Kati ya mechi ya Simba dhidi ya geita gold.

Translated version

The video clip for the goal scored by the international player 'Osman Sako' during the football match of Simba against Geita Gold.

Figure 6. Students' use of different social media content to analyze the sustainability concept

This model is relevant for promoting 3D thinking of sustainability and developing and applying interdisciplinary skills from MLAT. Data indicates that students applied skills related to the domains of mathematics (ratio, probability, and relation), language (listening and writing), arts (drawing), and technology (digital literacy). Students reported having searched for and listened to a variety of content, such as music and news from social media. This represents one of the dimensions of digital literacy (the ability to search and interpret information from digital media). Also, students used various diagrams to represent the relationships that exist among the economy, society, and environment. This illustrates the use of arts in communicating their ideas. Figure 4 illustrates the extent to which domains of MLAT were applied by students simultaneously.

The developed model implies the possibility of using social media content in promoting 3D thinking about sustainability among learners in MLAT classrooms. This is because the teaching model helps

teachers find the best way to implement a particular teaching strategy. Based on this, the researchers believe that teachers may find it easier to use social media content in a way that promotes 3D thinking of sustainability among learners in their classrooms.

The developed model aligns with the TL theory in the sense that it helps students engage in critically reflecting on social media content and share their views on what they see in relation to the concept of sustainability. TL theory calls for teachers to provide opportunities for learners to critically reflect on their assumptions and decide the best point of view for their future (Mezirow, 1997, 2008). By using the model, students were able to challenge the practices of various discourses they observed from social media content such as songs and football video clips. Furthermore, the fact that students were able to use social media content different from the one used in the classroom shows the extent to which the model is associated with self-directed learning. One can argue that the model prepares learners for present and future challenges as it enables learners to translate MLAT skills used in one context to other contexts. TL theory emphasizes teachers to facilitate learners to self-directed learning rather than depending on teacher-guided learning (Mezirow, 1997). Overall, the model enabled students and teachers to challenge their assumptions about the link between real-life context (social media content) and the application of MLAT skills. Findings from the implementation of the model in the classroom show that both teachers and students realized that social media content can offer a context for students to practice their skills for solving real-life problems, including sustainability issues. This corresponds with the TL theory requirement for teaching goals, which is that it should help people challenge their assumptions and transform their practices (Mezirow, 1997, 2008). Therefore, it can be argued that the developed model transforms teaching and learning by enabling teachers to integrate social media content in integrated MLA to enhance 3D thinking of sustainability.

Although insights on using social media content in teaching and learning are found from previous research (Anwas et al., 2020; Dhiwangkara et al., 2020; Xodabande, 2017), these previous studies focused on how students can use social media content to acquire new knowledge or access learning materials. The present study goes beyond using social media content for acquiring knowledge and accessing learning materials to using social media content to test students' application of knowledge and skills from MLAT. In other words, this research treated social media content as a laboratory from which students practice and test the application of skills that they developed from studying MLAT on sustainability. Moreover, previous studies have developed models for teaching with social media but focused only on a single subject (Abirin & Obra, 2019), which is different from the present study that focused on integrated four subjects (MLAT). This makes the present study contribute to the research discourse by adding the dimension of disciplines that can benefit simultaneously from the model of using social media content in the classroom.

CONCLUSIONS AND RECOMMENDATIONS

The study aimed to develop a model for using social media content to promote 3D thinking on sustainability among students. Design-based research (DBR) was adopted as the research design. From the DBR, the model with eight phases whose relationships are cyclic was developed. The researchers noted that teaching sustainability concepts using this model in MLAT classrooms leads to students' development and applications of knowledge and skills from the four subjects (MLAT). Therefore, the researchers believe that teachers can transform their implementation of ESD if they adopt the developed model. However, teachers can use this model only if they have content knowledge about sustainability and skills for teaching integrated subjects. Consequently, the researchers recommend increased access to Teacher Professional Development on sustainability and an interdisciplinary teaching approach. The assessment of teachers' practices on using social media shows that teachers use social media as interactive tools in teaching. The lack of using social media content as context for students' development and application of knowledge and skills is limited. This implies a lack of creativity among teachers in using social media in their teaching practices. Based on the findings, teacher educators should support teachers with skills for using mobile applications creatively.

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