International Journal of Learning, Teaching and Educational Research
Vol. 23, No. 10, pp. 290-317, October 2024
https://doi.org/10.26803/ijlter.23.10.14
Received Aug 25, 2024; Revised Oct 11, 2024; Accepted Oct 24, 2024

Exploring Challenges Influencing the Discontinued Utilisation of the Flipped Classroom Pedagogy: A Case of South Africa Underprivileged High School and Organic Chemistry

Josphine Munyaradzi Chakawodza*, Emmanuel Mushayikwa and Magdeline Stephen
University of the Witwatersrand
Wits School of Education, 27 St Andrews Road, Parktown,
Johannesburg, South Africa

Abstract. The COVID-19 pandemic accelerated technological advancements in education. However, when the threat of COVID-19 subsided some schools discontinued the use of technology-enhanced flipped classroom. This study reports on challenges that could have influenced the discontinued utilisation of technology-mediated flipped classroom model that supported some of the underprivileged high schools of South Africa during the COVID-19 era. While acknowledging that the final decision on whether to discontinue rests with the teachers, learner challenges are equally important as they can contribute to the teachers' decisions. Hence, this study, anchored by the TPACK framework and Maslow's hierarchy of needs theory, explored both learner and teacher challenges that influence discontinuation of the use of the flipped learning model. This entailed using semi-structured interviews of purposively selected teachers and learners (N=8) to close this gap in the literature on the use of flipped classroom in the post-COVID-19 era focusing on organic chemistry. Using deductive thematic analysis, the key challenges that could have contributed to the discontinuation of the use of this teaching model were identified as lack of access to Internet services, stable Wi-Fi and ability to navigate the online learning system, competence, motivation, effect of lack of support from the educational institutions and teacher overloading. These findings contribute to the literature on the continued use of this teaching model beyond emergencies such as COVID-19 by highlighting challenges that educational practitioners should be wary of. Additionally, the study has implications for the need to fast-track infrastructure and teacher professional development in underprivileged high schools.

*Corresponding author: *Josphine Munyaradzi Chakawodza, josphine.chakawodza@wits.ac.za*

Keywords: challenges influencing discontinuation; flipped classroom model, organic chemistry; underprivileged high school

1. Introduction

The use of blended teaching strategies, particularly flipped classroom (FC) pedagogy, has grown tremendously during the last decade. In this study, the latter is presented as a blended learning model, which is concerned with how the in-person traditional teaching methods and technology-mediated learning (online learning) phases are combined (Tomas et al., 2019). In this study, blended teaching, characterised by many definitions, is conceptualised as a 'thoughtful' combination of the traditional in-person teaching and online teaching components (Garrison & Vaughan, 2008). As indicated in prior work in which the principal author was involved, flipped classroom, as a pedagogical method, comprises two phases: one in the traditional in-person teaching (in-class with no use of technology) is utilised and the other where technology-mediated online learning teaching growth was further catapulted by the advent of the COVID-19 pandemic (Maphalala & Mpofu, 2023) which hit South Africa in 2020 resulting in the closure of schools so as to contain the spread of the disease.

These school closures signalled a temporary end to the predominant use of in-person traditional teaching and learning at all educational institutions. In-person traditional teaching has been prevalent in most South African schools (Mmakola & Maphalala, 2023), particularly the underprivileged schools, because of several challenges they face, which can be directly or indirectly traced to underfunding (Fisher et al., 2017). However, to continue with teaching and learning during COVID-19, various forms of technology-mediated learning and self-learning took place as mitigatory measures (Damoah & Omodan, 2022). More affluent schools and a few underprivileged schools quickly switched to technology-mediated learning in which online and blended teaching (inclusive of flipped classroom) were utilised (Mmakola & Maphalala, 2023). Teachers were faced with the challenge of quickly adjusting to the new teaching methods, including online teaching, which is perceived as more difficult (Mmakola & Maphalala, 2023). However, most learners from poor communities were left to fend for themselves as the underprivileged schools failed to provide quality digital learning measures (Damoah & Omodan, 2022).

After the COVID-19 pandemic, most institutions of higher learning and affluent schools continued with the use of varying forms of digital learning while most underprivileged schools used pre-COVID-19 in-person traditional teaching methods (Damoah & Omodan, 2022). However, research aimed at developing an understanding of the challenges being experienced with regards to the integration of technology post the COVID-19 era and focusing on the South African context is still limited (Maphalala & Mpofu, 2023; Mmakola & Maphalala, 2023). Hence, this study explored challenges that could have influenced the decision to discontinue using technology-mediated FC during the post-COVID-19 era at one of the underprivileged schools of South Africa focusing on grade-12 organic chemistry. This was achieved by exploring the challenges that were experienced

by both learners and teachers during the COVID-19 pandemic. Considering the benefits of utilising technology-mediated FC to teach grade-12 organic chemistry, this study is important as it seeks to illuminate the challenges which could have influenced the discontinuation of FC pedagogy in underprivileged schools of South Africa. By so doing, it is hoped that any existing and future FC projects will receive necessary interventions to ensure their existence, which is intended to meet the needs of the learners in underprivileged schools, who happen to be the majority in South Africa.

In this study and in the South African context, underprivileged schools belong to the lower-level quintiles. The quintile-level system ranks schools in terms of how poor they are or how affluent they are, with the poorest schools belonging to quintile-level 1, while the most affluent ones are found in quintile-level 5 (van Dyk & White, 2019). This quintile ranking system was motivated by the need to allocate more government funding where it was needed most because the poor communities, such as townships and rural areas in which lower quintile-level schools are located, cannot adequately support them (van Dyk & White, 2019). In this study, one of the most difficult physical sciences topics, organic chemistry, was taught using FC at one of these underprivileged schools located in the Mpumalanga province of South Africa during term 1 of 2021 (Schell & Mazur, 2015; Seery & O'Connor, 2015). FC 'inverts' the classroom by ensuring that what is normally taught during the in-class component of blended teaching is moved to the online component and completed as individual pre-class work (Fisher et al., 2018; O'Flaherty & Phillips, 2015; Schell & Mazur, 2015). Schell and Mazur (2015) added the caveat that FC is a learner-centred teaching approach that takes attention away from the teacher as the source of learning and places it on learners and their learning.

Essentially, what FC or flipped learning (FL) must do is change the teacher's role from one who transmits knowledge to a facilitator of learning who ensures that learners assume active roles while becoming responsible for their own learning. Nonetheless, FC pedagogies do not share uniform characteristics as some can still exhibit traits of passive teaching. In contrast, in-person traditional teaching methods are not all the same, as some can promote active learning (Kapur et al., 2022). Additionally, according to Schell and Mazur (2015), infusing technology into flipped classrooms is not mandatory. Despite this, leveraging technology in a way that addresses learner needs, such as freeing up time for in-person traditional teaching to potentially promote deeper learning of concepts such as grade-12 organic chemistry, is important (Flynn, 2015; He et al., 2022).

In this study, the use of FC was deemed suitable because of the difficult nature of organic chemistry which has persistently resulted in poor scores of grade-12 learners during National Senior Certificate (NSC) examinations, as shown by the NSC Diagnostic Reports (Department of Basic Education, 2022, 2023). Some of the organic chemistry challenges identified in the literature include the discipline being too abstract, unfamiliar terminology, and students struggling with nomenclature and physical properties of organic chemistry (Chakawodza et al., 2024a, 2024b). The use of FC comes with many potential benefits, such as

promoting student engagement, academic achievement and active learning, which promotes conceptual understanding of organic chemistry (Chakawodza et al., 2024a, 2024b). He et al. (2019) added that the overarching aim of promoting active learning must be rooted in the need to foster conceptual understanding and development of analytical skills while promoting collaborative learning and creativity among learners. More importantly, He et al. (2019) indicated that active learning strategies demand a lot of time. In addition to this, Kapur et al. (2022) emphasised the importance of devoting part of the in-person class time to reteaching concepts that learners struggled with during the pre-class work so as to ensure the success of the FC utilised. This meant that the teachers had to continue putting in extra hours to analyse learners' performance to improve their academic achievement so as to be able to address the issues relating to organic chemistry challenges which have been highlighted.

Further, He et al. (2019) asserted that it is also important for teachers to consistently check if all learners completed the pre-class work as most undergraduate learners have not yet fully developed self-discipline and skills to manage their time effectively. By extension, grade-12 learners would also require this constant monitoring to ensure that pre-class work is completed, thereby adding extra work for the teachers. Similarly, it is important to address questions as to whether learners' failure to complete pre-class work results in fewer interactions, teacher overload, lack of support from the school (Li & Li, 2022) or lack of teacher competence to flip the classroom and lack of access to Internet facilities and suitable devices (Mmakola & Maphalala, 2023). Moreover, He et al. (2019) added that teachers using FC pedagogies must make many difficult decisions regarding elements to include in each of the two phases of the FC model.

Based on the above, this study sought to determine the challenges that could have influenced the teachers to make such a decision while highlighting the responsibilities of the educational entities such as the schools, school governing bodies and the provincial and national departments of education in ensuring the necessary support for both teachers and learners. It could be argued that these educational entities play a significant role in providing the funding and necessary training of teachers. To determine the challenges that could have led to the discontinued use of FC pedagogy, the responses to the semi-structured interview questions in the interview schedules (for both teachers and grade-12 learners) presented in Appendix 1 were analysed. The problem stated below attempts to clarify the research problem that this study sought to address.

1.1 Problem Solving

Organic chemistry is a discipline characterised by persistent failure to understand, resulting in low academic achievement at all study levels. This problem of persistent failure rate of grade-12 learners in organic chemistry-related questions during NSC examinations was mitigated using technology-infused FC pedagogy during the COVID-19 peak resulting in improved academic achievement, as indicated in a study by Chakawodza et al. (2024a). Despite this, the use of FC pedagogy was discontinued just after COVID-19 along with other digital learning forms used by other underprivileged schools (Damoah & Omodan, 2022). This

was done regardless of the initial plans to scale up the use of FC pedagogy to include other subjects and grades in the school which was the research site. Several reasons for the discontinuation of FC are identifiable in literature and include work overload and lack of support from educational institutions (Li & Li, 2022), competence and motivation (Maphalala & Mpofu, 2023; Mmakola & Maphalala, 2023). Considering that most of these challenges are context-bound, the problem of the discontinuation of the FC needs to be clearly understood by illuminating challenges that could have contributed to this discontinuation so as to ensure that learners can continue to benefit from this type of FC model in South Africa especially given the scarcity of research that focuses on the sustained use of this model beyond the COVID-19 era. To close this gap, the following research questions were formulated.

1.2 Main Research Question

What challenges could have contributed to discontinuing the use of the flipped classroom to teach organic chemistry to grade-12 learners at an underprivileged South African school?

1.3 Sub-Research Questions

1. What teacher challenges contributed to discontinuing the use of FC pedagogy at an underprivileged high school in South Africa, focusing on organic chemistry?
2. What learner challenges could have influenced the teachers' decisions to discontinue using the FC pedagogy at an underprivileged high school in South Africa, focusing on organic chemistry?

2. Literature Review

A review of literature was conducted to shed more light on the research problem outlined above, focused on flipped learning and blended teaching, active learning, organic chemistry challenges, and challenges faced during the use of FC pedagogy. This entailed starting by reviewing literature on what FC and blended teaching is all about.

2.1 Flipped Classroom and Blended Learning

Flipped classroom is one of the blended learning models (Fisher et al., 2018; Schell & Mazur, 2015; Seery & O'Connor, 2015). The blended teaching concept is characterised by a myriad of definitions, for example, simply as a combination of both in-person traditional teaching and online learning (Seery & O'Connor, 2015) and, more specifically, as a thoughtful combination of in-person traditional teaching and online teaching methods (Garrison & Vaughan, 2008). The latter has already been adopted in study in this field because of its all-encompassing traits. For example, Chakawodza et al. (2024a) demonstrated that the thoughtfulness could entail ensuring that the blended teaching methods used meet educational needs, such as promoting active learning, which will ultimately lead to academic achievement.

According to Tomas et al. (2019), blended learning models such as FC, flex, supplemental and station rotation (just to mention a few) arise when the various ways in which in-person traditional teaching and online learning components of

blended teaching are combined. For the purposes of this study, only FC or FL will be discussed briefly because the other models are out of the scope of this paper. As noted previously, Seery and O'Connor (2015) underscored the need to ensure that both phases of FC operate as a single entity where the in-person traditional teaching extends (or informs) into the online component, and vice-versa. Additionally, FC ought to incorporate active learning strategies to realise the positive educational outcomes that this pedagogy purported to promote (He et al., 2019; Li & LI, 2022; Tomas et al., 2019).

2.2 Active Learning

Active learning has been defined as learner-centred strategies that allow learners to think about what they are learning and perform other activities, accompanied by a reflection on these learning activities (Kapur et al., 2022; Tomas et al., 2019). The fundamental aim is to promote deeper understanding, analyse, create and work collaboratively with peers (He et al., 2019). These high order skills resonate with the widely used Bloom's taxonomy, which places learner cognitive skills into a rank order, starting with simple recall of information and extending to higher-order skills such as analysis and evaluation (Adams, 2015). This is important because the Department of Basic Education places much emphasis on these cognitive skills. It could be argued that, as learners develop higher-order thinking skills, their academic achievement improves. As Adams (2015) asserts, higher cognitive levels signify in-depth learning. Therefore, pedagogies that promote this are desirable. Considering that organic chemistry concepts are perceived as difficult to understand, the active form of flipped classroom should be used to improve academic achievement among learners from an underprivileged school of South Africa. This is particularly important given that most learners in South Africa attend these underprivileged schools, ranked lowest on the quintile system.

2.3 Organic Chemistry Challenges

Despite being perceived as a discipline that is difficult to understand because of the reasons outlined in the introduction section of this study, organic chemistry is a prerequisite course for most students who wish to study science-related courses such as biochemistry, medicine, microbiology, genetics and environmental sciences (Tekane et al., 2020). This makes it critical that grade-12 learners develop conceptual understanding of this important discipline. Some of the organic chemistry challenges that learners face include unfamiliar terminology that is difficult to understand (Tekane et al., 2020). This problem is further compounded by the idea that most of the learners from underprivileged schools in South Africa, who form the largest learner cohort, are second or third-language speakers of the predominant language of instruction, which is English. Furthermore, organic chemistry requires learners to go through several steps in order to solve complex problems, whereas the solutions are generally non-algorithmic (Tekane et al., 2020).

The focus of this study is grade-12 learners (high school) and utilises FC pedagogy, unlike that conducted by Tekane et al. (2020) at university level which utilised supplemental blended teaching. This emphasises the need to conduct the current study as it must be noted that challenges faced by university students are different from those faced by high school learners, particularly those from

underprivileged schools. For example, university students do not struggle with unstable Wi-Fi and Internet connections in addition to having access to well-equipped computer laboratories and computers in the libraries (while at the university campus). The current study sought to find out why FC pedagogy, which was used to mitigate organic chemistry challenges during the COVID-19 pandemic, was discontinued despite the notable improvement in academic achievement and learning engagement outcomes at an underprivileged school of South Africa. Furthermore, learners' struggles with nomenclature and getting formulae wrong are well-documented in the diagnostic reports on the NSC examinations (Department of Basic Education, 2022). This emphasises the need to carry out this investigation because of the potential that FC pedagogy has in addressing learner challenges such as those identified in South Africa and other places in the world.

It could be argued that some of the challenges, particularly the lower order questions such as recall, can be addressed using frequent easy quizzes, which can be graded by the learning management systems (such as Moodle and Blackboard) software which is used to organise the online learning in some FC models (Maphalala & Mpofu, 2023). However, a few studies conducted in South Africa which focused on the adoption of technology-mediated teaching during COVID-19 have also highlighted several challenges that both the teachers and learners faced, which could provide insights on why the FC in this study was later discontinued.

2.4 Challenges Faced during the Use of Flipped Classroom Pedagogy

According to Mmakola and Maphalala (2023), teachers lack the competence to deliver quality online lessons because of problems with the recording of lessons, large classes and poor voice quality of videos, while students struggle with time management and lack of access to the Internet services. Mmakola and Maphalala (2023) also highlighted teacher struggles in engaging learners, pointing to a lack of competence. Additionally, Flynn (2015) also indicated that learners were initially reluctant to answer questions, explain concepts or participate in groupwork but that this changed when active learning strategies were utilised, resulting in learners debating their answers. However, in this study, the teachers endeavoured to foster active learning. There appears to be a wide variety of FCs being used and the designs of some of them were based on the contextual factors and motivated by a need to meet learner needs. This assertion is supported by Fazal and Bryant (2019) who indicated that blended teaching, inclusive of FC, is dependent on context.

Fisher et al. (2017) added that blended teaching (inclusive of flipped classroom) in underprivileged schools of South Africa was hampered by a lack of suitable devices and unreliable or lack of Internet services. The lack of access to these services was experienced by the learners in the present study, which led to the development of an offline mobile app. However, the learners had to refresh the content on their apps at school using the Internet services provided by the teacher as the school Wi-Fi was down and, even when it was available, the speed was just too slow thus making it unreliable and unable to cater for the needs of all the

learners (Chakawodza et al., 2024b). However, given that the study was conducted during the peak of the COVID-19 pandemic, inconsistent refreshing of content on the mobile app was blamed on absenteeism owing to sickness (Chakawodza et al., 2024b).

Furthermore, in the study by Chakawodza et al. (2024b), which is connected to the current one, attempts to mitigate against issues relating to teacher competency in the production of quality videos were made by the use of screencasts from YouTube, as recommended by Seery and O'Connor (2015) and used by Flynn (2015) who adopted a combination of self-made videos and YouTube videos. This recommendation was also considered against the backdrop of Flynn's (2015) assertion that the most difficult and time-consuming part of implementing flipping processes lies in part in video preparations. Given this, it could be argued that the occasional use of YouTube screencasts also partly dealt with the challenges of teacher overload (Chakawodza et al., 2024b).

Flynn (2015) further ascribed the success of the organic chemistry flip to teaching assistants who analysed student assignments and identified areas of difficulties, which they then communicated to the teachers. This could have allowed teachers to address these difficulties timeously, emphasising the need to support teachers by providing them with teaching assistants to help with some of the easier tasks. However, further questions as to why they discontinued the flipping of the class when learners were no longer falling sick in large numbers because the threat of COVID-19 has subsided cannot be avoided. Questions as to whether this could have been caused by the challenges identified so far still linger, particularly, given Fuchs's (2021) findings, with regard to teacher competence. While emphasising that FC requires a high level of teacher competence, extra and creative work, Fuchs (2021) went on suggest that teachers would require a manual on how to design successful FC models. It could be argued that, if the manual is to be developed, then it must consider the importance of contextual factors highlighted by Fazal and Bryant (2019). This model must also tackle challenges relating to lack of motivation.

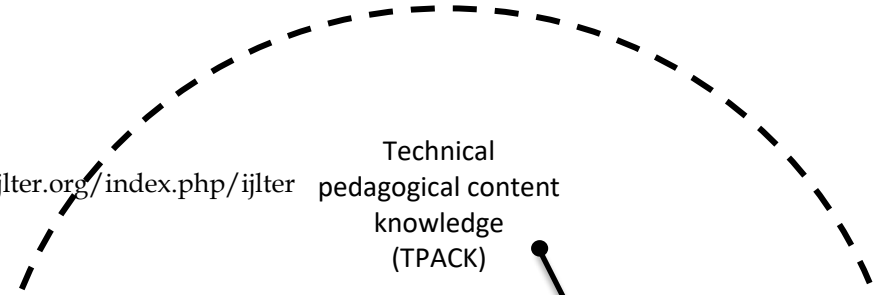
Interestingly, lack of self-motivation (Mmakola & Maphalala, 2023) was cited as a challenge impeding the use of blended learning (FC included) among learners while Li and Li (2022) asserted that FC results in motivation of students and development of positive attitudes. The source of the lack of motivation could not be clearly ascertained; however, research shows that some learners do not prefer individual learning as they feel that they paid fees to access teacher expertise while others still indicate their preference for the in-person traditional teaching to which they are accustomed (Flynn, 2015; Fuchs, 2021; Krahenbuhl, 2017; Olmefors & Scheffel, 2023). In addition, Olmefors and Scheffel (2023) found that learners that are already proficient in the subject matter tend to be less motivated to complete the pre-class work. This could be caused by the idea that the online work is usually designed to be less challenging, as recommended by researchers, to ensure compliance (Fisher et al., 2018; He et al., 2019; O'Flaherty & Phillips, 2015). This contradiction in literature emphasised the need for this study to be conducted to develop a clear understanding of what exactly influenced the discontinuation

of the use of FC pedagogy to teach organic chemistry at an underprivileged school of South Africa.

While focusing on other contexts, He et al. (2019) indicated that sometimes FC is negatively impacted by hasty implementation, which could result in learners becoming frustrated. This could be compounded by teachers and learners struggling to use the complicated technologies (He et al., 2019). However, in this study, most of the challenges identified from the literature were addressed upfront, except for a few. This made it imperative that this study be conducted. Li and Li (2022) further pointed out that some of the disadvantages of FC are increased workload on the part of both teachers and students, students' failure to complete pre-class work, students' reluctance to participate in interactive work and a lack of adequate support from the schools. Nevertheless, it could be argued that the support required could be in the form of financial resources, effective timetabling, suitable devices such as computers, Internet services and other relevant infrastructure. Additionally, the lack of support may be entrenched in the assessment policies that have not yet transformed to cater for the integration of technology. The following theoretical framework was utilised to determine the challenges that impede the use of FL at an underprivileged high school in South Africa.

3. Theoretical Framework

This study was anchored by Maslow's hierarchy of needs theory (Maslow, 1943) and the Technological Pedagogical Content Knowledge (TPACK) which was proposed by Mishra and Koehler (2006). The TPACK framework emphasises teachers' ability to determine the most suitable ways of teaching concepts to learners and leverage technology in ways that promote better understanding (Apotheker & Veenstra, 2015). Motivation issues are considered important for teachers to persevere in the wake of difficult conditions such as work overload and scarcity of resources. This is important considering that the use of FC has been associated with increased workload (Li & Li, 2022; Mmakola & Maphlala, 2023). Similarly, TPACK is suitable because this study focuses on the integration of technology into education and literature has highlighted the importance of teacher competence in using FL pedagogy (Apotheker & Veenstra, 2015). When applied to this study, pedagogical knowledge plays an important part in ensuring that FC is utilised effectively and this would determine whether the FC model becomes a success, which is related to the learning processes (Mishra & Koehler, 2006). The TPACK framework proposed by Mishra and Kohler (2006) was illustrated diagrammatically by Apotheker and Veenstra (2015), who helped shed more light on this important theory, arguing that content knowledge refers to teachers' knowledge of the subject matter, which in this study is organic chemistry. As shown in **Error! Reference source not found.** below, intersections among the various components of this theory gave rise to TPACK (located at the centre) which comprises technological pedagogical knowledge (TPK), pedagogical content knowledge (PCK) and technological content knowledge (TCK).



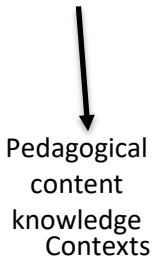


Figure 1: An illustration of the TPACK framework (adapted from Apotheker and Veenstra, 2015)

Moreover, knowledge of how to leverage technology is not the only important factor; teachers also require content knowledge based on organic chemistry to realise important educational outcomes such as academic achievement. Furthermore, issues of motivation play a very important role. To make sense of motivation issues which played a significant role in this study, Maslow's hierarchy of needs theory was utilised. According to Maslow (1943), the physiological needs or basic needs determine whether a person becomes motivated or not. Such basic needs include the need for food and shelter. Given that the school which was the research site was located in an underprivileged community, the learners were faced with constant struggles for such basic needs. As Maslow (1943) points out, if these fundamental needs are not met the individual cannot progress to higher needs such as needs for safety, to belong and to strive to improve their understanding with a view of developing self-esteem in the discipline and ultimately self-actualise. This means valuing schoolwork and ensuring that the necessary things for successful learning would be ignored. This makes it impossible to motivate learners to complete their classwork let alone prioritising getting suitable devices to engage in online learning. For the few learners and teachers that have managed to satisfy their basic needs, the second level of needs include safety needs. Additionally, when teachers and learners constantly encounter technical difficulties, they would become frustrated, resulting in a lack of motivation to attempt the work. Additionally, learners must feel safe to work on an online platform to guarantee any motivation.

Most importantly, for any FC model to become a success and stand the test of time, learners must be motivated to complete the pre-class work, which in this study was online. It could be argued that, if learners consistently fail to complete the pre-class work then teachers will be left with no choice but to discontinue the use of the FC pedagogy. Likewise, when teachers are overloaded and fatigued because of the large classes that are prevalent in most underprivileged schools of South Africa (Fisher et al., 2017) they may not feel motivated to take on more responsibilities that are associated with utilising FC pedagogy. This lack of motivation may manifest itself as reluctance to engage in professional development aimed at improving competence in navigating the online learning component of FC. According to Maslow (1943), the needs to have a manageable workload and classes that are less crowded may be lower needs that must be satisfied to guarantee motivation to take on more tasks associated with a continued use of FC pedagogy. Challenges such as the digital divide, which have been highlighted in literature, negatively impact the FC pedagogy, particularly at underprivileged schools which are underfunded while learners coming from poor communities also struggle to secure Internet services. It must be noted that, regardless of whether teachers decide whether to use FC or not, learners have an important role in influencing such decisions. The methodology utilised to collect the data which were analysed using the two theories is described in the section that follows.

4. Method

4.1 Research Design

This study utilised the interpretivist paradigm which allowed for the identification of challenges that impede the continued use of FC pedagogy to teach grade-12 organic chemistry, a physical sciences topic which is notoriously perceived as difficult based on the experiences of the participants (Pervin & Mokhtar, 2022). In this exploratory study, an attempt to understand how the possible challenges identified could have influenced the discontinuation of the FC model implied in the research questions makes the interpretivist paradigm suitable (Pervin & Mokhtar, 2022). Intricately linked to the interpretivist paradigm is the use of the qualitative research approach as both are based on subjective meanings from participants (Pervin & Mokhtar, 2022). Adopting the qualitative approach allowed the participants to freely express themselves during the evaluation of the FC pedagogy. This evaluation was undertaken using semi-structured interviews, which allowed the researcher to probe to develop an in-depth understanding of the issues at play, which could have led the teachers to revert to the use of the in-person traditional teaching method, which was relatively passive. The interview schedules (one for the teachers and another for the learners) are available in Appendix 1 of this paper.

The interviews were conducted online via ZOOM, audio recorded and transcribed orthographically to ensure an honest representation of what the interviewees said, which is in keeping with the ethical considerations made during the application of the ethical clearance from the Institutional Review Board of the university. Owing to its flexibility, thematic analysis makes it possible to analyse data in a wide range of ways, thus rendering it suitable for many different

types of research questions (Braun & Clarke, 2012). The codes were then used to analyse the transcribed interviews and the five themes identified from the literature using ATLAS.ti 24. The sampling strategies used are outlined below.

4.2 Sampling

A total sample of N=8, which comprised two physical sciences teachers and six learners (3 boys and 3 girls) was interviewed. The two teacher interviewees were selected because they had participated in the use of the flipped classroom pedagogy. Even though one of them was the main experimental teacher while the other one was the control group teacher, both teachers engaged in team-teaching, particularly during the morning lessons, afternoon periods outside the normal timetable, during weekends and during school holidays. These teachers were initially selected using purposive sampling because they were supposed to engage in team-teaching to ensure internal validity of the study, as pointed out by Chakawodza et al. (2024a). The two teachers were the only ones that were engaging in team-teaching at the school.

The learner interviewees were also selected using purposive sampling as they had to be from the subgroup taught using an active form of technology-mediated FC pedagogy. Equal numbers of boys and girls were interviewed individually because the whole experimental subgroup that was initially involved had approximately equal numbers of girls and boys, as indicated by Chakawodza et al. (2024a, 2024b). This also ensured that the study was not adversely affected by gender as a confound. The interviewees were purposefully selected from the classes that participated in the FC programme based on how frequently they completed their work and based on their standardised test scores, which was administered as part of the initial study by Chakawodza et al. (2024a). Two were highly active and had previously demonstrated high academic achievement, two had a relatively average participation and academic achievement while the other two had relatively low participation rates and low academic achievement. The participation rates were determined using the Moodle learning analytics and the learners' participation in in-person class activities. Purposeful sampling was suitable as it ensured a true representation of the whole subgroup of learners who were taught using the FC pedagogy. This sampling strategy was more likely to meet one of the objectives of the study, which was to determine how learner experiences could have influenced the teachers' decision to discontinue the use of FC pedagogy. The sampling strategy utilised ensured that the three categories of learners used were a suitable representation of the subgroup from which the sample was obtained.

As indicated in the previous work of which this study is a part, the interview schedules were validated by two education experts with PhD. qualifications and two experienced teachers with postgraduate qualifications (one from a neighbouring school and another one who was the head of department for physical sciences and acting deputy principal at the research site). The interviews were checked for construct and content validities. Following this validation process, any questions that were deemed unsuitable were replaced with more suitable ones and those that were ambiguous were clarified (Chakawodza et al.,

2024b). Chakawodza et al. (2024a, 2024b) indicated that the school was also initially selected using purposive sampling. The selection criteria used included factors such as a large learner population studying physical sciences, underprivileged status (or occupying the lowest rank of the quintile system, quintile-level 1) and easily accessible to the researcher. The quintile-level 1 school was chosen because most of the learners in South Africa attend such schools. Collected data were analysed as described in the section that follows.

5. Data Analysis

Thematic analysis was chosen because of its flexibility (Braun & Clarke, 2012). Themes that were identified during the review of the literature were utilised using mostly deductive coding. By indicating that deductive coding was predominantly used shows that elements of inductive coding could have been applied particularly to identify challenges that were not clearly identifiable from literature, such as teacher motivation. Inductive coding was used to explore the possibility of this theme emerging (Braun & Clarke, 2012). These themes that represent the key challenges that could have led to the discontinued use of the FC pedagogy were the lack of access to Internet services, stable Wi-Fi and the ability to navigate the online learning platform, the effect of lack of support from educational institutions on teachers or learners, lack of competence, lack of motivation and overloading. Deductive coding was deemed suitable because the study sought to contribute to the existing literature on challenges that could have influenced discontinued use of the FC pedagogy, particularly during the post-COVID-19 era focusing on the South African context and organic chemistry. This entailed generating codes that were applied to the data to identify the themes (Braun & Clarke, 2012).

The codes used to identify each of the five themes are illustrated in **Error! Reference source not found.** (in Appendix 2). To determine the relative effect of each of the factors represented by the themes, the number of quotes related to each of the five themes was also determined and illustrated in **Error! Reference source not found.** (in Appendix 2), which provided insights on how significant each of the themes was. This way meaningful patterns that could be used to address the research questions were identified by which the frequency counts of quotes on each of the themes were determined (Braun & Clarke, 2012; Pearse, 2019). However, these patterns only served as a guide, as more interpretation of the interviewee quotes carried more weight, particularly when the way the points were raised was scrutinised for any hidden meanings. The factors were separated into learner challenges and teacher challenges to address the two sub-research questions. Verbatim quotes selected that represented the themes were provided as supporting evidence to ensure transparency of the data analysis process. To ensure validity of this qualitative study, the verbatim transcriptions were discussed by three investigators (investigator triangulation). This ensured that individual bias was avoided and that correct interpretations were captured. These agreed-upon interpretations informed the research findings presented the section that follows.

6. Research Findings

6.1 Teacher Challenges

To address research question 1, data collected were analysed to find out teacher challenges that could have contributed to the problem of discontinuation of the use of the flipped learning model. Findings pertaining to the five key themes outlined in **Error! Reference source not found.** (Appendix 2) are presented in the subsections that follow, starting with the theme relating to digital divide of teachers.

6.1.1 Theme 1: Teachers' lack of access to suitable Internet services and stable Wi-Fi

Teacher-2 pointed out that there were no Wi-Fi and Internet services in the school, which made it impossible to sustain any form of blended learning, such as the technology-enhanced flipped classroom, as seen in the quotation below.

> *"… it needs the school to be onboard and offer the necessary support like Wi-Fi and Internet access. The problem is when you come to the school, the school says. uh, we don't have money you must go to the district. At the district they tell you to go to the circuit. It's like it needs to start up there."*

From what the teacher said, it became plausible that lack of access to suitable Internet and Wi-Fi facilities could have influenced the teachers' decision to stop using the flipped classroom pedagogy. The teacher sounded frustrated because of a seeming lack of commitment to addressing the problem. Teacher-2 also expressed her frustrations about the lack of provision of Wi-Fi and Internet services at the school.

6.1.2 Theme 2: Lack of teacher competence

An analysis of the frequency counts of the theme relating lack of teacher competence featured strongly, as shown in Table 1 (Appendix 2). Drawing from the TPACK framework, it becomes plausible that the teachers could have lacked the TCK to tailor the content to be taught to learner problems in the organic chemistry discipline for grade-12 because one of the learner interviewees (Respondent-4) mentioned the following: *"Sometimes, I found the work on the App difficult."* This shows that the teacher was struggling to decide on the level of difficulty of the content that was supposed to be done individually as pre-class work in the online component of the flipped component. It could be suggested that, if the teacher had been aware of the learners' learning problems, pre-class work in the online component of the flipped component, then the level of difficulty could have been managed better.

Furthermore, the teachers could have failed to respond to the needs of the learners by ensuring that the elements of the blended flipped classroom model included more games. This portrays a lack of teacher competence in terms of technological pedagogical content knowledge as proposed by Mishra and Koehler (2006) and further explained by Apotheker and Veenstra (2015). When learner interviewees were asked about the elements of the FL model they preferred to have more of, Respondent-1 (learner interviewee) said the following:

> *"Games! More of the games. I will be relaxed while at the same time I am learning when I play educational games."*

On the same note, Respondent-1 indicated the need for more activities and interactions. It is important to highlight the excitement that Respondent-1 expressed by saying "*Games!*" with an exclamation and went on to repeat saying "*More games*". This response appeared as if the respondent was pleading for the teacher to post more activities of that nature, which shows the teacher was struggling to meet learner needs. Teacher-1 also corroborated this by indicating this when he mentioned that they struggled with encouraging learners to interact on the discussion forum. This corroboration by Teacher-1 can be taken as portraying a lack of teacher competence in leveraging technology into the learning process, according to the TPACK framework by Mishra and Koehler (2006). According to Apotheker and Veenstra (2015), teachers' knowledge of which concepts and how to present them using technology to improve the learners' understanding is important. In this study, more interactions, more activities and managing the level of difficulty of the activities could be said to have been some of the ways to improve teacher competence in using FC pedagogy considering learner needs and challenges in organic chemistry. Additionally, Teacher-1 underscored the importance of training learners over a longer period by saying the following:

> *"I think if we are to implement it fully, we need to come down and start from grade 10 where the learners get more used to engaging on that platform and then continue to answer their own questions in the form of quizzes."*

By indicating the above, Teacher-1 acknowledged the inadequacy of the training they offered to the learners on how to navigate the online learning platform, which signals a lack of teacher competence in leveraging technology into learning as part of the TPACK framework. Teacher-1 concluded by saying the following:

> *"If the DoE (Department of Education) is to take this onboard, or wherever this is introduced, teachers need to be capacitated and motivated to accept the new way of doing things because it will help in terms of learning engagement and in terms of achievement."*

The excerpt above makes it more plausible that lack of teacher competence could have been the most negative factor that could have led to the discontinuation of the use of flipped classroom pedagogy. While teacher competence could be regarded as the biggest negative factor that contributed to the discontinuation of FC model, it must be noted that Teacher-1 also underscored the need for teachers to be motivated. This shows that lack of motivation could have been a possible challenge that influenced the teachers' decisions.

6.1.3 Theme 3: Lack of teachers' motivation

An analysis of the interview data collected shows that both teachers and learners could have lacked motivation to persevere in the face of challenges. This could have been a result of a lack of teacher motivation, lack of parental guidance and learners not valuing school. Teacher-1 had this to say on issues relating to motivation:

> *"They (teachers) need to be on board and take it up as a necessary skills development programme that they are willing to embark on."*

This teacher bemoans a lack of motivation from other teachers who were not even participating in the implementation of the FC model. The situation painted here is dire, as most of the teachers are so demotivated that they did not even want to participate in any form of professional development. When Maslow's hierarchy of needs theory is applied, it shows that there could other basic needs that the teachers are lacking, such that they are not even motivated to professionally develop themselves. According to Maslow (1943), if these basic needs are not fulfilled then the teachers would remain demotivated. Such basic needs include food, shelter and safety (Maslow, 1943). These were not interrogated as they were beyond the scope of this study; however, further research to find out the basic needs that teachers may be lacking is recommended.

6.1.4 Theme 4: Teacher overloading

Teacher-1, who was the primary teacher for the subgroup that was taught using FC, pointed out that there was need for the school to employ a teaching assistant to help when he said the following:

> *"We need a teaching assistant that is motivated because this means that they will have to go that extra mile. The teaching assistants and the educators can also take turns to engage these learners on that platform it can help-it doesn't have to be only one educator because it will become too much."*

It is important to note that the teacher clearly expressed how overwhelming the work was, which emphasises that FC cannot be conducted by a single person as more teachers must assist. Additionally, the teacher made it clear that it is not just any teaching assistant but one that could work long hours. This shows how dire the situation was. However, questions can be raised as to whether this overloading could not be linked to lack of teacher competence, which can be explained by using the need to ensure that teachers have technological knowledge. It could be argued that, if the teacher was proficient in using technology, there is a chance that some of the tasks would not be as time-consuming, such as in the preparation of videos. This assertion is based on the idea that surely some of the time could be freed up by grading the assignments and quizzes using technology which would reduce the load, particularly when there is a teacher assistant to carry some of the load. Some of the issues raised here could be an effect of lack of support from educational institutions.

6.1.5 Theme 5: Effect of lack of support from educational institutions on teachers

When Teacher-2 implied that the school could have done more to ensure that they have access to Internet services in Section 5.1.1, it shows a lack of support from educational institutions. This was more evident when the district office and the provincial education department could not offer any help in this regard. Interestingly, the Department of Basic Education had previously hired teaching assistants, but this support was discontinued, as mentioned by Teacher-2. Reasons as to why this stopped were not clear. It could be argued that, if teachers needed teaching assistants, then they would need them more this time around, given the extra load associated with preparing online work. Teacher-2 expressed dissatisfaction from the lack of support by saying the following:

> *"…it needs the school to be onboard and offer the necessary support like Wi-Fi and internet access. Yes, the problem is when you come to the school, the school says we like. uh, we don't have money go to the district. At the district they tell you to go to the circuit. It's like it needs to start up there, yes, I think if the minister can identify or can see that we need blended learning. uh and for it to take place, we need resources or certain resources."*

The negative effect of lack of support for teachers is evident in the interview excerpt above. It appears that the teachers lacked support from the school, from the district office, from the circuit and from the Department of Basic Education, which is at national level.

6.2 Learner Challenges

Findings on learner challenges were used to address research question 2, which was concerned with finding out how learners could have contributed to the teachers' decisions to discontinue using the flipped learning model. The data collected were analysed, and the findings about each of the themes, like those of teachers, are presented below, starting with the lack of learners' access to Internet services and stable Wi-Fi, considering that the success of any technology-related teaching model hinges on learners' ability to access digital learning and being able to use it.

6.2.1 Theme 1: Learners' lack of access to Internet services and failure to navigate the online learning platform

Inequalities pertaining to access to Internet facilities is well documented in literature on South African schooling system (Damoah & Omodan, 2022; Fisher et al., 2017; Maphalala & Mpofu, 2023; Mmakola & Maphalala, 2023). Respondent-1's comment below highlights struggles with accessing Internet services:

> *"Some learners were struggling to refresh the app, but I would try to have a little data to refresh."*

> *"Sometimes, I could only submit the quiz at school when I didn't have enough data. There were also a few times when I would get an error message."*

Based on the above quotes, it is more likely that the learners also suffered from the digital divide, which could have influenced their ability to complete pre-class work on time. For example, if the pre-class work was being submitted the following day at school, then the teacher would not have enough time to analyse learners' performance and adjust the in-person traditional lesson accordingly so as to address the misconceptions, which defeats the real essence of having FC. Using the TPACK framework, it appears that these learner struggles impact negatively on the learners' ability to use TCK effectively for learning while negatively affecting teachers' capabilities to infuse TPK in a way that influences learners' content knowledge of organic chemistry (PCK) which, according to Mishra and Koehler (2006), is crucial to effective learning. Furthermore, the learners, like many in the subgroup, failed to use the chat tool and the discussion forum to ask questions. Alternatively, the technical problems experienced

(although few) could have been exacerbated by the digital divide of the learners, particularly given that, when the learners were booted out of the system once, they could not get themselves back and had to wait for the teacher to assist them. This was a clear case of the digital divide, which manifested itself as a lack of competence to navigate the online learning platform.

6.2.2 Theme 2: Lack of competence from learners

As indicated previously in Section 0 above, some of the learners found the work difficult. This could be interpreted as a portrayal of lack of learner competence. In addition to this, another learner interviewee (Respondent-2) said the following:

> *"There were times when I didn't understand a thing. That's when I didn't find it easy. For example, when we were doing polymerisation, I found it difficult."*

When the TPACK framework by Mishra and Koehler (2006) was applied, the learners could have lacked content knowledge of some organic chemistry topics such as polymerisation. Additionally, some of the learners could have struggled with the navigation of the online learning given that the teacher recommended that learners be introduced to technology-mediated flipped learning in grade-10 to ensure that they got used to it. This could also reflect the learners' lack of competence in navigating the online platform, which shows a lack of technological knowledge and, combined with the preceding finding, this becomes a lack of TCK, which is illustrated in **Error! Reference source not found.**. However, some of the problems that appeared to be a lack of competence could have been more of a lack of motivation because learning how to use the chat tool is not very complicated.

6.2.3 Theme 3: Learners' lack of motivation

Teacher-1 and Teacher-2 both expressed disappointment with the priorities of the learners in that they preferred to spend money buying social media data instead of buying data for schoolwork. Teacher-2 mentioned the following:

> *"I ask them, what do you do when you get home, then the other one said, I go home and eat. After eating… when the other one said, ma'm, she spends the whole entire weekend on Facebook, she is forever online. So, you can see that they love being online, but now they buy Facebook data but they don't have data for schoolwork."*

The above was corroborated by Teacher-1 and another learner interviewee, respectively, Respondent-1 commented as follows:

> *"Some of them will tell you that it was a lack of Internet access, but they are always on WhatsApp so, it has to do with tradition of learners reserving their data for recreational purposes and not for schoolwork. If it's schoolwork, then they want the school to provide everything."* (Teacher-1)

> *"I found the app the app interesting but some of my classmates complained about the data problem, but they do not want to ask the teacher to refresh the app for them."* (Respondent-1)

An analysis of these interview excerpts shows that it is not so much about the lack money to buy data but more one of lack of motivation, which led to the learners prioritising social media participation over schoolwork. When Maslow's theory on motivation is used it appears as though these learners who were from underprivileged communities lacked basic needs such as food and adequate shelter making schooling a secondary priority given that interactions on the online platform were few. Alternatively, it could be that they did not like the use of flipped classroom at all because, if it was a question of prioritising social media participation, then they should have gone to one of the teachers' classrooms to refresh the content on the mobile apps. Such learners do not seem to care about at school at all, which could be a sign that certain basic needs have not been fulfilled resulting in lack of motivation (Maslow, 1943). However, in some instances what appears to be a lack of motivation could have been a case of overloading of learning.

6.2.4 Theme 4: Overloading of learners

In this study, some learners did not experience any pressure of extra work as some wished they could get more practice work. However, some of them did, as shown in the quote below.

> *"Most of the time I have a lot of work to do-a lot of homework. By the time I did physical sciences I would be tired because I usually start with accounting. I have to be honest."*

The quote above shows that the extra work was not entirely because of the use of the FC model because the respondent referred to work from other subjects like accounting. This problem could have manifested itself this way because the school does not seem to take a multidisciplinary approach to the implementation of technology into teaching, which is a portrayal of a lack of support from the school. Using the TPACK framework by Mishra and Koehler (2006), it could be argued that the technological knowledge of implementing such FC models was also lacking.

6.2.5 Theme 5: Effect of lack of support from the school on learners

The school's inability to provide Wi-Fi and Internet services was also identified as a lack of support from the school, which could have hampered the use of FC pedagogy. The school could not afford other resources, such as computers that many learners could use, particularly for those with unsuitable devices. It could be argued that the school failed to provide the necessary support to learners to ensure the sustained use of the FC model. If the school could not support the grade-12 learners doing physical sciences, how possible was it for it to support more learners taking more subjects? This emphasised the need for school support to make it easier for learners to continue utilising the flipped model. Respondent-5 emphasised the above saying the following:

> *"It was a challenge for us to refresh the App using the data from school Wi-Fi."*

7. Discussion

An analysis of the interview data above identified five challenges that could have influenced the discontinuation of the use of the flipped classroom as the

pedagogical choice suitable to address learner challenges in organic chemistry. To determine this, both teacher and learner challenges were considered, which requires that the two sub-research questions be addressed, starting with research question 1 on teacher challenges.

7.1 Teacher Challenges that Contributed to the Discontinuation of FC Pedagogy

Several teacher challenges that could have contributed to the discontinuation of the FC pedagogy in this study could be determined from the research findings. These include lack of teacher competence, lack of motivation of teachers, access to Internet facilities, effect of lack of support for teachers from educational institutions and teacher overloading. Some of these challenges have been identified by other scholars. For example, lack of teacher competence was evident in this study when the teachers struggled to meet learner needs, which must be the driving factor for integrating technology. This could have led to more difficult work being done as pre-class work. This shows that the teachers needed to fully understand the idea that lower objectives such as recalling of information and explaining concepts should be tackled by learners as preparation for more complex work that should be reserved for the in-person traditional class. Researchers focusing on flipped classroom have emphasised this (Fisher et al., 2018; He et al., 2019; O'Flaherty & Phillip, 2015).

He et al. (2019) underlined the idea that less cognitively demanding work needs to be done as pre-class work by indicating that doing so ensures that learners complete the work. They also implied that teacher competence is key to the success of FC when they indicated that the use of the pedagogy requires that teachers make several complex decisions regarding elements that should be in the pre-class and in-person phases. Additionally, this finding is congruent with the findings by other researchers (Maphalala & Mpofu, 2023; Mmakola & Maphalala, 2023) who identified that lack of teacher competence as a key factor affecting blended teaching (flipped classroom included) and recommended mandatory technology-related training of teachers. Besides lack of teacher competence, Mmakola and Maphalala (2023) also identified digital divide and lack of support from school as critical factors that impact negatively on the success of blended teaching (flipped classroom included).

In this study, the teachers bemoaned the lack of provision for suitable Wi-Fi and Internet services. The school's Wi-Fi was down for most of the time; however, the few times it was working the speed was too slow to effectively support the teachers let alone the learners. From the findings it seemed clear that the school was evading responsibility by sending the teachers to the district office and the district office also referred them to the provincial education department. Even though this shows how determined the teachers were to ensure that they continue to use the FC pedagogy, it would not have been sustainable for them to continue financially supporting the school. Based on this, it is expected that the teachers will eventually stop using the FC pedagogy. While this could be a result of lack of Internet services and stable Wi-Fi, it can also be conceptualised as an effect of lack of support from educational institutions. Closely related to this was the overloading of teachers.

Increased workload of teachers, which became an important finding in this study, was also identified by other researchers (Fuchs, 2021; Flynn, 2015; Li & Li, 2022). Some of the extra load could have emanated from video preparation, a problem that could be mitigated by using freely available videos such as YouTube videos (Flynn, 2015). Furthermore, the research findings show that schools need to employ teaching assistants to help ease the load. This suggestion can potentially reduce the workload given that Flynn (2015) indicated that the author used the services of teaching assistants to analyse learner performance, resulting in learner struggles being captured and addressed timeously. This is crucial in this study which focused on organic chemistry, a discipline that is perceived as difficult to understand. Research findings showed that the teachers were demotivated.

Even though the literature reviewed in this study did not explicitly mention lack of teacher motivation as a challenge influencing the discontinuation of the use of FC pedagogy, the findings discussed above make it plausible that some of them were demotivated. In this study, it became apparent that it is not only learner motivation that could hamper the success and continuation of the FC model as most of the teachers at the research site did not show any interest in participating in the study. Even more worrisome is that they were not motivated enough to learn new skills. This discovery becomes a contribution to the literature on the FC model in the South African context. Despite teachers' lack of motivation not being identified as a factor for the initial interest in using FC and being unable to persevere in the wake of challenges, mixed results on learner motivation are identifiable in literature. At this point, it becomes important to explore learner challenges that could have influenced teachers to discontinue using the FC pedagogy. This entails addressing the sub-research question 2 outlined below.

7.2 Learner Challenges that Could Have Influenced Teachers' Decisions to Discontinue the Utilisation of FC Pedagogy

Challenges like those of teachers were explored as possible learner challenges. For example, when competence was explored, it became evident that some of the learners struggled to navigate the online learning platform and they were not aware that they could send an email to get help. As much as this could have been a teacher challenge, it could also be identified as a learner challenge because the learners (although not many) did not even ask for help from the teacher. This raises a lot of questions such as whether this was just a convenient excuse not to complete the pre-class work, which could be an indication of a lack of motivation. Interestingly, studies on blended teaching show that learners exhibited signs of lacking self-motivation (Mmakola & Maphalala, 2023; Olmefors & Scheffel, 2023).

As highlighted in the literature review, the learners that were achieving high marks lacked motivation to complete pre-class work (Olmefors & Scheffel, 2023). However, according to Li and Li (2022), learners's motivation levels were fostered by the use of the technology-mediated FC. This contradiction in the literature requires further research to ascertain under what conditions learner motivation is blostered by the use of the type of FC that was utilised in this study. Closely, related to this was that research shows that most learners prefer in-person traditional teaching methods over FC, partly because of the less evident teacher

expertise, a general dislike of group discussions and peer interactions (Flynn, 2015; Fuchs, 2021; Krahenbuhl, 2017; Olmefors & Scheffel, 2023).

Based on the above, the preference for in-person traditional teaching methods could be the reason why learners do not feel motivated by the use of FC pedagogy. Furthermore, the idea of using easier questions as part of the pre-class work could explain why more proficient learners were not motivated. However, it is not clear in this study if the work was less challenging because some of the learners interviewed indicated that they found the pre-class work difficult. Given this, the reasons for lack of motivation could not be fully ascertained because some of the learners mentioned that they found FC pedagogy and all the learning activities interesting, particularly the flashcard game. Therefore, the research findings about motivation were also mixed in this study. Additionally, the lack of motivation could be ascribed to a lack of parental support, as some of the students stayed alone in child-headed homes so they could be close to the school. Lack of motivation among learners could be linked to lack of Internet facilities.

In this study, the learners suffered from a lack of access to Internet services and Wi-Fi, which negatively affected the completion of pre-class work. Most of the learners could not afford to purchase data to refresh the content on their Moodle apps. Therefore, such learners could only refresh their apps when they got to school, which became a challenge at times, particularly when they were absent from school. As such, some learners lagged in completing schoolwork and could not be assisted by the teacher when they fell sick. These findings on lack of access to Internet services were corroborated by Mmakola and Maphalala's (2023) findings.

Furthermore, some of the learners' attitudes towards school left more questions than answers when they chose to spend the little money they had to purchase social media data bundles instead of purchasing data that could be used to complete the pre-class work. Moreover, some of them did not refresh their apps using the Internet facilities provided by the teachers. These findings can be interpreted as strong evidence of a lack of motivation. When these learners persistently failed to complete their pre-class work then teachers would have been forced to discontinue the use of the technology-mediated FC. Failure to complete pre-class work was not peculiar to the present study as Li and Li (2022) also flagged it as a potential negative outcome of FC. By virtue of being an underprivileged school, the school, which was the research site, could not provide Wi-Fi and Internet facilities (effect of lack of support from educational institutions on learners) that the learners could use for learning purposes.

These significant findings above on learner challenges show that, even though the learners did not directly make the decision to discontinue the use of FC, their actions could have influenced the teachers' decisions. However, the learners did not raise issues relating to extra workload, which could be directly linked to the FC model, as some of them wished that the teachers could give them more practice work. This finding could be explained using He et al.'s (2019) observation that learners being taught using FC could benefit from learning that was spread out

thereby creating room for more practice work that would enhance deeper understanding of concepts. However, for some, the failure to complete pre-class work could also have resulted from pressure of work created by failure to utilise a multidisciplinary approach to implementing FC, resulting in extra load from other subjects such as accounting.

8. Conclusions, Recommendations, and Limitations

Challenges influencing the discontinuation of the FC pedagogy at one of the underprivileged high schools of South Africa focusing on organic chemistry were explored. These include lack of teacher competence, motivation of teachers, Internet services and capabilities to navigate online learning platforms, effects of lack of support from the educational institutions such as the school and the district office on teachers and learners in addition to teacher overloading. Furthermore, learners this study did not directly make the ultimate decision to discontinue FC model but they contributed towards this by not completing pre-class work owing to lack of motivation or access to Internet services or both. This could have been owing to lack of support from parents and educational institutions that failed to provide Internet services and suitable devices. The present study contributes to the literature on technology-mediated FC by highlighting factors that could lead to the discontinuation of the use of this pedagogy during the post-COVID-19 era. More importantly, lack of teacher motivation figured strongly, which is contrary to literature that identifies lack of motivation as mostly affecting learners. Study findings can be generalised to underprivileged schools (with similar contextual factors) in South Africa and globally. The study has implications for educational leaders and teachers wishing to implement an FC model that could stand the test of time while being responsive to the challenges of South African underprivileged schools and the difficult nature of organic chemistry. Additionally, it is recommended that educational leaders reconsider hiring of teaching assistants to reduce teachers' workloads. Hopefully, this could motivate teachers to use the FC pedagogy. Further, learners' prioritisation of pre-class work is recommended. However, by focusing on one school and conducting semi-structured interviews of only eight respondents for seven weeks, this study has limitations. Therefore, future longitudinal studies with larger samples are recommended.

9. Acknowledgements

This study acknowledges the contributions of the participant and the granting of permission to conduct the research. Support from the University of the Witwatersrand and the National Research Foundation (NRF) is acknowledged.

10. Declaration of Interest Statement

This study was not directly funded by any organisation, and no organisation or individual was specifically interested in the results.

11. Ethics Statement

An ethics clearance certificate from the University of the Witwatersrand was obtained prior to the commencement of data collection.

12. References

Adams, N. E. (2015). Bloom's taxonomy of cognitive learning objectives. *Journal of the Medical Library Association, 103*(3), 152–153. https://doi.org/10.3163/1536-5050.103.3.010

Apotheker, J., & Veenstra, I. (2015). Twenty-first century skills: Using the Web in chemistry education. In J. García-Martínez, & E. Serrano-Torregrosa (Eds.), *Chemistry education: Best practices, opportunities and trends* (pp. 565–594). Wiley-VHC Verlag.

Braun, V., & Clarke, V. (2012). Thematic analysis. In V. Braun, & V. Clarke (Eds.), *APA handbook of research* (pp. 57–71). American Psychological Association.

Chakawodza, J. M., Nakedi, M. M., & Kizito, R. N. (2024a). Effectiveness of blended teaching on academic achievement in organic chemistry: A case of Grade-12 learners from an underprivileged South African school. *International Journal of Learning, Teaching and Educational Research, 23*(3), 248–274. https://doi.org/10.26803/ijlter.23.3.13

Chakawodza, J. M., Nakedi, E. M., & Kizito, R. N. (2024b). Effectiveness of flipped classroom pedagogy in promoting learning engagement in grade-12 students in the context of South Africa and COVID-19. *International Journal of Science Education*, 1-27. https://doi.org/10.1080/09500693.2024.2342574

Damoah, B., & Omodan, B. I. (2022). Post-COVID-19 pandemic era teaching and learning strategies in South African schools. *E-Journal of Humanities, Arts and Social Sciences, 3*(11), 90–103. https://doi.org/10.38159/ehass.2022sp3118

Department of Basic Education, South Africa. (2022). *NSC Examinations 2021: Diagnostic report – Part 1 (Content subjects)*. https://www.education.gov.za/Portals/0/Documents/Reports/2021NSCReports/2021%

Department of Basic Education, South Africa. (2023). *NSC Examinations 2022: Diagnostic report – Part 1.* https://www.education.gov.za/Portals/0/Documents/Reports/2022NSCReports/2022%20Diagnostic%20Report%20Part%201%20Content%20Subjects.pdf?ver=2022-02

Fazal, M., & Bryant, M. (2019). Blended learning in middle school math: The question of effectiveness. *Journal of Online Learning Research, 5*(1), 49–64. https://www.learntechlib.org/primary/p/183899/

Fisher, J., Bushko, K., & White, J. (2017). *Blended beyond borders: A scan of blended learning obstacles and opportunities in Brazil, Malaysia, & South Africa.* wise. https://files.eric.ed.gov/fulltext/ED586369.pdf

Fisher, R., Perényi, Á., & Birdthistle, N. (2018). The positive relationship between flipped and blended learning and student engagement, performance and satisfaction. *Active Learning in Higher Education, 22*(2), 97–113. https://doi.org/10.1177/1449787418801702

Flynn, A. B. (2015). Structure and evaluation of flipped chemistry courses: Organic & spectroscopy, large and small, first to third year, English and French. *Chemistry Education Research and Practice, 16*(2), 198–211. https://doi.org/10.1039/c4rp00224e

Fuchs, K. (2021). Innovative teaching: A qualitative review of flipped classrooms. *International Journal of Learning, Teaching and Educational Research, 20*(3), 18–30. https://doi.org/10.26803/ijlter.20.3.2

Garrison, D., & Vaughan, N. (2008). *Blended learning in higher education: Framework, principles, and guidelines.* John Wiley & Sons.

He, W., Holton, A., Gu, H., & Farkas, G. (2019). Differentiated impact of flipped instruction: When would flipped instruction work or falter? *International Journal*

of Teaching and Learning in Higher Education, 31(1), 32–49. https://files.eric.ed.gov/fulltext/EJ1206961.pdf

Kapur, M., Hattie, J., Grossman, I., & Sinha, T. (2022). Fail, flip, fix, and feed – Rethinking flipped learning: A review of meta-analyses and a subsequent meta-analysis. *Frontiers in Education*, *7*, 1–19. https://doi.org/10.3389/feduc.2022.956416

Krahenbuhl. (2017). An engaging, yet failed flip. *InSight: A Journal of Scholarly Teaching, 12*, 132–144. https://files.eric.ed.gov/fulltext/EJ1152089.pdf

Li, Z., & Li, J. (2022). Using the flipped classroom to promote learner engagement for the sustainable development of language skills: A mixed-methods study. *Sustainability, 14*(10), Article 5983. https://doi.org/10.3390/su14105983

Maphalala, M. C., & Mpofu, N. (2023). Experiences of South African academics moving from contact to emergency remote teaching: Lessons for the future. *International Journal of Innovative Technologies in Social Science, 40*(4), 1–12. https://doi.org/10.31435/rsglobal_ijitss/30122023/8084

Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50*(4), 370–396. https://doi.org/10.1037/h0054346

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mmakola, S., & Maphalala, M. (2023). Blended teaching and learning in South African secondary schools in the post-Covid-19 pandemic era. *International Journal of Innovative Technologies in Social Science, 4*(40), 1–10. https://doi.org/10.31435/rsglobal_ijitss/30122023/8081

O'Flaherty, J., & Phillips, C. (2015). The use of flipped classrooms in higher education: A scoping review. *Internet and Higher Education, 25*, 85–95. http://dx.doi.org/10.1016/j.iheduc.2015.02.002

Olmefors, O., & Scheffel, J. (2023). High school students' perspectives on flipped classroom learning. *Pedagogy, Culture & Society, 31*(4), 707–724. https://doi.org/10.1080/14681366.2021.1948444

Pearse, N. (2019). *An illustration of deductive analysis in qualitative research* [Conference session]. Proceedings of the European Conference on Research Methods in Business and Management Studies (Vol. 2019-June, pp. 264–270). Academic Conferences Limited. https://doi.org/10.34190/RM.19.006

Pervin, N., & Mokhtar, M. (2022). The interpretivist research paradigm: A subjective notion of a social context. *International Journal of Academic Research in Progressive Education and Development, 11*(2), 419–428. http://dx.doi.org/10.6007/IJARPED/v11-i2/12938

Schell, J., & Mazur, E. (2015). Flipping the chemistry classroom with peer instruction. In J. García-Martínez, & E. Serrano-Torregrosa (Eds.), *Chemistry education: Best practices, opportunities and trends* (pp. 319–343). Wiley-VCH Verlag. https://doi.org/10.1002/9783527679300.ch13

Seery, M., & O'Connor, C. (2015). E-learning and blended learning in chemistry education. In J. García-Martínez, & E. Serrano-Torregrosa (Eds.), *Chemistry education: Best practices, opportunities and trends* (pp. 651–669). Wiley-VCH Verlag. https://doi.org/10.1002/9783527679300.ch26

Tekane, R., Pilcher, L. A., & Potgieter, M. (2020). Blended learning in a second year organic chemistry class: Students' perceptions and preferences of the learning support. *Chemistry Education Research and Practice, 21*(1), 24–36. https://doi.org/10.1039/C9RP00099B

Tomas, L., Evans, N. S., Doyle, T., & Skamp, K. (2019). Are first year students ready for a flipped classroom? A case for flipped learning continuum. *International Journal of Education Technology in Higher Education, 16,* Article 5. https://doi.org/10.1186/s41239-019-0135-4

van Dyk, H., & White, C. (2019). Theory and practice of the quintile ranking of schools in South Africa: A financial management perspective. *South African Journal of Education, 39*(1), Article 1820. https://doi.org/10.15700/saje.v39ns1a1820

Appendix 1: Interview Schedules

Interview Schedule for Teachers

1. Does the school provide reliable Wi-Fi for use by the whole school?
2. How reliable is the school Wi-Fi?
3. Would you say you are coping with workload which has increased because of the FL program?
4. How do you see the problem of scarce resources affecting the FL program going forward?
5. Would you say you have mastered the art of developing learning material to upload onto the Moodle APP for the use by your students?
6. How motivated would you say your students are?

Interview Schedule for Students

1. Did you at any given time experience technical problems when you were using the Moodle app to learn organic chemistry?
2. If so, what kind difficulties were these and fast were they resolved?
3. Do you now have access to the school Wi-Fi?
4. If yes, how reliable is the Wi-Fi?
5. Do you always have enough data to refresh your app when you are away from school?
6. Would you say you were motivated during the time you were learning organic chemistry?
7. Did you at any point struggle to navigate the online platform.? If yes, what was the problem and how was it resolved?
8. How often did you participate in discussions related to organic chemistry with your classmates?

Appendix 2: Themes and Codes

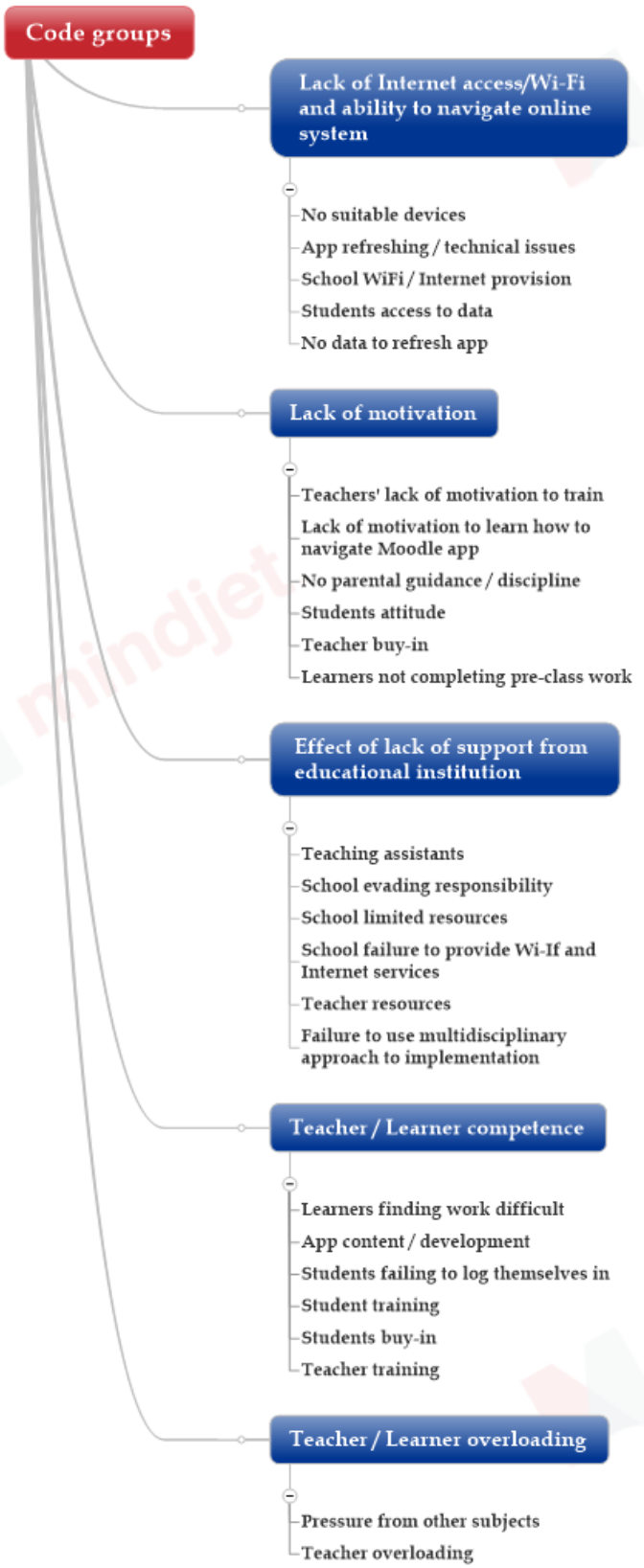


Figure 2: Themes and related codes

Table 1: Number of quotations per interviewee per theme

Theme	Respondent-1 Gr=6 (Learner)	Respondent-2 Gr=3 (Learner)	Respondent-3 Gr=0 (Learner)	Respondent-4 Gr=2 (Learner)	Respondent-5 Gr=2 (Learner)	Respondent-6 Gr=0 (Learner)	Teacher-1 Gr=13	Teacher-2 Gr=6	Total
Lack of Internet access/Wi-Fi and ability to navigate online system Gr=12; GS=3	4	1	0	0	1	0	4	2	**12**
Lack of motivation Gr=10; GS=3	2	0	0	0	0	0	6	2	**10**
Effect of lack of support from educational institution Gr=10; GS=7	0	0	0	0	0	0	7	3	**10**
Teacher / Learner competence Gr=18; GS=5	4	2	0	2	1	0	8	1	**18**
Teacher / learner overloading Gr=2; GS=1	0	0	0	0	0	0	2	0	**2**
Total	**10**	**3**	**0**	**2**	**2**	**0**	**27**	**8**	**52**

Notes

Grounding (number of quotes) Gr
Number of codes in Theme GS