

Implementing communication technologies to enhance learning efficiency at a technical vocational education and training college in Cape Town

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Abstract. This paper explores the impact of extending instructional time at technical vocational education and training (TVET) colleges using WhatsApp's mobile social network (MSN) application. In South Africa, there is relatively little discussion on extending instructional time within the TVET sector, yet instructional time loss is consistently mentioned as one of the most significant challenges. During the study, the subject of Computer Programming was examined in light of poor learner performance. This study employed mixed-methods research following a pragmatic paradigm to formulate educational policies potentially dealing with TVET instructional time losses in South Africa. Data were collected from two TVET centres (FB1 and FB2) involving two lecturers and 48 students in Cape Town. Despite the study's mixed results, qualitative data reflected the need to extend instructional time and improve the efficiency of applications like WhatsApp. Quantitative data reflected an overall percentage pass rate of 56% and 100% for FB2 and FB1, respectively. The messaging application, however, has challenges, such as disrupting conversations. By participating in learner WhatsApp groups, the paper believes lecturers can reap positive benefits from these initiatives. This study adds voice to mixed-method practices. To maximise pedagogical efficiency, this study recommends that educators provide practical guidance on using MSN applications to increase instruction time.

Keywords: instructional time, learning efficiency, mobile social networks, TVET, participatory action research

1. Introduction and background

Research on the importance of instructional time has a long tradition in teaching and learning outcomes. The concept has not been treated as such by technical vocational education and training (TVET) institutions. To our knowledge, none of the reviewed studies has focused on addressing instructional time to improve learner efficiency within the TVET sector. Due

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to the challenges regarding low pass rates that TVET institutions in South Africa constantly experience [10, 11], this paper discusses an alternative approach to the problem by extending instructional time through MSN applications. The paper illustrates how MSN can potentially be used for teaching and learning [12, 27]. In addition, the paper discusses how well-administered platforms can expand instruction time beyond institution boundaries, making the inclusion of lecturers in such groups a necessity.

The foundation for positive learning outcomes is built on uncompromised instructional time. Therefore, extending instructional time is a critical factor that enhances learning efficiency. Bloom [7] states that all learning requires time to meet the objectives. However, research has shown mixed results, with some researchers showing that other factors such as quality of instruction [29, 40], affective entry behaviours and cognitive entry behaviours are more important. Although Dağlı [9] has shown a connection between instructional time and learning efficiency, there is still a lack of research that has been carried out within the TVET sector with a particular focus on National Certificate: Vocational (NCV) programmes to establish a link.

The concept of instructional time has attracted less attention, particularly within the TVET sector in South Africa, yet learning efficiency is impacted. The common issues perceived to affect learning efficiency and supposedly given more attention include funding [48], poor relationships between labour markets and the programmes [22], articulation issues [31], poor industry experience for the lecturers [33] and mismatch of learners and programmes [39]. Observations in South Africa have shown disruptions in learning each year due to different socio, political, and economic challenges but still get less attention.

To fill this gap, this study seeks to answer the following research question:

How can extending instructional time complement teaching and learning using WhatsApp groups?

The study utilised MSN, particularly WhatsApp, to extend the instructional time beyond the regular lecturing timetables and enhance learning efficiency for learners studying Computer Programming as a subject at a TVET college. Quality of instruction [40], cognitive entry behaviours, and funding are also factors that contribute to learning efficiency [34]. WhatsApp was chosen as the MSN application of choice in this study due to its accessibility [49], flexibility, and low data costs [23] as well as its ability to enhance communication and collaboration among TVET students [4]. Nonetheless, it is essential to recognise that disparities in access and proficiency may still exist and could influence the equitable use of WhatsApp among different student groups.

A key objective of the study is *to investigate and identify strategies for complementing learning efficiency by extending instructional time within the context of MSN groups.*

This study suggests a new perspective on how MSN applications, such as WhatsApp, complement learning efficiency within a learning environment by extending instructional time. The rest of the article is structured as follows: section 2 reviews the literature, section 3 presents the methodology, section 4 presents the results, section 5 discusses the results, and section 6 concludes the paper.

2. Literature review

The literature was reviewed using a systematic approach to ensure rigour, reproducibility, comprehensiveness, and explicitness [6]. Systematic literature reviews are characterised as having limited bias due to the involvement of many reviewers in the selection of key sources [28]. Additionally, researchers should be aware of the potential biases resulting from the mapping review. For example, not all studies will be included in the review, and the review may miss essential studies.

2.1. Understanding the TVET concepts

In this study, NCV learners are used as the unit of analysis in the TVET sector in South Africa. The term TVET is defined as a range of learning experiences relevant to the world of work and which may occur in various learning contexts, including educational institutions and the workplace [45]. Several researchers have used different terms like ‘vocational education’ [42], ‘vocational training’ [35], ‘technical vocational education and training’ [37]. Despite the differences in terminology, a commonality prevalent in all cases is that “TVET comprises training and skills development activities relating to occupational fields, production and livelihoods” [26]. In South Africa, the Further Education and Training Colleges Amendment Act No. 1 of 2013 [10] paved the way for the term TVET from FET. By providing secondary school learners from grade ten upwards with an alternative learning option to the academic mainstream, TVET contributes to addressing skills shortages and reducing unemployment levels.

2.2. TVET challenges

The TVET sector is under constant strain to meet labour demands. Some of the identified challenges associated with the TVET sector include labour-market mismatch, negative employer perception [22, 50] and negative societal perceptions of the TVET sector, which creates the misconception that the pathway is for weak learners [3, 50]. Subsequently, the resulting output of learner inefficiency is still felt in its three facets: skill, knowledge, and competence. Keeping this in mind, understanding instructional time concepts is critical for TVET lecturers and students.

2.3. Instructional time

To maximise opportunities in the learning process, educational initiatives must carefully consider instructional time. Bloom [7, p. 682] pointed out that “all learning, whether done in school or elsewhere, requires time”. Similarly, Gándara [17] corroborates the idea by saying, “... there is a relationship between the amount of time invested in learning and the quantity and quality of learning that occurs for any given group of students”. Although increasing instructional time may not eliminate learner deficiencies, positive changes are expected to result in significant improvements. According to Temple and Mohammed [44], increased instructional time benefited foundational grades more than upper grades in high schools in the United States of America. Conclusive studies on educational gains from increased instructional time in TVET programs such as the NCV are still lacking in South Africa. Assuming a link between instructional time

and learning outcomes, extending contact through MSN platforms such as WhatsApp may be a viable solution worth investigating.

2.4. Mobile social networks in learning

The term mobile social network (MSN) is used in this study to refer to the convergence of social media and mobile learning. Various terms such as social network sites (SNS), MSNs, online social networks (OSN), and mobile instant messaging (MIM) [49] have been used interchangeably with other researchers attempting to separate them. According to Mao et al. [30], “an MSN is a social network overlaying one or several types of mobile networks”. The availability of social network platforms through mobile devices brought about the concept of MSNs [30, 38]. Synonymous with MSN applications is the capability of bringing together people sharing the same purpose. Examples of MSN applications include WhatsApp, Facebook Messenger, Instagram, and Snapchat. WhatsApp’s popularity among students in the South African TVET sector is justified by its accessibility, cost-effectiveness, and versatility. Given its widespread use, students can easily communicate and collaborate with peers and lecturers, facilitating group discussions, sharing resources, and getting timely feedback [32, 36].

Moreover, its multimedia capabilities allow for diverse forms of learning, accommodating various learning styles and preferences. Students can initiate one-on-one conversations or participate in group discussions, allowing real-time communication and collaboration. Additionally, WhatsApp’s low data usage makes it particularly suitable for students in South Africa, where data cost is still relatively high for those from low-income economies. WhatsApp proved a viable alternative during the COVID-19 pandemic when face-to-face interaction was limited, especially among TVET students who used zero-rated platforms. Overall, WhatsApp is a valuable tool for enhancing communication, collaboration, and learning experiences among students in South Africa. Accordingly, WhatsApp was chosen as the preferred MSN tool in this study.

Because they are not geographically limited, MSNs have significant potential in teaching and learning. Researchers mention the availability of learning content from any location [27, 49]. A study [47] highlights educational affordances such as collaborative learning, blended learning, and the development of learning communities. MSN applications’ robustness, security, accessibility, and ease of use contribute to their popularity in teaching and learning. Despite MSN capabilities, Awoke and Zikargae [5] have identified challenges in teaching and learning, such as lecturer resistance, an associated distraction caused by uncontrolled platforms, and infrastructure difficulties. Nonetheless, MSN is more synonymous with its ability to bring together people who share the same goal, and learners are among people who share a common interest. Understanding contact styles is expected to improve focused discussions, motivation, and direction, with lecturers also expected to be a part of these platforms.

2.5. Conceptual framework

A conceptual underpinning that drives reasoning must create a coherent scientific argument and express a shared understanding of the phenomena of interest. As stated by Habermas [20], our selected conceptual framework directs our arguments and paradigmatic viewpoints for validity reasons. Key to argumentation, we present two guiding principles to support our claim:

Framework for the Rational Analysis of Mobile Education (FRAME) [25], and connectivism [41].

The FRAME model [25] focuses on three key factors: device, learner, and social aspect. The FRAME model suggests that when devices interact with learners, it fosters device usability, while interactions between devices and social elements give rise to social technology. Additionally, engaging with social contexts promotes interaction learning, highlighting the importance of social interactions in the learning process.

As a discipline, teaching and learning are steered by learning theories, and for the same reason, this study selected connectivism as the guiding theory because of its applicability in mobile learning. Key concepts in connectivism include [2]:

- diversity of opinions
- existence of knowledge in non-humans
- the currency of connections
- networks and chaos

While acknowledging some criticism against connectivism, such as philosophical deficiency on how humans acquire knowledge [24], we argue that the theory explains learning within mobile environments better than traditional learning theories.

Lecturers' understanding of and participation in MSN environments is a stimulant for such environments' productivity since they may be the technology's blockers when making instructional decisions [47]. To close this gap, our research aims to provide strategies for optimising learning efficiency by extending instructional time within the context of MSN groups.

3. Methodology

This study utilised a mixed-method approach to collect and evaluate responses from NCV students and lecturers. As influenced by pragmatism, we believe a single scientific explanation or technique cannot inform a study. There are two reasons for combining techniques in this study: significance enhancement and treatment integrity [21, 43]. We used NVIVO software for theme analysis of qualitative replies following [8] protocols. We utilised SPSS, a statistics tool for data analysis, to analyse the quantitative data.

The study was conducted at two TVET centres, FB1 and FB2, in South Africa's Western Cape province. These two centres are from the same college but in different geographical locations: FB1 is in an area where most of the learners come from middle-class families, whereas FB2 is in the Cape Flats, where most of the students come from, Townships. Data collection followed ethical procedures, such as obtaining permission from the college principal and written consent from the participants. 20 and 28 learners were recruited using convenience sampling at FB1 and FB2, respectively. While criticised for its potential bias, convenience sampling was the best alternative due to the limited number of TVET colleges in the Western Cape province. Using triangulation, we validated quantitative findings using a qualitative approach to eliminate potential bias. Due to the participatory nature, the study was carried out in three phases, with feedback from each stage feeding into the next stage as suggested [46].

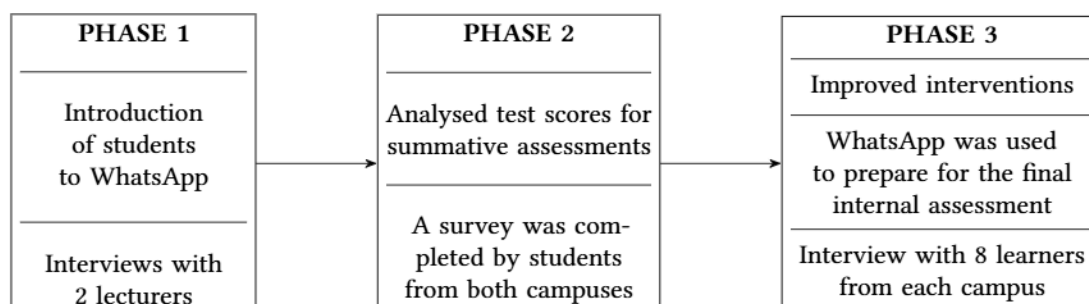


Figure 1: Research process.

3.1. Phase 1

We first introduced WhatsApp to all participants to assist students with computer programming issues outside the classroom. We looked at learner attendance throughout term one and the number of learning hours allotted each week for each topic at each campus. This was done to determine the true amount of time lost in face-to-face classes. Two subject lecturers were interviewed to gain a broader perspective on instructional time. We adopted the identities LFC1GM and LFC2WM for the lecturers located at FB1 and FB2, respectively, to maintain anonymity.

3.2. Phase 2

The results from phase 1 were fed into phase 2 to enhance the intervention. After implementing WhatsApp and lecturer interviews on each campus, we analysed test scores for summative assessments. In FB1, 15 of the 20 individuals answered the questionnaire, but in FB2, 24 of the potential 28 participants responded. A questionnaire was used to collect data on WhatsApp usage experiences to seek comments on the Device, Social, and Learner aspects, as mentioned in FRAME [25].

3.3. Phase 3

Results of phase 2 were used to improve interventions for phase 3. In the last phase, WhatsApp was used to prepare for the final internal assessment. After the phase, we contacted eight learners from each campus to get their thoughts on increasing teaching time and if they had any issues that may help improve learner efficiency. We used descriptive statistics to examine all the test results from phases 1, 2, and 3.

4. Results

This section presents the findings under the following subheadings:

4.1. Results from the quantitative approach

As shown in figure 2, FB2 had the lowest attendance with a median of 39.4 days out of a possible 60 days prescribed by the Department of Higher Education. The longer left whisker indicates that attendance data was skewed negatively. One of the FB2 students had the lowest attendance of only 24 days in term 1. As a result of these factors, it can be concluded that some students lose a significant amount of instructional time as individuals, which is further exacerbated when there are college-level instructional time losses such as strikes, academic opening meetings, and sports events. A startling discovery revealed that the two colleges had different numbers of periods per week for the same subject. FB1 was given 5 hours, while FB2 was given 4.17 hours.

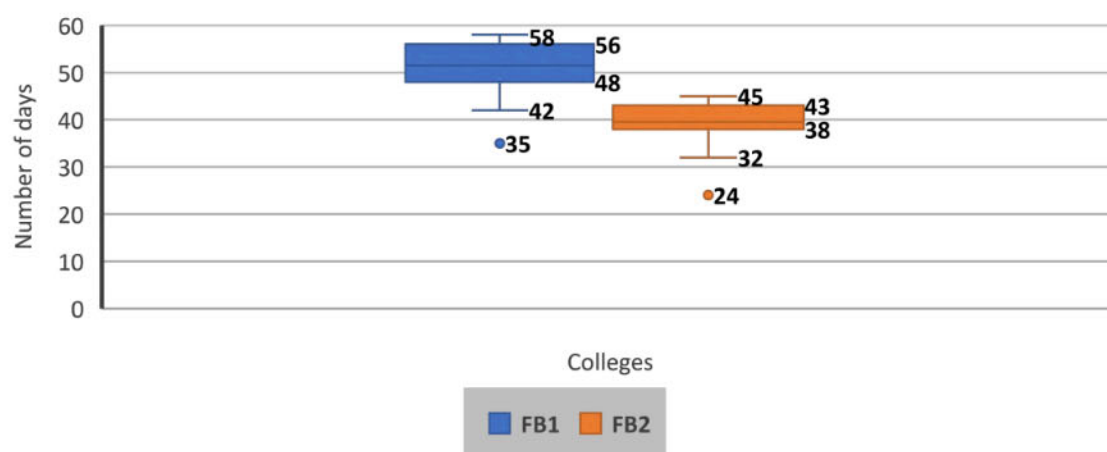


Figure 2: Attendance for phase 1.

The phase continued with learners using WhatsApp groups for Computer Programming lecturers as part of the planning. After class, there would be time for questions and answers. However, participants were permitted to ask questions throughout the day. Answers came from other students and subject lecturers, depending on who responded first. When subject lecturers have time, they will moderate all responses. The principal researcher took part by posting questions and answering some of the learners' questions. Following the PAR observation stage, the following section reports the phase 2 questionnaire findings.

Device ownership

All survey respondents ($n=40$) stated that they had cell phones and could access the information taught in WhatsApp groups anytime. The students agreed that their mobile phones were adequate for learning using WhatsApp. On the other hand, several respondents stated that they preferred more expensive devices with more memory and a larger screen size because they wanted more versatility in their use. When asked about their experience with other MSN programs, most students ($n=35$) said they were experts in WhatsApp rather than Viber, Twitter, Facebook Messenger, and other apps.

Access to the Internet

A striking similarity was that learners from both campuses had access to Wi-Fi while at college, which perhaps reflected the importance of access to Wi-Fi placed by the college administration. The results for Internet access outside of college presented in table 1 show that most of the learners ($n=34$) did not have access to Wi-Fi and instead relied on purchasing data bundles.

Table 1

How learners access the Internet when at home.

Option	%	Count
Home Wi-Fi	15.00%	6
Data bundles	85.00%	34
I have a contract phone	0.00%	0
Total	100%	40

Furthermore, when questioned about the main problems they faced during participation, half of the participants ($n=20$) said that data costs prevented them from participating fully. Learners also identified inadequate timetabling, tardiness, and difficulty understanding ideas as significant contributors to instructional time waste. Contrary to popular belief, learners did not consider lecturer tardiness or campus protests significant factors in instructional time loss.

Results from theory test scores

Theory test scores were used to depict knowledge as a descriptor of learning efficiency. Table 2 compares test scores for theory tests 1, 2, and 3 for FB1 and FB2. As shown in table 2, the results did not reflect consistent progression in test scores. According to the median representing the data distribution centre, FB1 test scores improved from 67% to 74% for T1 to T2 tests. As for FB2, there was a slight improvement from 60% to 61.5%. These results perhaps suggest an impact on WhatsApp usage. Contrary to expectations, the results did not reflect the same changes in T3 test scores. Instead, findings indicated a dip in the T3 test score to 56.5 for FB1 and, contrary, an increase to 67% for FB2. The positive increase in the highest score from 90% to 94% for FB1 was notable.

Table 2

Theory test score results.

Attribute	FB1			FB2		
	T1	T2	T3	T1	T2	T3
Population size	20	20	20	28	28	28
Median (%)	67	74	56.5	60	61.5	67
Minimum score (%)	34	43	0	28	42	0
Maximum score (%)	90	94	94	82	76	81
First quartile (%)	52.5	60.25	48.75	52	51.5	58
Third quartile (%)	76	82.25	66	68	66.75	69.75
Interquartile range (%)	23.5	22	17.25	16	15.25	11.75

A non-parametric Friedman test for differences for repeated measures was conducted and rendered a p-value of .001 for FB1, which was statistically significant for the three theory test scores. A similar test was done for FB2 and rendered a p-value of .156, which was not statistically significant. The results extracted from SPSS are shown in table 3.

Table 3

Friedman test results for theory test scores.

College	Sample size (N)	Friedman p-value	Conclusion	Terms with statistically significant difference & p-value
FB1	20	.001	Statistically significant difference	T2-T3 (p=.000) T1-T2 (p=.048)
FB2	28	.156	Not statistically significant different	No differences

Results from practical test scores

To assess learner skill changes, we used practical test scores. Figure 3 compares test scores for practicals 1, 2, and 3 for FB1 and FB2, represented using a boxplot. The first two boxplots on the x-axis represent P1 practical scores for FB1 and FB2, followed by P2 for FB1 and FB2, with the last two representing P3 for FB1 and FB2, respectively. Notably, for FB1, the mean was more than the median for practical 1 (P1), suggesting positively skewed data. There was a positive increase in the median for FB2 for the three practical tests (60, 61 and 67%) for P1 and P2.

There was a statistically significant difference in performance in practical tests for FB2 as depicted by the p-value (.001) shown in table 4.

Table 4

Friedman test results for practical test scores.

College	Sample size (N)	Friedman p-value	Conclusion	Terms with statistically significant difference & p-value
FB1	20	.845	Not statistically significant different	There are no significant differences between all practical tests
FB2	28	.001	Statistically significant difference	P3-P2 (p=.008) P3-P1 (p=.003)

The overall percentage pass rate was 56% and 100% for FB2 and FB1, respectively.

4.2. Results from the qualitative approach

This sub-section presents the themes that were generated from the qualitative data.

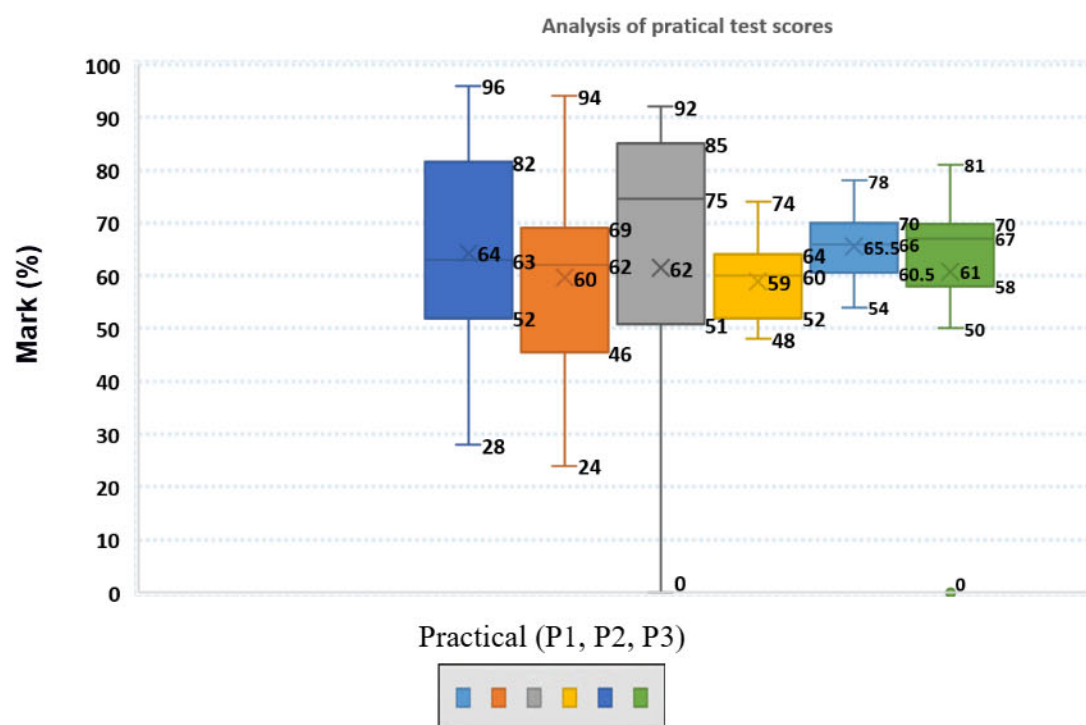


Figure 3: Practical test score results.

Lecturer's lack of awareness of instructional time

None of the two lecturers interviewed knew of the total hours stipulated in the departmental documents (subject guidelines for Computer Programming). When asked the exact number of periods and hours recommended per subject, LFC1GM said "Yaa. Every week, there are seven periods, with each period having 55 minutes, seven sessions a week. Honestly, I did not know that information." Lecturers claimed that several factors led to instructional time loss, with transport being the main cause.

Support for WhatsApp use to extend instructional time

Data collected from the two lecturers revealed that WhatsApp was vital for collaboration among learners beyond the traditional classrooms and extending instructional time. There were mixed feelings from lecturers on whether WhatsApp motivates learners. LFC1GM commented that motivation arises from the learner being in the same circle with the lecturer by saying:

"You know, sir, you are now at par with what we are and with what we want. And you get that..., eh..., more like respect from them as well. ..."

In contrast, LFC2WM stressed, "Just seeing a screenshot of something, I don't think someone might get assistance from that". However, the two lecturers highlighted that WhatsApp can be used to contact learners beyond traditional teaching hours.

The need for a framework in MSN-mediated environments

The lecturers agreed on the need for a framework to govern the direction of using MSN for teaching and learning. When asked about the need for a framework, LFC2WM said “Yes, eh and then ehh. You don’t want each of the 7 subjects to have things going in a different direction. So, a policy could guide all 7 subjects or whoever wants to participate. I also think that if the policy is in place, the infrastructure to support it will follow”. Another respondent, LFC1GM, said “... I think that is the best. That is the best if we are to move forward”. The lecturers suggested that rules would be easy to implement if there was a framework. The findings from the lecturers suggest that the availability of a framework for teaching and learning using WhatsApp would assist in goal alignment and risk mitigation.

Action for phase 1

Guided by PAR, results from phase 1 gave lecturers a platform to conscientise the learners on the concept of instructional time loss and its potential impact on learning efficiency. As participants, lecturers encouraged learners to participate fully in WhatsApp discussions as part of extending instructional time.

In response to the reasons for participation in WhatsApp groups, three key reasons were cited by learners:

- to share ideas with classmates about the subject
- to ask for important information missed in class
- to gain more knowledge on the subject
- to recover lost time

The above response on reasons for participation in WhatsApp concurs with the literature [13, 19] that knowledge is *socially constructed*. However, the principal researcher observed some muted voices in the WhatsApp group discussions. Some participants might have acted as ‘social loafers’ or ‘free riders’ [16]. None of the respondents strongly disagreed that WhatsApp helps increase learning time beyond traditional learning time.

Control of WhatsApp group

The respondents identified some key benefits of having control over WhatsApp, such as focused discussion, rules, motivation, leading, and confirmation when the lecturer is part of the group, which is meant to extend instructional time. In response to the question on how the group admin managed to control the flow of discussions, FB2-7 said: “He asked questions, and some of the students answered if they knew the question; if not, the admin would tell us the answer. In that way, there was a flow of discussion”. Learners from FB1 and FB2 concurred on having extended time with the lecturers as part of the WhatsApp groups. FB1-6 suggested, “If we can be given extra time and extra classes, we can have enough time. And if learners can meet lectures halfway.” FB2-17 shared a similar sentiment by suggesting, “By laying down all the rules beforehand, all the responses and the behaviour was appropriate by everyone.” This shows that students wanted to extend instructional time and that lecturers should be part of the groups

to motivate and lead the conversations. Learners cited enhancing peer learning, mobility, and the application's popularity as key reasons for using WhatsApp in Computer Programming. Informed by PAR stages, phase 2 findings indicated that when lecturers perceive the potential value of MSN as positive and the existence of a framework for use in extending instructional time, they are more likely to collaborate positively with learners.

The learners' responses are presented below following the FRAME model [25] and connectivist learning theory [41].

Mobile affordances

Mobility – The learners regarded mobility as contemplation for choosing mobile devices for learning. They suggested that accessing learning content on their mobile devices through WhatsApp was a cheaper way of extending instructional time. Learners enjoyed accessing learning content at any given time, irrespective of geographical boundaries. Regarding WhatsApp groups, FB-10 claimed “Yes. It helps learners to ask questions when studying at home.”

Diversity of opinions – The respondents noted that WhatsApp offered diversity by enabling concepts to be explained differently by various group members, thereby widening the spectrum of understanding concepts. FB1-18 stated: “Yes, depending on the group participation, it can help other learners as sometimes learners can explain it differently as the way they understood to do something which someone else might be able to understand better”.

Currency of connections – Learners constantly seek ways to connect with other intelligent learners. All respondents said yes to whether learners could identify those who provided correct answers on WhatsApp. FB1-1 stated: “Yes, I was able to. I have quite good connections with the people who do answer, and if I need something personally answered, I could message them personally if I require it.”

Connectivity – Most of the learners from FB2 indicated that data was still an issue as most of them do not have Wi-Fi at home and instead rely on buying expensive data bundles. FB2-22 said:

... The colleges should provide us with data. That is my thinking outside the college because some of us ... we do want to join these groups, but the problem — say, for example, if someone sends a video, the thing that I did not understand while I am watching the video, the data gets finished.

Responding to the connectivity question, only 15% of participants said they used Wi-Fi at home. This is consistent with our expectation that connectivity remains challenging, particularly for learners from low-income communities.

5. Discussion

The study explored the impact of extending instructional time utilising MSN applications such as WhatsApp, in which lecturers played a key role in enforcing rules within the groups for TVET learners.

Awareness of instructional time

The study discovered that lecturers and learners do not explicitly understand instructional awareness. However, the lecturers agreed with early studies (e.g., Bloom [7]) that all learning requires time. According to Abadzi [1], institutions within poor economies experience more instructional time loss. The current study also discovered that FB2 learners lost more time than FB1 learners, where the majority of learners come from families with slightly better social and economic status. While factors such as device status are a concern, most learners appear to have devices capable of easily accessing the WhatsApp group. However, the study found that MSN platforms require a lecturer responsible for scaffolding and maintaining operating rules. The findings corroborate the study by [18], which, among other aspects, validated teaching presence on technology-mediated initiatives. Lecturers are instrumental in MSN environments, too.

The study found that WhatsApp can potentially extend instructional time, allowing learners to access learning content anywhere, anytime. This finding can also be used to draw similar conclusions for other MSN applications with similar capabilities to WhatsApp. Literature has placed the importance of virtual time [14] as it enables access to learning content irrespective of geographical location. The current, therefore, put forward the following proposition (P1).

P1: When there is a perceived understanding of awareness of instructional time, lecturers' and learners' use of MSN to extend instructional time will be high.

WhatsApp affordances

The study found several affordances from WhatsApp as experienced by the learners, including collaboration, diversity of content, the currency of nodes, focused discussions, motivation, activation of muted voices, the immediacy of feedback, and others.

The study found that if instructional time is extended using WhatsApp with lecturer support, it will enable learners to reach mastery because of the support and control offered.

P2: Learners can reach mastery if instructional time is extended using MSN with lecturer support.

In mastery learning, achievement is kept constant with time as the variable [15]. Learners in favourable areas or states attain mastery criteria faster [15]. The findings show that FB1 attained a 100% pass rate at the year's end, suggesting the presence of knowledge, skills, and competence in one sitting. Bloom hypothesised that any learner could attain mastery given enough time, help and support.

In this regard, we conclude that aspects of FRAME [25] and connectivism [41] were present in WhatsApp affordances. Learning efficiency is a possibility combined with awareness of instructional time and lecturer control. Nonetheless, factors such as bandwidth, connectivity and chaos associated with MSN platforms must be addressed.

Theoretical and practical implications of the study

This study offers empirical evidence for the principles of connectivism theory in the context of vocational education through the effective application of communication technology. The study

demonstrated that the principles of connectivism (such as networked learning environments and supporting knowledge production and sharing) are helpful guides for creating technology-enhanced learning experiences in vocational education settings.

Empirical insights into the FRAME framework's application and improvement within the educational technology integration framework are offered by the TVET college in Cape Town's deployment of communication technologies. As highlighted in the literature and through the lenses of the FRAME model, WhatsApp accommodates diverse learning styles. In this study, MSN instances such as WhatsApp offer practical benefits for learners, such as mobile and social affordances, which are critical in teaching and learning subjects such as Computer programming.

Furthermore, WhatsApp allows additional resources to mitigate instructional time losses. Our findings are intended to demonstrate how the mentioned affordances apply to analogous TVET settings experiencing significant instructional time losses. A potential limitation of the study may lie in its generalisability to TVET contexts distinct from that of South Africa.

The implementation of WhatsApp enables TVET colleges to enhance learning efficiency by providing students with anytime, anywhere access to educational resources and collaborative learning opportunities.

6. Conclusions

From the study, we conclude that MSN applications such as WhatsApp extend instructional time to complement teaching and learning. The outcomes are expected to hold practical significance for environments similar to South Africa. Further, instructional time scheduled normally for TVET academic teaching and learning is never achieved. The study's findings reveal that unforeseen events such as natural disruptions, student strikes, transport disruption, and other factors beyond the TVET control make it impossible for learners to recover lost time and extend existing teaching and learning time.

The literature reviewed in this paper gave a solid background on understanding instructional time within the TVET sector. Our methodology applied helped researchers to view the phenomenon from within. Mixing qualitative and quantitative data helped to strengthen our results. The study results suggest that some learners with learning challenges benefit from interacting with faster learners. However, it must be noted that the successful implementation of WhatsApp for teaching and learning hinges on the participation of lecturers, who are expected to moderate discussions and maintain order.

Further study could explore the effectiveness of specific frameworks in guiding teaching and learning activities on WhatsApp within other educational sectors, examining their impact on student engagement, learning outcomes, and risk management strategies. Comparative studies utilising different MSN tools to increase instructional time could be explored.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

The study was done as part of Godwin P. Dzvapatsva's PhD, supervised by Sumarie Roodt. Edmore Chinhamo, Bingwen Yan, and Courage Matobobo helped put the paper together and read through the paper.

References

- [1] Abadzi, H., 2009. Instructional Time Loss in Developing Countries: Concepts, Measurement, and Implications. *The World Bank Research Observer*, 24(2), pp.267–290. Available from: <https://doi.org/10.1093/wbro/lkp008>.
- [2] AlDahdouh, A.A., 2019. Individual Learning Experience in Connectivist Environment: A Qualitative Sequence Analysis. *International Journal of Research in Education and Science (IJRES)*, 5(2), pp.488–509. Available from: <https://www.ijres.net/index.php/ijres/article/view/536>.
- [3] Allais, S. and Wedekind, V., 2020. Targets, TVET and Transformation. In: A. Wulff, ed. *Grading Goal Four: Tensions, Threats, and Opportunities in the Sustainable Development Goal on Quality Education*. Leiden, The Netherlands: Brill, chap. 15, pp.322 – 338. Available from: https://doi.org/10.1163/9789004430365_015.
- [4] Annamalai, N., 2019. Using WhatsApp to Extend Learning in a Blended Classroom Environment. *Teaching English with Technology*, 19(1), p.3–20. Available from: <https://eric.ed.gov/?id=EJ1204549>.
- [5] Awoke, Y.A. and Zikargae, M.H., 2023. Exploring the opportunities and challenges of social media use in teaching and learning processes at public universities in Ethiopia. *Cogent Education*, 10(2), p.2277558. Available from: <https://doi.org/10.1080/2331186X.2023.2277558>.
- [6] Azarian, M., Yu, H., Shiferaw, A.T. and Stevik, T.K., 2023. Do We Perform Systematic Literature Review Right? A Scientific Mapping and Methodological Assessment. *Logistics*, 7(4), p.89. Available from: <https://doi.org/10.3390/logistics7040089>.
- [7] Bloom, B.S., 1974. Time and learning. *American Psychologist*, 29(9), p.682–688. Available from: <https://doi.org/10.1037/h0037632>.
- [8] Braun, V. and Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), pp.77–101. Available from: <https://doi.org/10.1191/1478088706qp063oa>.
- [9] Dağlı, Ü.Y., 2019. Effect of increased instructional time on student achievement. *Educational Review*, 71(4), pp.501–517. Available from: <https://doi.org/10.1080/00131911.2018.1441808>.
- [10] Department of Higher Education and Training, 2014. *Building on Expanded, Effective and Integrated Post-School Education*. (White Paper for Post-School Education and Training 11). Available from: <https://www.gov.za/documents/white-papers/white-paper-post-school-education-and-training-building-expanded-effective>.
- [11] Department of Higher Education and Training, 2017. *Statistics on Post-School Education*

- and Training in South Africa: 2015. Pretoria: Department of Higher Education and Training. Available from: <https://tinyurl.com/bdens6up>.
- [12] Dintwa, T. and Sithole, B.M., 2021. Teachers and Students' Perceptions of Using Mobile Devices and Social Media in the Teaching and Learning of Business Subjects. *Journal of Emerging Trends in Educational Research and Policy Studies*, 12(3), pp.99–106. Available from: https://doi.org/10.10520/ejc-sl_jeteraps_v12_n3_a1.
- [13] Downes, S., 2007. Learning networks in practice. *Emerging Technologies for Learning*, 2, pp.19–27. Available from: <https://www.academia.edu/2869378>.
- [14] Duncheon, J.C. and Tierney, W.G., 2013. Changing Conceptions of Time: Implications for Educational Research and Practice. *Review of Educational Research*, 83(2), pp.236–272. Available from: <https://doi.org/10.3102/0034654313478492>.
- [15] Fredrick, W.C. and Walberg, H.J., 1980. Learning as a Function of Time. *The Journal of Educational Research*, 73(4), p.183–194. Available from: <https://doi.org/10.1080/00220671.1980.10885233>.
- [16] Gabelica, C., De Maeyer, S. and Schippers, M.C., 2022. Taking a free ride: How team learning affects social loafing. *Journal of Educational Psychology*, 114(4), p.716–733. Available from: <https://doi.org/10.1037/edu0000713>.
- [17] Gándara, P., ed., 2000. *The Dimensions of Time and the Challenge of School Reform*, SUNY series, Restructuring and School Change. Albany: State University of New York Press. Available from: <https://tinyurl.com/37ufxuet>.
- [18] Garrison, D.R., Anderson, T. and Archer, W., 2010. The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, 13(1), pp.5–9. Special Issue on the Community of Inquiry Framework: Ten Years Later. Available from: <https://doi.org/10.1016/j.iheduc.2009.10.003>.
- [19] Goldie, J.G.S., 2016. Connectivism: A knowledge learning theory for the digital age? *Medical Teacher*, 38(10), pp.1064–1069. Available from: <https://doi.org/10.3109/0142159X.2016.1173661>.
- [20] Habermas, J., 1984. *The theory of communicative action*, vol. 1 Reason and the rationalization of society. Boston: Beacon Press. Available from: <https://teddykw2.files.wordpress.com/2012/07/jurgen-habermas-theory-of-communicative-action-volume-1.pdf>.
- [21] Halcomb, E.J., 2019. Mixed methods research: The issues beyond combining methods. *Journal of Advanced Nursing*, 75(3), pp.499–501. Available from: <https://doi.org/10.1111/jan.13877>.
- [22] Ibrahim, A. and Mat Nashir, I., 2022. Demand-supply Mismatch in TVET Academic Programmes: What Is It and What Should It Be? *Journal of Technical Education and Training*, 14(2), p.177–189. Available from: <https://doi.org/10.30880/jtet.2022.14.02.016>.
- [23] Jackson, E.A., 2020. The Use of WhatsApp for Flexible Learning: Its Effectiveness in Supporting Teaching and Learning in Sierra Leone's Higher Education Institutions. *International Journal of Advanced Corporate Learning (ijAC)*, 13(1), p.pp. 35–47. Available from: <https://doi.org/10.3991/ijac.v13i1.11381>.
- [24] Jung, I., 2019. Connectivism and Networked Learning. In: I. Jung, ed. *Open and Distance Education Theory Revisited: Implications for the Digital Era*. Singapore: Springer, SpringerBriefs in Education, pp.47–55. Available from: https://doi.org/10.1007/978-981-13-7740-2_6.
- [25] Koole, M.L., 2009. A Model for Framing Mobile Learning. In: M. Ally, ed. *Mobile Learning*:

- Transforming the Delivery of Education and Training*. AU Press, chap. 2, p.25–47. Available from: <https://doi.org/10.15215/aupress/9781897425435.01>.
- [26] Latchem, C., ed., 2017. *Using ICTs and Blended Learning in Transforming TVET*. UNESCO and Commonwealth of Learning. Available from: <https://en.unesco.org/sites/default/files/247495eng.pdf>.
- [27] Lee, C.E., Chern, H.H. and Azmir, D.A., 2023. WhatsApp Use in a Higher Education Learning Environment: Perspective of Students of a Malaysian Private University on Academic Performance and Team Effectiveness. *Education Sciences*, 13(3), p.244. Available from: <https://doi.org/10.3390/educsci13030244>.
- [28] Leenaars, C., Tsaion, K., Stafleu, F., Rooney, K., Meijboom, F., Ritskes-Hoitinga, M. and Bleich, A., 2021. Reviewing the animal literature: how to describe and choose between different types of literature reviews. *Laboratory Animals*, 55(2), pp.129–141. Available from: <https://doi.org/10.1177/0023677220968599>.
- [29] Leino, K., Nissinen, K. and Sirén, M., 2022. Associations between teacher quality, instructional quality and student reading outcomes in Nordic PIRLS 2016 data. *Large-scale Assessments in Education*, 10(1), p.25. Available from: <https://doi.org/10.1186/s40536-022-00146-4>.
- [30] Mao, Z., Jiang, Y., Min, G., Leng, S., Jin, X. and Yang, K., 2017. Mobile social networks: Design requirements, architecture, and state-of-the-art technology. *Computer Communications*, 100, pp.1–19. Available from: <https://doi.org/10.1016/j.comcom.2016.11.006>.
- [31] Matshoba, R.M., 2019. *Investigating the articulation of National Qualifications Framework level 4 engineering vocational and academic qualifications with higher education qualifications*. Submitted in fulfilment of the requirements for the degree Magister Educationis. University of Pretoria. Available from: <http://hdl.handle.net/2263/76903>.
- [32] Mbolekwa, Z., 2021. *The role of WhatsApp in promoting academic peer support in TVET College programmes among students*. MEd ICT in Education. University of Johannesburg. Available from: <https://hdl.handle.net/10210/495951>.
- [33] Mesuwini, J. and Mokoena, S.P., 2023. TVET Lecturer Work-Integrated Learning: Opportunities and Challenges. *International Journal of Learning, Teaching and Educational Research*, 22(8), p.415–440. Available from: <https://doi.org/10.26803/ijlter.22.8.22>.
- [34] Moyo, T. and McKenna, S., 2021. Constraints on improving higher education teaching and learning through funding. *South African Journal of Science*, 117(1/2). Available from: <https://doi.org/10.17159/sajs.2021/7807>.
- [35] Muchleemann, S. and Wolter, S.C., 2020. The economics of vocational training. In: S. Bradley and C. Green, eds. *The Economics of Education: A Comprehensive Overview*. 2nd ed. Academic Press, chap. 40, pp.543–554. Available from: <https://doi.org/10.1016/B978-0-12-815391-8.00040-9>.
- [36] Nwokike, F.O., Ezeabii, I.C. and Oluka, S.N., 2021. Social Media: A Platform for Effective Instructional Delivery of Technical and Vocational Education and Training (TVET) Programmes. *International Journal of Education, Learning and Development*, 9(5), pp.37–47. Available from: <https://tinyurl.com/4ets54tt>.
- [37] Oviawe, J.I., Uwameiye, R. and Uddin, P.S.O., 2017. Bridging Skill Gap to Meet Technical, Vocational Education and Training School-Workplace Collaboration in the 21st Century. *International Journal of Vocational Education and Training Research*, 3(1), pp.7–14. Available from: <https://doi.org/10.11648/j.ijvetr.20170301.12>.

- [38] Peng, S., Yang, A., Cao, L., Yu, S. and Xie, D., 2017. Social influence modeling using information theory in mobile social networks. *Information Sciences*, 379, pp.146–159. Available from: <https://doi.org/10.1016/j.ins.2016.08.023>.
- [39] Rimal, I., 2023. Effectiveness of Vocational Training on Light Vehicle Mechanics in Underprivileged Children's Educational Programs, Nepal. *Journal of Technical and Vocational Education and Training*, 17(1), p.57–64. Available from: <https://doi.org/10.3126/tvet.v17i1.52419>.
- [40] Senden, B., Nilsen, T. and Blömeke, S., 2022. Instructional Quality: A Review of Conceptualizations, Measurement Approaches, and Research Findings. *Ways of Analyzing Teaching Quality*. Scandinavian University Press, chap. 5, pp.140–172. Available from: <https://doi.org/10.18261/9788215045054-2021-05>.
- [41] Siemens, G., 2005. Connectivism: A Learning Theory for the Digital Age. *International Journal of Instructional Technology and Distance Learning*, 2(1). Available from: http://www.itdl.org/Journal/Jan_05/article01.htm.
- [42] Suharno, Pambudi, N.A. and Harjanto, B., 2020. Vocational education in Indonesia: History, development, opportunities, and challenges. *Children and Youth Services Review*, 115, p.105092. Available from: <https://doi.org/10.1016/j.childyouth.2020.105092>.
- [43] Sutherland, K.S., McLeod, B.D., Conroy, M.A. and McCormick, N., 2022. Developing Treatment Integrity Measures for Teacher-Delivered Interventions: Progress, Recommendations and Future Directions. *School Mental Health*, 14(1), pp.7–19. Available from: <https://doi.org/10.1007/s12310-021-09423-z>.
- [44] Temple, A.L. and Mohammed, S.F., 2020. The Effect of Instructional Time Frequency on Middle School Students' Mathematics Achievement Scores. *International Journal of Research in Education and Science*, 6(4), p.705. Available from: <https://doi.org/10.46328/ijres.v6i4.1265>.
- [45] UNESCO, 2022. *Transforming Technical and Vocational Education and Training for successful and just transitions: UNESCO strategy 2022-2029*. Paris: UNESCO. Available from: <https://unesdoc.unesco.org/ark:/48223/pf0000383360>.
- [46] Vaughn, L.M. and Jacquez, F., 2020. Participatory Research Methods – Choice Points in the Research Process. *Journal of Participatory Research Methods*, 1(1). Available from: <https://doi.org/10.35844/001c.13244>.
- [47] Xue, S. and Churchill, D., 2020. Teachers' private theories and their adoption of affordances of mobile social media: a qualitative multi-case study of teachers' integration of WeChat in higher education in China. *Educational Media International*, 57(3), pp.208–232. Available from: <https://doi.org/10.1080/09523987.2020.1824421>.
- [48] Yende, S.J., 2021. Funding Opportunities and Challenges: A Case of South African Institutions of Higher Learning. *Journal of Public Administration*, 56(1), pp.70–79. Available from: <https://doi.org/10.10520/ejc-jpad-v56-n1-a6>.
- [49] Yuan, C.H. and Wu, Y.J., 2020. Mobile instant messaging or face-to-face? Group interactions in cooperative simulations. *Computers in Human Behavior*, 113, p.106508. Available from: <https://doi.org/10.1016/j.chb.2020.106508>.
- [50] Yusoff, R.M., Harun, A. and Zakaria, A.M., 2020. TVET in Malaysia: Capabilities and Challenges as Viable Pathway and Educational Attainment. *Journal on Technical and Vocational Education*, 5(1), pp.52–58. Available from: <http://upikpolimas.edu.my/ojs/index.php/JTVE/article/view/372>.