Optimising Computer Supported Collaborative Learning within Higher Education: Insights from Student Collaboration on Take-home Group Tasks in Uganda

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Abstract

The growth in computer-supported Collaborative learning (CSCL), especially in higher education, has attracted many research studies. However, there remains a paucity of empirical studies on *how* it can be taken up within higher education in real-world settings. This study, undertaken with undergraduate students in a Ugandan university, takes up Design Based Research, specifically using Google docs, to provide an empirical example, illuminating how teachers can optimise technology as informed by the SAMR model in order to support Collaborative learning towards the attainment of higher order thinking skills. The study generated some design principles which can be used to inform CSCL. These principles, undergirded by the imperative for teachers to support learners in CSCL, include the provision of a feedback loop to enable learner support; designing in ways that cater for diverse learner styles; tracking and rewarding student contributions; supporting learners to explore and optimise the affordances of tools to complement each other as well as using technology in ways that allow for progression in students' thinking as well as in their technological skills. The study has implications for teacher training, particularly the inclusion of technology as a key component in solving educational problems within their practice. Specifically, teacher education programmes should ground pre-service and in-service teachers in theoretical frameworks which can support their practice.

Keywords: Design-Based Research; Computer-supported Collaborative Learning; SAMR model; educational technology; Uganda

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Introduction

Collaboration, as Laal, Laal and Kermanshahi affirms, "has become a 21st-century trend" (2012, p. 1699), given the need for society to work together on multi-disciplinary issues of critical concern, shifting the emphasis from individual to group effort/interdependence. Collaborative learning (CL) is an educational approach involving learners working together to solve problems, complete tasks, and/or create products. It is learner Centred, with the teacher as facilitator, and learners as active participants in small group activities, taking responsibility for their learning and building societies as well as team skills through the give-and-take of consensus-building (Chen, Jones, & Xu, 2018; Van Leeuwen & Janssen, 2019). CL is situated within the tradition of theories such as the Zone of Proximal Development (ZPD) (Vygotsky, 1930/1978); Communities of Practice (COP) (Lave & Wenger, 1991); Group Cognition (Stahl, 2005) and Activity Theory (AT) (Engestrom, 1987), which conceive of learning as social, inter-subjective and inter-psychological.

The proliferation in the use of technology to support CL has attracted a growing number of research studies, leading to the emergence of Computer Supported Collaborative Learning (CSCL) as a field of study (Jeong, Hmelo-Silver, & Jo, 2019; Long, Nah, Eschenbrenner, & Schoonover, 2013). CSCL refers to using ICTs to facilitate asynchronous and synchronous group-learning activities (Chen, Wang, Kirschner, & Tsai, 2018). Research has linked Collaborative tasks to student engagement in knowledge construction; critical thinking and problem-solving; learner achievement and satisfaction; social skills, and self-esteem (Fu & Hwang, 2018; Maqtary, Mohsen, & Bechkoum, 2019). Moreover, CSCL has affordances for monitoring student input in Collaborative learning activities (Holliman & Scanlon, 2006) and overcoming the limitations of time and space to improve learning outcomes (Lipponen, Hakkarainen, & Paavola, 2004). These positive benefits of CSCL, however, call for sound instructional design.

Indeed, as Resta and Laferrière (2007) affirm, the growing use of CSCL has raised questions regarding its effectiveness as an approach to teaching and learning. Secondly, while there is a proliferation in the development of instructional goals that target higher-order thinking and problem-solving as driven by constructivist approaches (Dirckinck-Holmfeld, 2002; Hmelo-Silver, 2004), there remains a paucity of research on how to achieve this using technology. Thirdly, as Resta and Laferrière (2007) point out, research is needed on the uptake of CSCL within higher education in real-world settings to identify both barriers and facilitators in using CSCL to support learning. Moreover, the focus on CL, as a 21st Century skill, is timely given its possibilities in preparing learners for working life (Laal, Laal, & Kermanshahi, 2012). Against this background, this study took up action research to demonstrate how CSCL can be used to attain high-order thinking while also Optimising the use of technology.

Context of the Study

The government of Uganda recognises the importance of Information and Communication Technology (ICT), evidenced in the enabling policy framework established to support the institutionalisation of ICTs. ICT was recognised as a key priority thematic area in national development within the Comprehensive National Development Planning Framework (CNDPF) 2007 as well as Uganda Vision 2040. Further, the establishment of the Ministry of Information and Communications Technology (MoICT) in 2011; the Uganda Communications Act in 2013; The National ICT Policy (2014), as well as the launch of the Information and Communications Technology Sector Strategic and Investment Plan (ICT- SIP, 2015/16 – 2019/20) illuminates government's prioritisation of ICT towards national development (Lubaale, 2020). The ICT-

SIP (2015/16 – 2019/20) aims to accentuate service delivery and consequently social-economic transformation through utilisation of quality and affordable ICT services in all spheres of life, including education.

Higher institutions of learning in Uganda are at the forefront of implementing the integration of ICT in education. Indeed, the Ministry of Information and Communications Technology (2014) policy obligated universities to develop ICT Workforce through research and practice, amongst others. In Uganda, there are eleven (11) public universities, thirty-eight (38) private universities, four (4) military universities and three (3) other degree-awarding institutions. The Ministry of Education and Sports (MoES) in Uganda has promoted the integration of ICT in education as an academic subject, a teaching/learning aid, and a device for effective school administration and management (Nambi, 2018). Higher education institutions in Uganda such as Makerere University, Kyambogo University, Makerere University Business School, Mbarara University of Science and Technology, Muni University, Gulu University, and Uganda Management Institute have taken up educational technology as means to increase student enrollment, access and quality of education (Ali, Buruga, & Habibu, 2019). However, the optimisation of ICT has been hampered by low bandwidth, unstable internet, poor ICT infrastructure in terms of hardware, electricity and other inter-connectivity devices, as well as inadequate ICT competence level (Ochwo, Atibuni, & Sekiwu, 2018; Paul, Musa, & Nansubuga, 2015). These challenges have impacted the uptake of ICTs within higher education in Uganda.

While there has been a proliferation of studies on the uptake of ICT within institutions of higher education in Uganda, the focus has been largely on users' attitudes towards ICT as well as challenges inhibiting its use (Ali et al., 2019; Bakkabulindi, 2012; Mugizi & Nagasha, 2023; Zhu & Mugenyi, 2015). Consequently, there is a dearth of research on how ICT is used in real-life classrooms within higher learning institutions in Uganda, which could provide exemplars of best practices.

It is within this contextual background that, as teacher educators, we share our experiences of integrating ICT to support teaching and learning within a Ugandan university. Particularly, we provide an empirical example regarding using CSCL within higher education, to support take-home group tasks, towards both the attainment of high order thinking skills and the optimisation of the use of technology.

Objectives of the Study

The following objectives informed the study:

i) To demonstrate how CSCL can be taken up to support performance on take-home group tasks in a higher learning institution in Uganda.

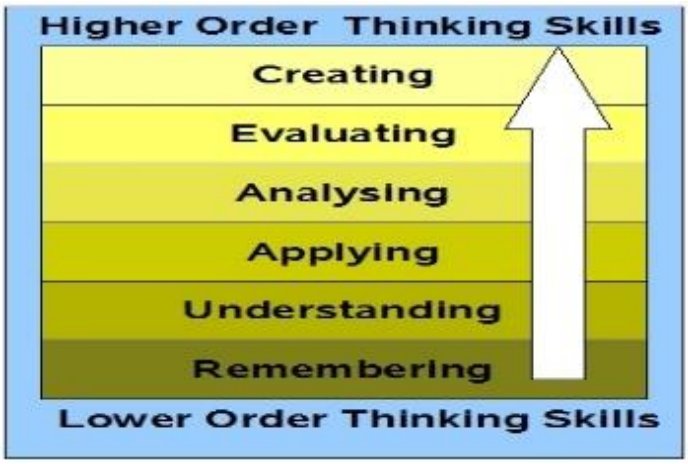
ii) To illustrate how CSCL can be used towards attaining higher-order thinking skills using take-home group tasks in a higher institution of learning in Uganda.

iii) To show how CSCL can optimise the use of technology to support take-home group tasks in a higher institution of learning in Uganda.

In the following sections, we explain the theoretical underpinnings that informed the study. This is followed by the method leading to the implementation of the CSCL intervention, highlighting the design principles that emanated from using CSCL to support take-home group tasks. Finally, we conclude the paper with a critical reflection on the implications of the study for teacher education as well as classroom practice.

Theoretical Underpinnings

The study set out to provide an empirical example as regards using CSCL within higher education towards both the attainment of high-order thinking skills as informed by Bloom's Taxonomy of educational objectives (Churches, 2010), as well as the optimisation in the use of technology, as informed by the SAMR model (Puentedura, 2006). Bloom's Taxonomy of educational objectives categorises thinking skills along a spectrum from lower-order thinking skills (LOTS) to higher-order thinking skills (HOTS) (Churches, 2010). This lens made it possible to track the progression of take-home group tasks using CSCL from LOTS to HOTS.



+Fig. 1 Bloom's Revised Taxonomy (Churches, 2010, p. 4)

The SAMR model (Puentedura, 2006), on the other hand, provided a lens to track the optimisation in the use of technology in addressing the take-home group tasks using CSCL from simple to more complex ways. It provides a framework to support educators in creating optimal learning experiences using mobile devices. The model includes four levels of technology integration (Substitution, Augmentation, Modification, and Redefinition). According to Hockly (2013), *Substitution* is the most basic enactment, where technology replaces a traditional learning tool, such as using WhatsApp instead of a blackboard to post an assignment. *Augmentation* goes beyond Substitution by using the other functions of technology, for example, to attach files, import videos, insert images, and copy and paste links using the Whatsapp platform. At *Modification***,** technology allows for redesigning the learning activity, for example, from brainstorming into an essay writing activity. *Redefinition* then extends the task by creating a new one that could not have been undertaken without technology. The SAMR model made it possible to track the optimisation in the use of technology from simple (Substitution) to more complex ways (redefinition).

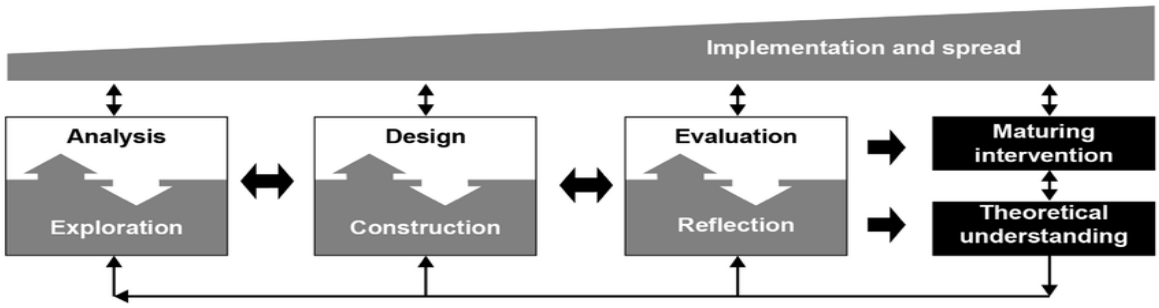
Method and Implementation: Design-based Research

Design-based research (DBR) is a systemic approach to planning and implementing innovations that emphasise an iterative approach to design with ongoing Collaboration with practitioners

(OH, 2011; Reeves, Herrington, & Oliver, 2005). DBR requires Collaboration to develop solutions to practical problems in learning environments with the identification of reusable design principles. The solutions that result from DBR "can be educational products (e.g., a multi-user virtual world learning game), processes (e.g., a strategy for scaffolding student learning in online courses), programmes (e.g., a series of workshops intended to help teachers develop more effective questioning strategies), or policies (e.g., year-round schooling)" (Huang, Spector, & Yang, 2019, p. 181). DBR was relevant for this study given its propensity to solve significant real-world problems, simultaneously seeking to discover new knowledge to inform the work of others with similar problems (Spector & Yuen, 2016).

DBR comprises three phases (see Figure 1): The first phase is analysis and exploration. It entails problem identification and/or diagnosis in consultation with practitioners. The phase generated a clear understanding of the problem within the specific context. The second phase is design and construction. It includes details of the implementation of the proposed intervention. This phase generated a justification for design principles. Finally, the third phase is evaluation and reflection. The phase generated the results of empirical findings and critical reflection on the design principles developed to inform scholarship and the practices of others in the field.

Fig. 2 A generic model for conducting design-based research (McKenney & Reeves, 2012)



Phase 1: Analysis and Exploration

This study was initially motivated by the researchers' reflections on our experiences as lecturers at a private university in Uganda. The large class sizes, typically with ratios of 1 teacher to 120 students per class, as well as the inadequate 3-hour contact time per week, necessitated blended learning, in which some learning tasks were engaged outside the face-to-face (f2f) sessions. The University supported blended learning—albeit limited- by providing wireless Internet connectivity, computer labs, and a Learning Management System (LMS). Some students also had access to personal technologies such as mobile phones, tablets and computers. Learning as such entailed both f2f as well as take-home tasks, with students working both individually as well as Collaboratively in groups.

The inefficaciousness of the group take-home task was the focus on our brainstorming as lecturers. We observed that while learners performed well on individual and group f2f tasks, their performance on group take-home tasks was generally poor. The presentations on the group tasks were thin on content depth and breadth and lacked academic rigor. It was commonplace, for example, for the students to present work devoid of illustrations and/or references. Incomplete

assignments also dominated, coupled with appeals for extensions of submission dates. As one student intimated, this could be attributed to their diverse living arrangements, with some living within university accommodations and others as non-residents. This, as she explained, coupled with the incompatible after-school work schedules, frustrated efforts on take-home group tasks. These issues consequently compromised the blended learning design, as the group tasks failed to complement f2f sessions towards student engagement and syllabi coverage.

The primary focus of this study was to establish ways of supporting learners on Collaborative learning group tasks to produce complete after-class tasks. In establishing the magnitude of this problem, as commended in DBR (Amiel & Reeves, 2008), we consulted other practitioners/ lecturers within the English department (in which we situated the study as expounded later).

Consultation with Practitioners

We consulted with three out of the seven lecturers in the Department—Charlie, Lauren and Linda (all pseudonyms) who volunteered to participate in the study. All three were lecturers in the English Department.

Table 1: Summary of the lecturer characteristics

No.	Name	Sex	Age	Highest qualification	Position	Teaching experience	Technological competence
1.	Charlie	Male	50-55	MA (Education)	Lecturer	15 years	Proficient
2.	Lauren	Female	60-65	PhD (Education)	Professor	20 years	Intermediary
3.	Linda	Female	40-50	PhD (Curriculum)	Lecturer	12 years	Proficient

These colleagues concurred that there was a disparity in academic rigour between f2f group and individual vs group take-home tasks. Charlie particularly expressed concern asserting, “When students have groups, very few do the work.” Charlie explained this demotivates those who would have wanted to give the work their best effort—”as they feel the rest is using them.” As he explained, “they either do not finish in time, or they rush and therefore do shoddy work.” Linda corroborated this, affirming that she was more satisfied with individual than group output. She explained that some students’ names appeared on a couple of group assignments, indicating that they simply asked their classmates to append their names to the work, even if they had not participated. Lauren also explained that in contrast to group work, students’ individual work was done effectively, and students generally beat the assignment deadlines.

Additionally, as a class coordinator/student leader intimated to Lauren, “the bright students do not contribute much to group discussions because they do not want to share their knowledge.” She explained an incident when one of her students, who had participated in a group assignment, also submitted an individual paper on the same task, which, as Lauren explained, was “much richer than the group paper.” Some students have attributed their poor performance on group tasks, as Lauren explained to ideas that “some groups are not good for them…they are incompatible… they have different living arrangements.” She affirmed, “in fact, there is a problem with take-home group work, and I intentionally avoid it.”

To ensure that all group members contribute to the work, Charlie explained that he always warned students to refrain from appending the names of those who had not participated in group tasks. He also encouraged “whistleblowers” to report cases where a non-participant’s name was appended to group work. He explained, however, that this had not worked, as students did not

provide him with this feedback. Lauren's strategy for group work was for students to work in groups of two—"a dual partnership", as she called it. She explained that the presentations of such work demonstrated the synergy of Collaboration.

In suggesting what practitioners should do to encourage Collaboration on after-school group tasks, Charlie castigated practitioners for the assumption that students can work in the groups assigned to them. He gave an example of incompatible individuals who work individually within a group— "you find them working in the same space, but each doing the work on their own." Students, in his opinion, "should have a say in the groups to which they are supposed to work." Linda reiterated this by explaining that her own practice had been letting the students choose their group. Charlie added that students were unprepared to Collaborate and/or work as a team. He blamed it on the current culture, which supports competition—"The selfishness and individualism in their upbringing paralyze interdependency". Lauren echoed this, attributing the inadequacy of Collaborative learning to the educational background in schools, which encourages competition rather than Collaboration— "the teacher rarely forms Collaborative groups—the learners do not get to experience it…Students do not know what to do."

As to whether technology can offer a useful intervention in supporting Collaborative learning, Charlie emphatically affirmed that it would make the work easier if students had access to and knowledge regarding how to use it. He warned about the challenge of adapting to change and the dearth of skill in using technology. He also mentioned the incapacitation of our educational institutions in terms of resources to purchase technology. Linda also supported using technology as an intervention, explaining that the presence of researched/scholarly exemplar lessons would be invaluable in guiding teachers on how to support learners regarding using technology to facilitate learning.

Similarly, Lauren affirmed that technology would most certainly support Collaboration, making it possible for students to contribute to assignments at different times— "they can Collaborate wherever and whenever." In using her own experience, she explained how one student had done his presentation at 10:00 pm; two others gave feedback by noon; others commented in the morning; and, by the fourth day, all the students had commented on the presentation, beating the deadline given by the teacher. Lauren confirmed then that technology made it possible to "work Collaboratively from wherever, whenever!" She explained, however, that access, coupled with the instability of Internet and power connections, could pose challenges to using technology to support Collaborative learning. Further, she raised what she refers to as a pertinent question: "are the teachers trained to support students to learn Collaboratively using education technology? To what extent can a teacher encourage a pedagogical approach at which he/she is not competent?"

Following the findings from the interviews, we confirmed the magnitude of poor performance on take-home group tasks and identified the possibility of taking up technology, particularly CSCL, to address the gap.

Phase 2: Design and Construction

This phase involved the implementation of the proposed intervention. The scholarship on Collaborative groups (Graham, 2002; Hathorn & Ingram, 2002; Zhang & Ge, 2006)informed the selection of a technological tool with affordances for CSCL. Following recommendations from this scholarship, therefore, we selected Google docs for the intervention, given its affordances for equal participation, interaction, interdependence, independence from the teacher, accountability, development of group skills, communication, and peer relationship. Google docs can also be optimised from simple Substitution to complex redefinition to support the transformation of

learning from LOTS to HOTS. Additionally, Google docs are accessible on the University LMS. Moreover, the learners' considerable exposure and access to technologies can be leveraged to support Collaborative learning using Google docs. Indeed, standard technologies were leveraged to encourage 21st-century learners to appreciate and learn (Prensky, 2001; Sebbowa, Ng'ambi, & Brown, 2014).

Intervention: Implementing Google docs as a tool for CSCL

The intervention was implemented during the second semester within "English Stylistics", a core course for all 2nd year Bachelor of Education students at the selected University. These pre-service teachers were in the penultimate year of their teacher education programme. English Stylistics was timetabled for three hours once a week for 16 weeks. The course's main objective was to equip students with skills to conduct literary analyses, mainly undertaken through critical appreciation of poetry and prose.

Our study provides a snapshot of CSCL, focusing on two groups that volunteered to participate. The groups comprised four students in one group and 3 in the second; 3 male and four female, ages 20-25, all in their second year of a bachelor's degree in education.

Table 2: Characteristics of the student participants

No.	Name	Sex	Age	Programme of study	Year of Study
1.	Giovani	Male	20-25	BA (Education)	2nd
2.	Concepta	Female	20-25	BA (Education)	2nd
3.	Catherine	Female	20-25	BA (Education)	2nd
4.	Phoscah	Male	20-25	BA (Education)	2nd
5.	Cate	Female	20-25	BA (Education)	2nd
6.	Janice	Female	20-25	BA (Education)	2nd
7.	Gerald	Male	20-25	BA (Education)	2nd

Procedure of Intervention

Implementing the intervention using Google docs comprised four phases, corresponding to the SMAR model. This framed the optimisation in the use of technology from simple Substitution to complex redefinition and informed progression from LOTS to HOTS. The ongoing evaluation enacted during each step of the intervention is lauded as Pombo and Moreira (2012) affirm that evaluation "during task development rather than solely at the end of the programme, gives a more thorough and multi-faceted evaluation which in turn ensures the overall quality of the course" (as cited in Bowyer, p. 19). Through the evaluation, design principles culminated from each phase of the intervention.

Phase 1: Substitution

This required the learners to complete tasks Collaboratively by typing responses into a Google doc. This correlated to *Substitution* (from the ***S***AMR model), through which Google docs replaced exercise books and/or blackboards. The students, required to Collaboratively make notes to show their understanding of the term "Stylistic Devices", outlined the aspects associated with it, including "themes", "diction", "allegory", "tone", "exaggeration", and "personification." Our analysis of the student notes posted on the Google doc located the use of technology within Substitution. The learners posted their notes on the Google doc in the way notes are posted on

whiteboards and/or blackboards within a traditional learning model. Additionally, within Bloom's taxonomy of thinking skills, the task to which they responded had elicited "remembering," which is a lower-order thinking skill.

In retrospect, while the students had assured us that they had used Google docs before, we took up about 20 minutes explaining and demonstrating how they should post their work. This notwithstanding, we received some WhatsApp messages from some requesting more clarity on how to post the assignment. We responded by sending a step-by-step guide on posting their responses using Google docs. The provision for open communication between teachers and learners, through WhatsApp's affordance of timely communication, made it possible for the teacher to support students by clarifying the guidelines for using Google docs. Indeed, instant messaging has been used as an alternative e-communication tool to coordinate as well as support learning (Ling, 2004; Wang, 2010).

Phase 1 of the intervention, therefore, generated a design principle for Optimising CSCL:

> It is important to create a provision for an instant and/or timely feedback loop between teacher and students as well as among students in designing for computer-supported Collaborative learning.

Indeed, as Laurillard (2008) reminds us, access to educational technologies such as Google docs, in this case, is not sufficient in itself. Teacher support is as such critical for facilitating learning.

Phase 2: Augumentation

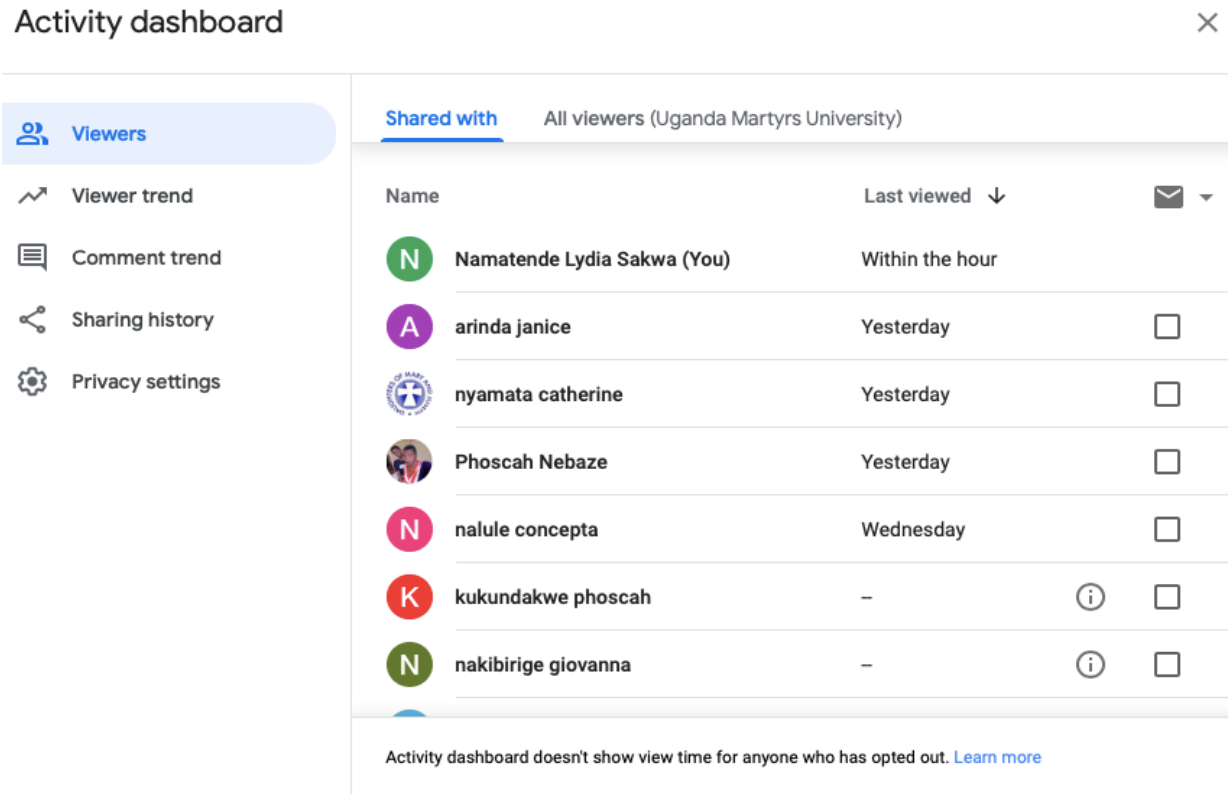
This phase involved using other functions of Google docs, such as attaching files, images, and links to enrich student output in the group take-home task. This correlates to *augmentation* (on the S*A*MR model). The students were asked to enrich the notes on Google docs using images, links and videos. This required additional guidelines for inserting images, links and videos. This accentuated the complexity in both the use of Google docs as well as in the level of thinking skills towards deeper understanding as supported by the use of illustrations. Using multiple (rather than a single) modes of illustration was made possible by using other functions to produce links, videos and images catered for more diverse learner styles and accentuated CSCL.
This phase, therefore, generated a design principle:

> It is important to create options for the use of multiple modes of expression such as audio, videos and audio-visual to cater to diverse learner styles in designing for computer-supported Collaborative learning.

In reflecting on this phase, we analysed the Google docs for evidence regarding knowledge and/or skills attained so far in using Google docs for CSCL. The document showed progression in students' use of Google docs to perform more complex tasks, such as attaching files, images, and links to the presentations demonstrating *augmentation*. Nonetheless, although a demonstration of deeper engagement with the task, their presentation was devoid of evidence that all the students had taken part in the Collaborative task: How was I to ensure that it was indeed "Collaboration" in which all the students had had an input? In grappling with this, I used Google docs' affordances for tracking participation by keeping logs (see Figure 3).

Fig 3. Tracking student participation

This informed the design of yet another design principle:



> In order to motivate computer-supported Collaborative learning, there should be a tracking system to monitor participation and a reward system to motivate the quality of contributions.

Indeed, scholars advise that closely monitoring how students work together in a Collaborative learning process is crucial for effective learning as it helps keep them on track (Chan & van Aalst, 2004; Wang, 2009). Further, as Chen and DeBoer (2015) affirm, making online tasks compulsory or contributing to a student's final grade is likely to increase engagement by offering higher extrinsic motivation.

Phase 3: Modification

This phase involved the use of Google docs to create new tasks. It correlates to *Modification* (on the SA*M*R model). The task required students to apply concepts learned in order to identify the different elements of style in two poems ("Building the Nation" by Henry Barlow and "A

Freedom Song" by Marjorie Oludhe Macgoye). This brainstorming activity, represented using two mind maps, elicited "application", a higher-order thinking skill, given that the students drew mind maps demonstrating the application of concepts learned so far. The first mind map (from Group 1) was drawn using tools from Microsoft Word and then shared with us as an attachment to an email (see Figure 4). The second mind map, on the other hand (from Group 2), was drawn using pen-and-paper and posted on the group's WhatsApp platform (see Figure 5).

Fig. 4 Group 1 Mind map showing the application of concepts

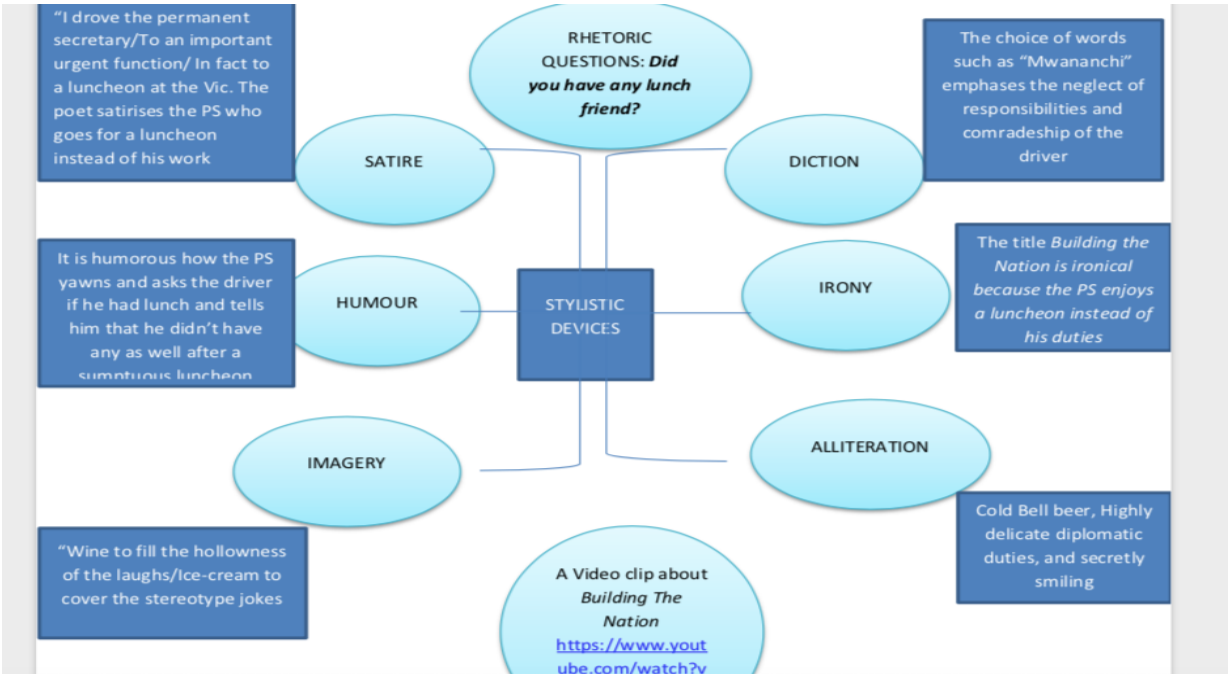
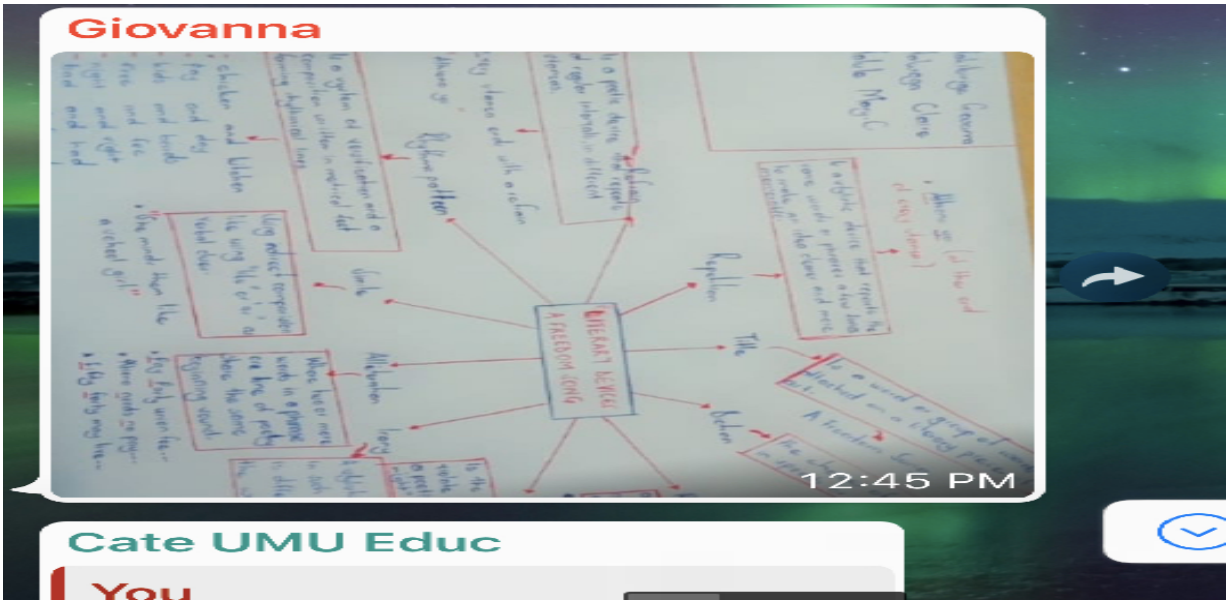
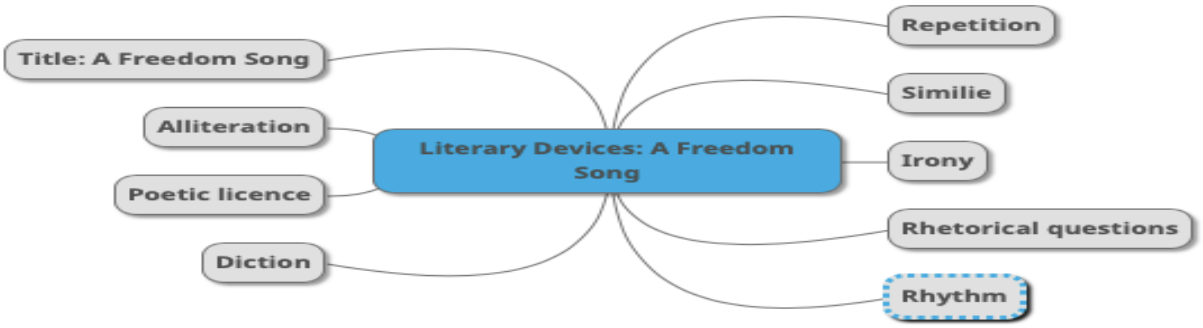


Fig. 5 Group 2 Mind map showing the application of concepts



The students' use of Microsoft Word and the traditional pen-on-paper drawing to represent their mind maps was a pointer to gaps regarding Optimising the use of Google docs. For example, Google docs could have been synced with Mind Map to produce the graphic representations of the group brainstorming activities. Therefore, I provided guidelines on using Mindmap as an example tool that can be synced with Google docs. Following these guidelines, the pen-on-paper group revised their mind map (see Figure 6).

Fig. 6 Using Mind Map to complement Google docs



This culminated in yet another design principle:

Learners should be supported to explore and optimise the affordances of given tools and to use various tools to complement each other to support computer-supported Collaborative learning.

Indeed, Wang's (2010) findings on using online spaces to support Collaborative learning corroborate this, recommending that several ICT tools be integrated into a shared workspace to monitor the learning process, share information, work on the same web page, collect feedback and maintain the page history.

The students were then required to use the mind map activity to inform the writing of analytical essays illuminating the literary style of the two poems. The phase also elicited "analysis"—a higher-order thinking skill. The students Collaborated in the messiness of writing a group essay.

A reflection of this phase through the analysis of student work-in-progress within Google docs was eye-opening as regards how much students had acquired skills in Optimising the use of Google docs. Specifically, the students used icons such as "add comment", "suggestions become edits", "accept suggestion", "reject suggestion", "mark as resolved", "reply", "show more", "link to this comment", in their back-and-forth communications with each other.

Phase 4: Redefinition

This phase involved morphing the task from analytical essay writing to a more complex evaluative peer review task. This correlates to *redefinition* (on the SAM***R*** model). Google docs had not only been to redefine the task but also to elicit evaluation—a higher-order thinking skill. The task involved using the icons on Google docs for peer review. Group 1 and Group 2 provided feedback to each other (see Figure 7).

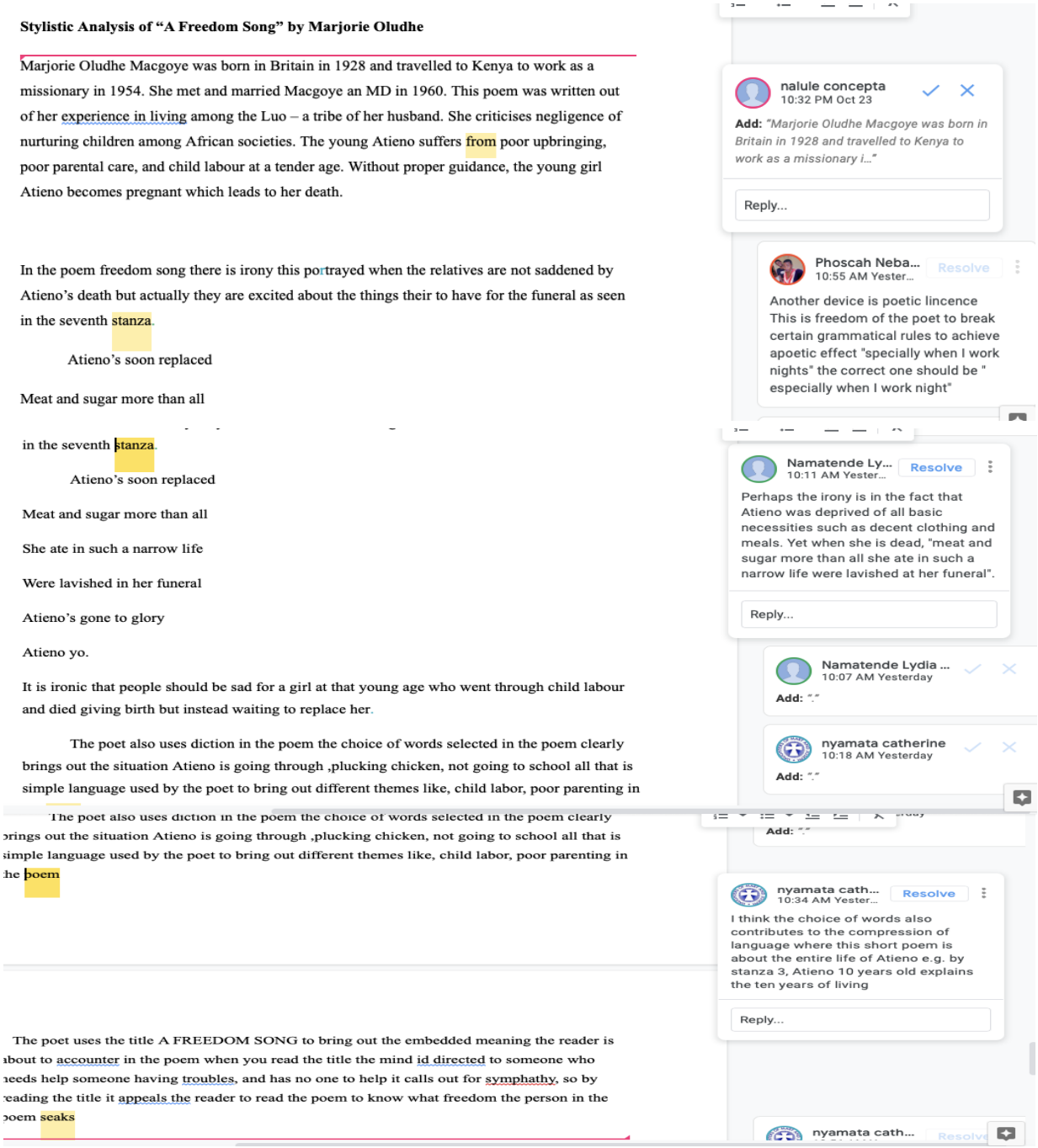


Fig. 7 Optimising Google docs for peer review

This phase, therefore, generated another design principle:

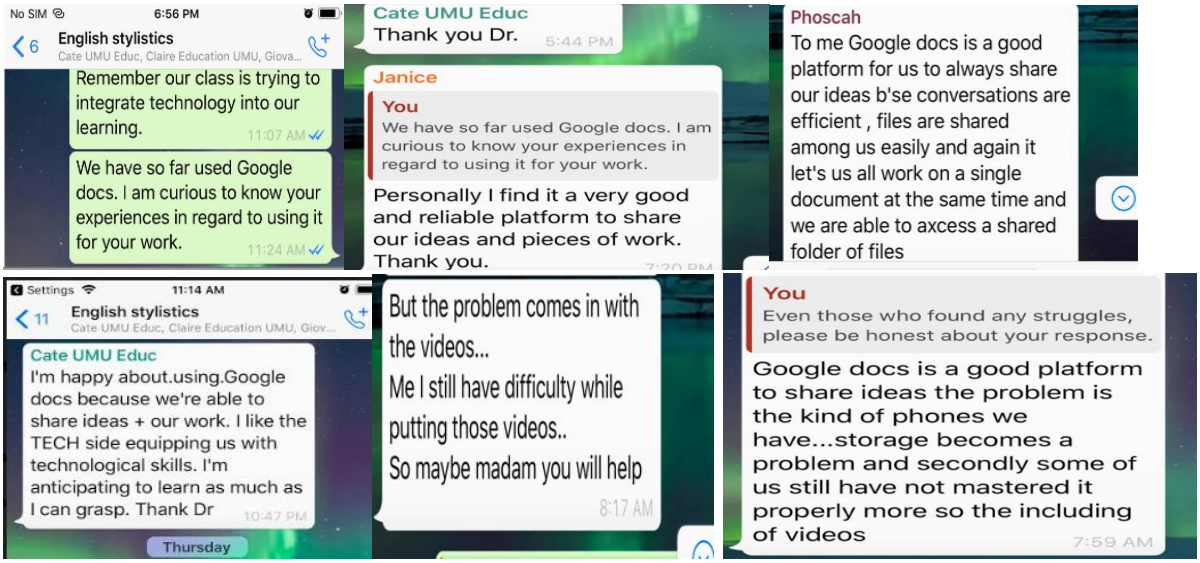
> Collaborative group work should optimise the technologies in question towards transformative learning.

Evaluation and Reflection

Scholars within education technology have commended the use of affective evaluation to check student experiences with online learning (Dabbagh & Bannan-Ritland, 2005; Shee & Wang, 2008; Sun, Tsai, Finger, Chen, & Yeh, 2008). Indeed, as Dabbagh & Bannan-Ritland (2005) affirm, "ensuring a positive reaction to the online learning experience is important for supporting

learning…a positive reaction to learning or training materials may not guarantee to learn, but a negative reaction can reduce learning" (p. 249). Therefore, we asked students to share their experiences regarding working on group take-home tasks using Google docs (see Figure 3).

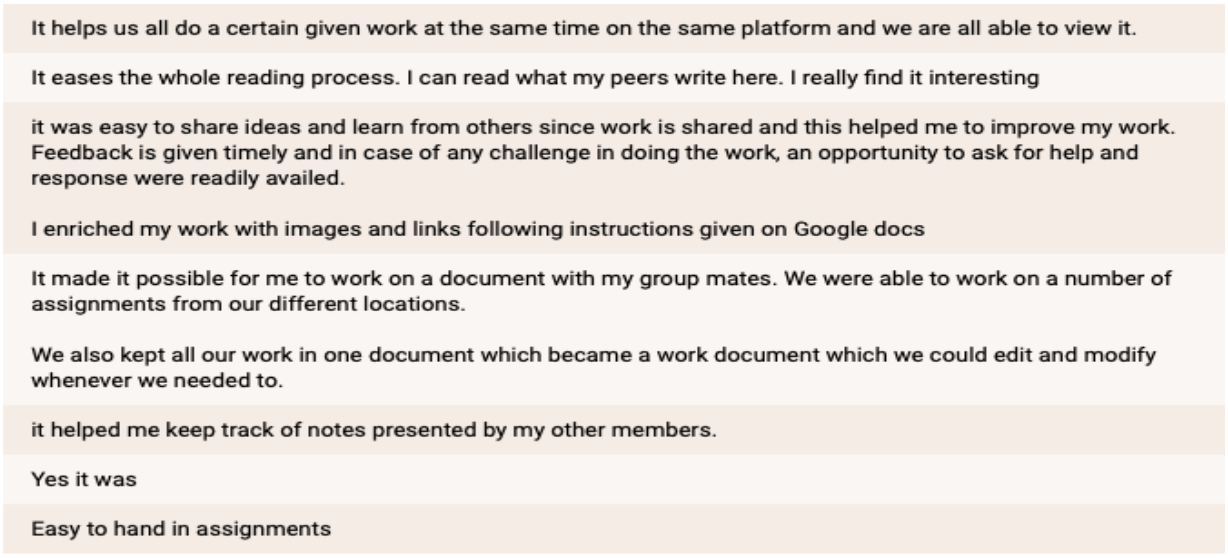
Fig. 8 Student experiences of using Google docs on a task



While the students generally applauded Google docs as useful for sharing ideas and documents and equipping them with computer skills, some expressed difficulty with uploading videos. There was also a concern regarding the limited storage capacity of students' phones, which illuminated a limitation of using Google applications on phones to support the bulk of CSCL. Some students complained about the slow Internet connectivity, which slowed them down, especially when they worked synchronously on the Google doc.

We also shared a Google form to evaluate the learners' overall experience with using Google docs to Collaboratively complete group after-school tasks: Six out of seven students had enjoyed using Google docs to a great extent (see Figure 9).

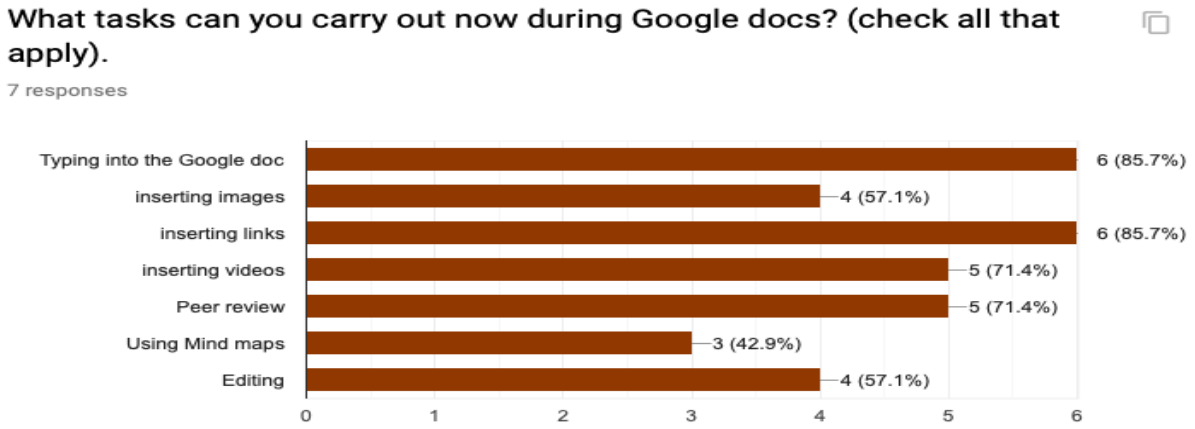
Fig. 9 The usefulness of Google docs to students' Collaborative learning



Further, most students initially struggled with some functions of Google docs, such as inserting

videos and drawing mind maps: 6 out of 7 could only use it to post assignments; 2 out of 7 could use it to insert links, peer review and make comments; 1 out of 7 could use it to insert images, videos, edit and draw mind maps. However, after the intervention, there was evident growth in Optimising Google docs to support group take-home tasks (see Figure 10).

Fig. 10 Improved optimisation of Google docs to support group Collaborative learning



Finally, we raised questions on student self-perception regarding the use of the tool. As Oliver & Harvey's (2002) research on the meaning of "impact" in evaluating learning technology explained, self-perception is another indicator of behaviour change. Most of the students (5 out of 7) rated themselves highly in their ability to undertake Collaborative work using Google docs. Indeed, 5 out of 7 students agreed that they would use Google docs to undertake other assignments. This indicates the possibility of transferring their skills to support learning in other contexts. Finally, 6 out of 7 agreed that using Google docs had made Collaborative work on group tasks more effective.

Conclusion

In addressing the pervasive gaps in performance on take-home group tasks, Google docs were taken up as an intervention for computer-supported Collaborative learning, given its affordances for Collaboration. The progression in students' engagement from lower-order to higher-order thinking skills and their optimisation of technology from simple Substitution to complex redefinition was informed by Bloom's Taxonomy of Educational Objectives and the SAMR model, respectively. This has implications for teacher training as regards the inclusion of technology as a key component in solving educational problems within their practice. Specifically, teacher education programmes should ground pre-service and in-service teachers in the theoretical frameworks which can support their practice. In this study, for example, our engagement with the Conversational Framework (Lauriallard, 2008), the SAMR model (Puentedura, 2006) and Bloom's taxonomy (Churches, 2010), provided a lens for systematically taking up computer-supported Collaborative learning to address an educational problem.

The study also has implications for the use of technology in practice. Teachers should intentionally use technology to optimise its affordances, equipping their students with more complex technical skills and heightening learning from lower to higher-order thinking skills. This methodical and/or planned progression will likely make learning more transformative.

The design principles developed during the intervention were undergirded by the imperative for teachers to support and monitor learners in enacting computer-supported Collaborative learning. The implementation process was underpinned by constant communication and feedback between the teacher and learners and between learners—to support the teaching-learning process, as Laurillard (2008) recommended in the Conversation Framework. The study generated design principles that should inform CSLC, including the provision for a feedback loop to support communication; designing the learning in ways that cater for diverse learner styles; tracking and rewarding student contributions; supporting learners to use various tools to complement each other to Optimising their affordances as well as Optimising technology towards transformative learning.

Finally, researchers within educational technology should provide exemplars of best practices grounded in theory and practice, to which teacher education programmes should expose teachers to provide possibilities for using technology to support their own teaching and/or learning.

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