Covid-19: Interdisciplinary Explorations of Impacts on Higher Education

Editors:

Tennyson Mgutshini, Kunle Oparinde and Vaneshree Govender

7

APPLYING CONSTRUCTIVISM THEORIES TO ONLINE TEACHING AT THE DURBAN UNIVERSITY OF TECHNOLOGY

T.P. Govender and O.O. Olugbara

Introduction

The influx of the coronavirus 2019 (Covid-19) disease that originated from Wuhan in China has compelled millions of people into undesirable lockdown, created infelicitous hiatus and untimely deaths worldwide. The World Health Organisation (WHO) declared the disease a pandemic. In an attempt to curb the spread of the infectious disease, institutions of higher learning across the globe have moved swiftly into the realm of emergency remote teaching (ERT), learning and research (Gewin, 2020; Sahu, 2020). Conventional face-to-face teaching has now been replaced with equivalent online teaching. Students, academics, researchers and managements have been struggling with the transition to online teaching. In a short span of time, the Covid-19 pandemic has highlighted the need for educational institutions to strengthen their practices in the design of curriculum and use of technology for innovative practices of education (Toquero, 2020).

Durban University of Technology (DUT) went into the highest level of lockdown declared by President Cyril Ramaphosa of South Africa on 27 March 2020. Students at the university were released from their lectures and requested to return to their homes. The movement of students out of university premises, residences and back to rural settlements has brought about a set of intrinsic challenges. Students had limited

or no internet access or no suitable devices to access ERT resources. DUT has tended to focus on resolving the issues associated with network connectivity, given the wide disparity between the connected urban students and unconnected rural students. A strong emphasis has been on providing students and staff with data bundles and computer devices to seamlessly shift to online teaching. It is understandable that a small number of students and staff are resistant to the measures of online teaching. However, there was a consensus that academics from institutions of higher learning cannot return to the full lecture halls because of the seriousness of the Covid-19 pandemic. This implies that higher education institutions in South Africa were confronted with the intrinsic challenge of ensuring the successful completion of the 2020 academic year in a sustainable way.

South Africa cannot afford to forfeit the 2020 academic year to Covid-19 as the country is ranked one of the most unequal societies in the world (Webster, 2019; World Bank, 2019). Whilst the national planning commission (NPC, 2012) for the country is ambitious with its 2030 vision for post-school education, the higher education landscape of the country mimics the historic past of the apartheid regime that has created wide inequality in all spheres. This inequality, as posited by Graven (2013) and Letseka and Maile (2008), has contributed to unequal educational opportunities for students from different socio-economic backgrounds. The Covid-19 pandemic has reinforced, strengthened, and exacerbated the chauvinism of unequal educational opportunities for students, which is more so of the existing bigotry between rural and urban students. The remnants of the country reinforce the notion of students in rural communities having disproportionate access to basic internet connectivity and access to quality education.

The purpose of this study was to explicate the application of constructivism theories with synchronous software application (SSA) for online teaching. The application is demonstrated with a case study of students from the departments of information systems and information technology at DUT. The methodological approach of this study draws primarily on desktop examination of theories of constructivism. In addition, qualitative research methods have been utilised to reflect on the experiences of the authors. This study contributes uniquely to the relatively new body of knowledge of a higher education institution adapting to the intrinsic challenges created by the Covid-19 pandemic by applying the fundamental theories of constructivism for online teaching. The authors undertook to reflect on the micro perspective within the context of the institution to reflect on the dynamics of transforming the higher education sector. The theories of constructivism by Piaget (1977), Vygotsky (1980) and Von Glasersfeld (1974) have been successfully applied to online teaching at DUT. This chapter contains four main sections that are succinctly summarised as

follows: the first section gives the introductory message, followed by explicating learning theories of constructivism for ease of lucidity. Thereafter, the application of the learning theories of constructivism is delineated for online teaching and the last section gives a concluding remark.

Learning theories of constructivism

Learning constructivism is an educational philosophy, which holds that people actively construct or build new knowledge upon previous experiences and foundations (Elliot, Kratochwill, Littlefield Cook & Travers, 1999). Constructivism postulates that students are not passive vessels, but they actively participate to construct own learning that can be influenced by their prior knowledge (Phillips, 1995). The passivity of teaching views a student as an empty vessel, sponge, or liability to be filled with knowledge. However, constructivism explicates that students construct meaning through active engagement with the world. The concept fosters a sense of personal agency because students have ownership of their learning (McLeod, 2017). Bada and Olusegun (2015) indicate that central to the tenet of constructivism is that learning is an active process. Constructivists advocate that learning is interactive and it is constructed on what students already know. Consequently, information may be imposed on students, but understanding cannot be imposed, because it must come from the inner mind. The literature on educational psychology has documented the continuum of constructivism into three broad categories. These are cognitive constructivism, social constructivism and radical constructivism that are succinctly ventilated in this section of the chapter.

Cognitive constructivism

The notion of cognitive constructivism states that knowledge is something that is actively constructed by students based on their existing cognitive structures. The purpose of cognitivist teaching methods, tools and environments is to assist students in assimilating new information upon their existing knowledge. In addition, it is to enable them to make appropriate modifications to their existing intellectual framework to accommodate that information. Cognitive constructivism is propagated through the theory of Piaget (1977) that advocates learning as constructive. It addresses how learning occurs but does not focus on factors that influence learning. Piaget (1977) believed in operative knowledge that postulates change and transformation as producing operative knowledge, which is a form of acquired learning that aids someone to perform functions. The operative knowledge is much related to skill, which Piaget said cannot be taught, but acquired through practice that makes perfect. It is a more basic knowledge when compared to figurative knowledge that focuses on relating accurate information about entities.

Theory of cognitive constructivism argues further that people produce knowledge and form meaning based upon their previous experiences. It covers learning theories, teaching methods and education reforms. The foundation of the theory of Piaget is adaptation of individuals to environment through assimilation and accommodation. Assimilation means that a person applies an already learned schema to understand or interact with an object (Barrouillet, 2015). Assimilation causes an individual to incorporate new experiences into the old experiences and thereby develop new outlooks, rethink previous misunderstandings, and evaluate what is important to ultimately alter perceptions. The concept of accommodation reframes new experiences into the mental capacity already present. Individuals conceive ideas in which the world operates and when things do not operate within that context, they must accommodate and reframe expectations with the resulting outcomes.

Social constructivism

Social constructivism refers to a learning theory that is built and socially negotiated through interactions with others (Hodson & Hodson, 1998). Learning is generally not an abstract concept, but a collaborative social activity that develops from interaction of individuals with culture and society (Dewey, 1986). Social constructivism was developed by Vygotsky (1980) who suggested that cognitive development stems from social interactions from guided learning within the zone of proximal development (ZPD) as people construct knowledge cooperatively. In addition, Vygotsky (1980) suggested that learning is first through interpersonal interactions and then individually through an internalisation process that can lead to deep understanding of the phenomenon being studied. The environment in which people are developed will influence their beliefs, knowledge, skills, experiences, how they think, what they think about and how they behave. This is because social knowledge is about societal conventions, norms, ethos, beliefs and behaviours.

Social constructivism is a theory of knowledge in sociology and communication theory that examines knowledge and understanding of the world that are developed cooperatively by individuals (Amineh & Asl, 2015). The theory assumes that understanding, significance and meaning are developed in coordination with people of a society. In the social constructivist approach, instructors are introduced as facilitators, inspirators, mentors, coaches, or promoters of knowledge and not as teachers or lords. A teacher who is the lord of a module gives a didactic lecture that covers the entire topic whimsically. However, a facilitator helps the students to get to their own understanding of the content being studied by providing an inspiration. Students play a passive role when an instructor teaches without providing inspiration.

However, they play an active role when the instructor inspires the learning process and helps the students learn the right knowledge. Hence, the teaching and learning process is about sharing experiences and negotiating socially constituted knowledge.

Radical constructivism

The tenet of the theory of radical constructivism is that any archetype of knowledge is constructed rather than perceived through senses (Von Glasersfeld, 1974). It is the theory of knowing, which states unequivocally that knowledge constructed by individuals does not tell anything about reality, but only helps to function in an environment. The theory does not deny the existence of objective reality, but it posits the non-existence of methods of attaining objective knowledge (Hardy, 1997). This hypothesis implies that knowledge is invented, not discovered, and that humanly constructed reality is constantly being modified and attempts to fit an ontological reality, but can never give a true picture of it (Von Glasersfeld, 1974).

The interactions of individuals with external structures coupled with their interpretations of those interactions are important components for constructing knowledge in radical constructivism (Steffe & Thompson, 2000). In the context of radical constructivism, knowledge consists of mental constructs that have satisfied the conditions of objective reality and it is used in the sense of adaptation by Piaget (1977). Knowledge refers to the sensory motor actions and conceptual operations that have proven to be viable in the experience of a knower. It is the idea of viability that makes radical constructivism an instrumentalist theory of knowledge. A viable construction is a mental or physical action that is consistent with experiences of individuals and fulfils an intended purpose (Hardy, 1997).

The theory of radical constructivism extends the concept of equilibration credited to Piaget (1977). Equilibration contends the existence of interactions between the parts of knowledge of individuals and their total body of knowledge at any given moment. The theory posits that “there is a constant differentiation of the totality of knowledge into the parts and an integration of the parts back into the whole” (Piaget, 1977:839). Radical constructivism elaborates on this conception of equilibration by arguing that these constructions are not interpretations or approximations of an external objective reality that the knower came to know, but rather constitute reality for the knower (Lerman, 1989). The theory puts the interactions, interpretations and equilibrations of an individual with all externalities at the centre of knowledge construction. This learning theory has direct implications for the nature of reality, but an objective reality cannot come to be known, so positivist and post-positivist positions are untenable. The knowledge theory is based on principles that knowledge

is not passively received, but actively constructed by cognising subject. Cognition is adaptive and serves an organisation of the experiential world, not the discovery of ontological reality (Husen & Postlethwaite, 1989).

Constructivism theories for online teaching

Literature on developmental psychology has suggested the benefits of agglutinating several learning theories in the classrooms. However, there is no clear understanding of how such agglutination will facilitate learning in a virtual environment. Previous authors have argued that computer mediated peer learning within a virtual environment can help promote student development and create positive outcomes (Khalili & Olugbara, 2011) as in the case of digital media archive systems (Ochieng, Olugbara & Marks, 2017).

However, previous studies have rarely discussed how the theories of constructivism can be applied to online teaching scenarios. Teaching in a virtual environment presents unique challenges such as high cost of data bundles, network connectivity bottlenecks in deep rural society, lack of appropriate devices for accessing learning content and inconstant availability of facilitators to mediate learning interactions. According to Ng'ambi, Brown, Bozalek, Gachago and Wood (2016), all students now own mobile devices and are socially interconnected. Anecdotal evidence, in 2020, at DUT supports the afore mentioned assertion. Students are able to actively interact with the presented content, academics and fellow students to ultimately aptly construct and co-construct their understanding of the curriculum.

This assertion applies to the constructivist notion of teaching and learning, however, the implementation of constructivism for online teaching generally presents a unique challenge for first year students who are frequently regarded as “undecided students”. The lack of “tertiary student maturity” and capability to easily acclimatise to the university environment to co-construct knowledge and actively participate in learning, presents an apparent challenge for constructivist online teaching.

In addition, students are expected to swiftly cope with the sudden change from face-to-face lectures to an online teaching mode, which may not be realistic. Bao (2020) supported this belief by stating that the challenges for students did not come from technical operational obstacles, instead, they have difficulties because of lack of a good behaviour to learning. Students often have inherent problems such as lack of self-discipline, suitable learning materials or good learning environments when they are self-isolated at home as in the case of the current lockdown worldwide. Students require social interactions with peers and instructors and require the right knowledge and comprehension of theories of constructivism.

In this study, we have exploited the notion of reinforcement learning to investigate theories of cognitive constructivism (Piaget, 1977), social constructivism (Vygotsky, 1980) and radical constructivism (Von Glasersfeld, 1974) for online teaching. It is hoped that reinforcement would encourage consistent participation of students in constructivist online teaching. Reinforcement learning is a potent tool in machine learning where the adaptability of algorithms to an environment is determined by evaluating the environmental feedback to action. The algorithm adapts to the environment for a positive incentive and strategy of positive incentive is strengthened continuously. However, the algorithm does not adapt to the environment for a negative incentive. The maximum cumulative return is obtained by the algorithm through incessant interaction with the environment and the strategy can be updated according to a reward penalty function (Zhou, 2018). In the context of constructivist online teaching, a reward function for students is not necessarily monetary. It could be as simple as sharing the idea of a well-performing student, giving praise for a good response to a question, asking a student to explain his/her idea to everyone in the network, allocating a certain percentage of the final score to online class attendance, providing free data bundles and internet access devices to students. The choice of an appropriate reward function will depend heavily on an institution and the context.

Case study of online teaching

A detailed case study of online classes was undertaken at the Faculty of Accounting and Informatics (FAI) at DUT. Moving instructions to online can enable flexibility, accessibility, cost effective education and personalised learning. However, the speed with which this movement to online instructions is expected to happen is unprecedented and staggering (Hodges, Moore, Lockee, Trust & Bond, 2020). The regime of the Covid-19 pandemic has resulted in an abrupt and almost overnight complete migration to online teaching. Bao (2020) states that it is a massive and disruptive shift to move all the existing courses online in a matter of days. In general, a complete online course requires an elaborate design of lesson plans, teaching materials and technology support teams. All these requirements present a strong ramification for changing education (Robinson & Aronica, 2015).

Neither students nor academics at DUT had a mental model of what to expect from the lockdown regime. Their schema of teaching and learning embraced traditional lecture venues and laboratories coupled with deep face-to-face interactions. This includes having dialogue with academics and students, asking questions and expecting answers, as well as verbal and non-verbal cues. In constructivism, learning is socially mediated and interaction is essential for negotiation of meaningful learning. Students and staff could no longer partake in this, because of the physical disconnection caused by the Covid-19 hiatus.

This disconnectedness has reduced interaction significantly and placed undue anxiety on students and staff. Problem-based learning or more creative project-based learning in a social setting became obsolete overnight. Students and instructors had to adapt to a new mental model and a schema against a new reality. They had to adapt to course materials and education pedagogies that fit into a new normality of online teaching and adjust the model when it is not viable. Moreover, students and instructors had to ultimately adjust the concept of online teaching. This new reality of a new schema coupled with the concept of adaptation correlates positively with the theory of Piaget (1977). In this context, the already learned schema is the conventional pedagogies associated with deep face-to-face teaching. The pedagogies must now be applied to the new online teaching environment.

The original idea of DUT was to implement the concept of frugal technology (Olugbara & Ndhlovu, 2014) based multimodal learning that would alleviate the burden of technology costs for students and staff. The university then embraced low cost technology such as smartphones, universal service bus (USB) and transporting of printed learning materials to students through Globeflight shipping services. The university is providing data bundles for staff and students monthly. In addition, staff were provided with mobile Mi-Fi hotspot routers, laptop computers, or desktop computers to alleviate high costs of technology. The reward function has proved to be highly effective because students and staff are participating regularly in online activities.

Synchronous software application (SSA)

The overarching objective of SSA is to replace physical face-to-face teaching with sustainable online teaching. This objective was achieved at DUT using different technology platforms that support internet connectivity, synchronous and asynchronous interactions. The synchronous platforms, including Microsoft Teams (MS Teams) and WhatsApp, have been used to demonstrate the application of constructivism theories to online teaching. In a constructivist online teaching environment, certain strategies must be implemented for empowering instructors to deconstruct conventional objectivist perceptions of teaching in the sense of radical constructivism by Von Glaserfeld (1974), promote social interaction with meaningful instructions as emphasised by social constructivism of Vygotsky (1980) and advocate learning as construction through teaching activities that see learning as appropriation as suggested by cognitive constructivism (Piaget, 1977). Tam (2000) identified certain basic characteristics of a constructivist environment for implementing constructivist teaching strategies. This includes sharing of knowledge by instructors and students. Instructors and students must share and delegate authority. The prime role of an

instructor is one of a facilitator or guide using guided practices in the teaching environment. Learning groups should consist of small numbers of students with a heterogeneous background.

Teaching activities that promote autonomy of students, higher-order thinking, critical reasoning, dialogue with negotiation and the use of interactive materials should be encouraged strongly in a constructivist online teaching environment. The nature of questions that an instructor asks the students, the kind of examples that the instructor uses to explain concepts and methods for solving a problem must be real, and not fictitious. Instructors must allow students to reflect because reflection can help students build a strong understanding of the hard concepts. Reflection is germane to learning; there can be no understanding without it and it is induced by verbalisation (Von Glasersfeld, 2001). It should be encouraged by fostering conversation. The theories of constructivism impact curriculum because instructors must design a curriculum plan that enhances the logical and conceptual growth of students. Learning is an active process in constructivism, where students create mental models that are constructs of the real world and test those models through experience. The resources and lesson plans that must be initiated for constructivist learning usually take a different approach from the traditional learning. Table 7.1 highlights the dimensional characteristics and implications of constructivism theories for online teaching.

Table 7.1 Dimensional characteristics and implications of constructivism theories for online teaching (adapted from Sadeghi, 2015)

Dimension	Constructivism	Implication
Educational paradigm	Constructivist approaches unfocused goals based on knowledge transfer	Knowledge transfer is a key factor in online lectures. Goals must be highly focused and instructors should use technology tools to communicate online lessons.
Experimental values	Learning practices based on real world examples	Students must be afforded maximal opportunities to practice on real world problems. The opportunities can be in the form of their participation in a global project, crowdsourcing or global software that engages a group of students and experts to cooperatively solve challenging problems.
Role of instructor	Student-centred teaching	Pursuit of student ideas, questions, interests, use of familiar examples and build on existing knowledge of students.

Value of errors	Mistakes as part of the learning process	Instructors should not aim for perfect lessons where there is no error. Errors in computer programming, for example, are part of the learning process that can help students acquire programming skills and develop a deep understanding of the necessary logics.
Origin of motivation	Internal motivation and true desire	Motivation must be constantly reinforced to ensure online students stay actively engaged. Students must be encouraged to engage with academics through online platforms. In addition, students should be inspired to share their challenges with peers through appropriate online discussion forums.
Individual differences	Multi-faceted consideration on the needs and preferences of students based on affective and physiological differences	Online teaching should accommodate the needs of individual students to promote personalised learning. Designers of online content and instructors should understand that students have heterogeneous backgrounds and learn differently.
Student control	Students have power to choose what section or what learning paths to follow	Instructors should allow for flexible and reflective teaching in terms of class schedules, alternate sections in the course and ruminating on previous lessons. Students must be able to recall previous lessons and access learning materials ubiquitously.
User activity	Students engage in the learning process for constructing knowledge	Instructors need to inspire students to conduct their own learning and collaborate in the knowledge construction process.
Collaborative learning	Provisioning of a variety of different technological facilities and support for collaborative learning	Instructors should encourage collaborative learning amongst students. For instance, through Microsoft Teams to setup groups for collaboration or using other online collaborative platforms like collaborative online international learning (COIL) and discussion forums.

Microsoft teams synchronous learning platform

The implementation of constructivist learning methods can be complemented using a synchronous technology platform that fosters a high level of interactivity. Constructivism is a philosophy that asserts learning occurs in contexts, but technology refers to the environment for contexture learning to occur. Technology in a nutshell provides an interactive platform and diverse tools for constructivist teaching and learning. The first SSA considered in this study for constructivist online teaching is the MS Teams medium. The platform is an enhanced technology for communication and collaboration in modern organisations. It is an upgrade of the Skype platform

for working at home, learning remotely and for scheduling meetings. The tool was adopted by DUT for synchronous teaching, working from home and holding distance meetings. The new content that DUT academics had to learn at the commencement of the lockdown regime was the synchronous methodology for online teaching. DUT academics had to learn to implement both synchronous and asynchronous strategies for online teaching. Moodle open source software is the conventional asynchronous learning management system (LMS) being used at DUT to supplement face-to-face teaching. MS Teams in conjunction with Moodle LMS ensure synchronous and asynchronous teaching and learning within all faculties at DUT. However, SSA based on MS Teams has conveniently replaced the conventional face-to-face lecture at the university.

The university has attempted to implement a blended multimodal teaching approach, but most of the staff and students preferred the SSA teaching because of fear and stigma associated with contracting the Covid-19 virus. Students and staff have found that MS Teams is simple to use and effective in the transition to synchronous online teaching. The MS Teams platform has the interface to depict a timetable of venues, class times and modules in a virtual learning space that can mimic the real learning space. Consequently, the faculty of Accounting and Informatics (FAI) at DUT has implemented MS Teams in a novel way to be utilised as a managed synchronous virtual learning classroom that simulates the physical lecture venue. In MS Teams, the departments within FAI are represented as teams with instructors represented as owners and organisers of meetings (online lecturers) and students are represented as team members (participants) for a module. Moreover, the concept of channels in MS Teams has been used by the faculty to represent the official venue timetable.

In a typical example, the department of Information System (IS) in FAI can have three channels, which are DB0001, DB0002 and DB0003. These are code names of physical lecture venues within FAI. The calendar scheduling option within Microsoft Outlook was used to set the lecture times in lecture venues represented as channels. Students are invited as participants to a venue through the e-mail facility in Microsoft Outlook. This would be presented in the general announcement area of a group in MS Teams. Students automatically become a part of a synchronous virtual lecture when they accept an e-mail request for that time in the group that is linked to a venue channel. All venue timetables are linked to channels within a department. MS Teams group such as modules and venues for a department can be loaded onto the system. The virtual lectures scheduled for instructors are linked to channel venues. The Executive Dean, Heads of Departments and/or Programme Coordinators can now report on the virtual allocation of the timetable through the channel facility of MS Teams. This mechanism enforces control, auditing, and accountability of online teaching.

Moreover, it assists both instructors and students in scheduling and attending virtual lectures. Figure 7.1 below shows an example of how the physical lecture venues in the Information Systems department have been mapped to virtual lecture venues using MS Teams.

Figure 7.1 MS Teams depicting physical timetable for IS department

The instructors from FAI have adapted to the MS Teams SSA based on the theories of constructivism. Figure 7.2 below shows the online layout of timetabling within the framework of MS Teams. In this instance, the already learned schema by an instructor is the physical delivery of timetabling associated with physical lecture venues. This lecture mode must now be applied to the new lecture modality of an online lecture venue created using MS Teams. Moreover, with respect to students, the already learned schema was receiving face-to-face instructions in the physical venues on campus. Students must now adapt to the methodology of online teaching venues for ubiquitous learning. One attractive feature of MS Teams is the support for a portable and “storable” whiteboard that differs from the static whiteboard in face-to-face classrooms for note taking. Online lecture notes can be taken and shared interactively within the online teaching environment by anyone using any kind of productivity enhancement tools such as Word processor, PowerPoint and Excel spreadsheet. Lecture notes that are taken using any of these productivity tools can be shared and stored for future references.

Figure 7.2 Module business information systems 2 depicted on logical timetable in MS Teams

WhatsApp synchronous learning platform

Since the inception of multimodal ERT, the first author of this chapter has been successfully using the WhatsApp instant messaging smartphone application in conjunction with Moodle LMS and MS Teams. WhatsApp is a cross-platform instant messaging and voice over internet protocol service of Facebook that allows the users to communicate using text, voice, image, and location. This technology platform was accepted by DUT to complement Moodle LMS and MS Teams for implementing multimodal ERT. WhatsApp is being used by all students in the computer programming (COMP 201) module because of their familiarity with the platform. Students had to adapt to using the WhatsApp environment for online learning besides using it for social communication. In addition, students had to apply their already learned WhatsApp schema to understand module content and online teaching delivery. Figure 7.3 below shows a screenshot of a WhatsApp group for synchronous communication of COMP201. There are 99 participants in the new online learning classroom who shared knowledge and engaged in active learning.

Figure 7.3 WhatsApp group for synchronous communication of COMP201

WhatsApp provides the intrinsic merits of improved communication amongst students and instructors. It supports the reach of students and facilitates their availability for consultations. It allows for the simulation of instances where instructors make announcements in a lecture venue, or where students and staff post all kinds of notices on physical noticeboards. It allows for full participation of students in interactivity and encourages the use of visual and audio aids for communications. It supports real-time feedback where for instance, an instructor posts a portable data format (PDF) document with screenshots of C++ codes. Students were able to access and execute the instructions given and provided instant feedback, especially when they encountered errors in the computer codes and they wanted instant answers. However, the application presents several inherent deficiencies that need to be emphasised in this chapter. There is the blurring of personal space because students would post messages at bizarre hours with no consideration for the personal space of the instructors. This is one useful application area for a bot or a web robot application that can engage with students to automatically respond to questions or queries raised by students at any time.

DUT is considering the implementation of such a bot system to support real-time responses to student queries. Sometimes, students claim that they do not own smartphones and could not access resources posted by an instructor. In addition,

there are regular complaints from certain students of lack of data and internet connectivity. Moreover, some students are posting messages in mother languages such as isiZulu. However, not all students in a group are isiZulu speakers and the Google Translate application does not always translate the information correctly. This is another useful application area for language immersion research to develop a robot that can efficiently translate local South Africa languages in an online teaching environment. This application will facilitate unrestricted interactions that can be caused by language hegemony. Language is an important factor that can inhibit seamless interactions in an online teaching environment. Figure 7.4 shows the number of media or document files in the WhatsApp group of consisting of 156 members, for instance.

Figure 7.4 Number of media or document files in the WhatsApp group of 156 members

The DUT experience has generally indicated the acceptance of SSA for online teaching. DUT staff and students are using several technology tools such as Google Documents for collaborative authoring, Dropbox for file sharing, email for enquiry, phone calls for communication, MS Teams for online teaching and WhatsApp for instant messaging. Figure 7.5 shows a screenshot of a conversation between an instructor and students regarding the date and time of a synchronous lecture in MS Teams.

Figure 7.5 Screenshot of a conversation between an instructor and students

Conclusion

In this chapter, we explicate the application of constructivism theories with synchronous software application for online teaching at the Durban University of Technology. This transition from conventional teaching to synchronous online teaching has been successful. The practical experiences of the authors indicate that constructivist online teaching processes foster collaborative learning and simplify the teaching of computer programming in a way that fosters interactivity. However, in most cases, academics are experiencing challenges with the sudden transition to constructivist online teaching. The shortage of adequate online infrastructure, lack of devices for students and issues of network connectivity can hinder the transition to complete constructivist online teaching. Academics had to make the transition from the conventional face-to-face lectures to online teaching almost overnight when emergency remote teaching was introduced swiftly at the commencement of the lockdown regime in April 2020. This process was considered too cumbersome for inexperienced online instructors. There is the need to introduce the resources of constructivism to academics and students for transforming the culture of teaching with the associated pedagogies. This will provide the means for empowering instructors with a moral imperative for deconstructing anarchistic perceptions of education as a service and reconstructing personal epistemologies, associations with students and education practices.

References

- Amineh, R.J. & Asl, H.D. 2015. Review of constructivism and social constructivism. *Journal of Social Sciences, Literature and Languages*, 1(1):9-16.
- Bada, S.O. & Olusegun, S. 2015. Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*, 5(6):66-70.
- Bao, W. 2020. Covid-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2):113-115.
<https://doi.org/10.1002/hbe2.191>
- Barrouillet, P. 2015. Theories of cognitive development: From Piaget to today. *Developmental Review*, 38:1-12. <https://doi.org/10.1016/j.dr.2015.07.004>
- Dewey, J. 1986. Experience and education. In: *The educational forum*, 50(3):241-252.
<https://doi.org/10.1080/00131728609335764>
- Elliott, S.N., Kratochwill, T.R.L. & Travers, J.F. 1999. *Educational psychology: Effective teaching effective learning*. Pennsylvania: McGraw-Hill College.
- Gewin, V. 2020. Five tips for moving teaching online as Covid-19 takes hold. *Nature*, 580(7802):295-296. <https://doi.org/10.1038/d41586-020-00896-7>
- Graven, M., Hewana, D. & Stott, D. 2013. The evolution of an instrument for researching young mathematical dispositions. *African Journal of Research in Mathematics, Science and Technology Education*, 17(1-2):26-37. <https://doi.org/10.1080/10288457.2013.826968>
- Habermas, J. 1984. *The Theory of Communicative Action: Jurgen Habermas*. Trans. by Thomas McCarthy. Portsmouth: Heinemann.
- Hardy, M.D. 1997. Von Glaserfeld's radical constructivism: A critical review. *Science & Education*, 6(1):135-150. <https://doi.org/10.1023/A:1008664626705>
- Hodges, C., Moore, S., Lockee, B., Trust, T. & Bond, A. 2020. The difference between emergency remote teaching and online learning. *Educause review*, 27:1-12.
- Hodson, D. & Hodson, J. 1998. From constructivism to social constructivism: A Vygotskian perspective on teaching and learning science. *School science review*, 79(289):33-41.
- Husen, T. & Postlethwaite, T.N. 1985. *International encyclopedia of education*. Oxford: Pergamon Press.
- Khalili, P. & Olugbara, O.O. 2011. Positive youth development in mobile dynamic virtual environment. In: P. Kommers & P. Isaías (eds.), *Proceedings of the IADIS International Conference e-Society*. Available at: <https://bit.ly/32kFi4B> [Accessed 30 July 2020].
- Lerman, S. 1989. Constructivism, mathematics and mathematics education. *Educational Studies in Mathematics*, 20(2):211-223. <https://doi.org/10.1007/BF00579463>
- Letseka, M. & Maile, S. 2008. *High university drop-out rates: A threat to South Africa's future*. Pretoria: Human Sciences Research Council.
- McLeod, S.A. 2017. *Kolb - learning styles and experiential learning cycle*. Available at: <https://bit.ly/3dhOpJK> (Accessed 10 January 2021).
- National Planning Commission. 2012. *National Development Plan 2030: Our future-make it work*. Available at: <https://bit.ly/3dqVXJ1> [Accessed 30 July 2020].

- Ng'ambi, D., Brown, C., Bozalek, V., Gachago, D. & Wood, D. 2016. Technology enhanced teaching and learning in South African higher education – A rearview of a 20 year journey. *British Journal of Educational Technology*, 47(5):843-858. <https://doi.org/10.1111/bjet.12485>
- Ochieng, D.M., Olugbara, O.O. & Marks, M.M. 2017. Exploring Digital Archive System to Develop Digitally Resilient Youths in Marginalised Communities in South Africa. *The Electronic Journal of Information Systems in Developing Countries*, 80(1):1-22. <https://doi.org/10.1002/j.1681-4835.2017.tb00588.x>
- Olugbara, O.O. & Ndhlovu, B.N. 2014. Constructing frugal sales system for small enterprises. *The African Journal of Information Systems*, 6(4):1.
- Phillips, D.C. 1995. The good, the bad, and the ugly: The many faces of constructivism. *Educational researcher*, 24(7):5-12. <https://doi.org/10.3102/0013189X024007005>
- Piaget, J. 1977. Problems of equilibration. In: M.H. Appel & L.S. Goldberg (eds.), *Topics in cognitive development*. Boston, MA: Springer, 3-13. https://doi.org/10.1007/978-1-4613-4175-8_1
- Piaget, J. 2008. Developmental psychology: Incorporating Piaget's and Vygotsky's theories in classrooms. *Journal of cross-disciplinary perspectives in education*, 1(1):59-67.
- Robinson, K.& Aronica, L. 2015. *Creative schools: Revolutionizing education from the ground up*. UK: Penguin.
- Sadeghi, S.H. 2015. Cultural context and e-practice: an assessment on USA institutions. *International Journal of Advanced and Applied Sciences*, 2(9):32-36.
- Sahu, P. 2020. Closure of universities due to coronavirus disease 2019 (Covid-19): impact on education and mental health of students and academic staff. *Cureus*, 12(4). <https://doi.org/10.7759/cureus.7541>
- Steffe, L.P. & Thompson, P.W. 2000. Interaction or intersubjectivity? A reply to Lerman. *Journal for Research in Mathematics Education*, 31(2):191-209. <https://doi.org/10.2307/749751>
- Tam, M. 2000. Constructivism, instructional design, and technology: Implications for transforming distance learning. *Journal of Educational Technology & Society*, 3(2):50-60.
- Toquero, C.M. 2020. Challenges and Opportunities for Higher Education Amid the Covid-19 Pandemic: The Philippine Context. *Pedagogical Research*, 5(4). <https://doi.org/10.29333/pr/7947>
- Von Glasersfeld, E. 1974. Piaget and the radical constructivist epistemology. *Epistemology and education*, 1:24. <https://doi.org/10.1007/BF03220058>
- Von Glasersfeld, E. 2001. Radical constructivism and teaching. *Prospects*, 31(2):161-173.
- Vygotsky, L.S. 1980. *Mind in society: The development of higher psychological processes*. Cambridge: Harvard University Press. <https://doi.org/10.2307/j.ctvjf9vz4>
- Webster, D. 2019. Why South Africa is the world's most unequal society. *Mail & Guardian*, 19.
- WHO. 2020. *Coronavirus disease (Covid-19) pandemic*. Available at: <https://bit.ly/3cpFHIE> [Accessed 20 March 2020].
- World Bank. 2019. *South African Overview*. Available at: <https://bit.ly/31qqAIE> [Accessed February 2021].
- Zhou, Z. 2018. *Machine learning*. Beijing: Tsinghua University.