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A framework development for the adoption of information and communication technology web technologies in higher education systems

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Background: The adoption of information and communication technology (ICT) tools into educational systems has been at the forefront of the educational sector for decades. The integration of Web 2.0 and Web 3.0 technologies is progressively being encouraged worldwide across several universities to support teaching and learning processes and to offer students the possibility of learning experiences and engagements to suit their digital needs.

Objectives: This article probes a framework development for the adoption of ICT web technologies in higher education systems (HES) and further suggests a framework for adoption with the aim of enhancing the mode of education delivery and improving business processes. An understanding of the benefits associated with Web 2.0 and Web 3.0 tools adoption is gained to support collaboration between students and educators and to build social presence through interactive learning. South African universities continue to experience circumstances in which many learners who enrol are novice users of Web 2.0 and Web 3.0 tools and require optimal support to bridge the gaps and the knowledge and skills exposure required. The problem with educators' inability to incorporate Web 2.0 and Web 3.0 tools in their teaching and learning practices exists.

Method: A mixed-method approach was applied in this study. The researchers conducted 15 separate interviews with educators coupled with randomly distributed questionnaires to students across three universities (North-West University [NWU], University of South Africa [UNISA] and University of Pretoria [UP]), a total of 969 was recoverable and analysed using analytical tool ATLAS.ti and SPSS. The researchers further validated the data consolidating both techniques used to generate a holistic assessment of the data analysed from the quantitative to support the qualitative findings.

Results: Findings revealed that these tools are useful and will have a positive effect on the pedagogical environment, although there are challenges that may be considered during the adoption. These challenges relate to human factors (e.g. technophobia and cultural beliefs), security issues (e.g. privacy and intellectual property rights [IPRs]), ethical and legal issues, ICT infrastructures (e.g. cost implication, risk and ICT teaching facilities); and university policy frameworks.

Conclusion: Despite these challenges, Web 2.0 and Web 3.0 technologies in HES offer varieties of teaching and learning platforms and an improved business administration process.

Keywords: Blended and integrated learning; collaboration and integrated learning; higher education system (HES); ICT; Social Software (Web 2.0); Semantic Web (Web 3.0).

Introduction

For decades, universities have offered their students minimal learning platforms and choices with regard to techniques used to convey course content (Ruxwana & Msibi 2018). Students have been forced to accept whatever is presented in whichever way it is presented, and universities have the tendency of using the traditional mode of delivery (Moges 2013). However, there is a realisation that the traditional approach is not effective in addressing and improving outcomes of student learning. The revolution and development in the area of information and communication technology (ICT) have significantly affected the approach to and quality of teaching and education in universities (Enakrire & Ocholla 2017). The adoption of Web 2.0 and Web 3.0 technologies as additional tools in education will not only enhance students' learning possibilities but also provide varied learning approaches (Chawinga & Zinn 2016). This means that students will be able to decide when, where and how to learn (Chetty 2012; Moges 2013; Ohei et al. 2015).

This article reports on the findings of an investigation into Web 2.0 and Web 3.0 technologies for adoption in higher education systems (HES).

The investigation was an attempt to address the era of traditional methods of teaching and learning, and venture exclusively into ICT-enabled tools of Web 2.0 and Web 3.0 technologies. Web 2.0 and Web 3.0 technologies have features that can enable community-based sharing, user-created content and personalisation (Moges 2013). This line of reasoning raises the following questions: (1) should Web 2.0 and Web 3.0 technologies be adopted to serve as additional tools that will improve teaching, learning and quality of education delivery? (2) What are the views of educators and students regarding Web 2.0 and Web 3.0 technologies and the benefits associated with these technologies? (3) What challenges do educators and students experience in the adoption of Web 2.0 and Web 3.0 technologies? (4) What support system is required to prepare educators and students for using Web 2.0 and Web 3.0 technologies in HES?

Literature

Higher education institutions are confronted with several challenges, both general and related to education specifically. The facilitation and learning processes should receive special attention (Tsiotakis & Jimoyiannis 2016). The South African HES has been experiencing pressure to meet the demands for social transformation and skills exposure needed for the new South Africa in recent decades (Jimoyiannis et al. 2013; Motala & Padayachee 2018).

There is also the constant burden of improving on strategic policy and delivery performance. Training educators in the educational uses of social software tools appears to be a key element of almost every development plan for education and educational reform efforts (Tondeur et al. 2017).

Considering the pressure facing the HES, coupled with the types of services that universities offer to their prospective students (McLoughlin & Lee 2010), effective use of social software tools by educators is fundamental in overcoming some of these challenges. Hamid et al. (2015) and others claim that these tools, namely blogs, wikis, Really Simple Syndication (RSS) feeds, YouTube, podcasts, media-sharing applications and social networking sites such as Flickr, Facebook, Twitter and Skype (Ching & Hsu 2011; Jimoyiannis et al. 2013; Remy 2018; Steen & Wache 2017; Yang 2018) are capable of supporting and encouraging informal conversation, dialogue, collaborative content generation and the sharing of knowledge, giving learners access to a wide range of ideas and representations. If adopted and used appropriately, these technologies have the potential to make student-centred learning a reality by promoting learner agency, autonomy and engagement in social networks that straddle multiple real and virtual communities independent of physical, geographic, institutional and organisational boundaries (Hamid et al. 2015; McLoughlin & Lee 2010).

Web 2.0 and Web 3.0 adoption

Lal (2011) mentions that the adoption and incorporation of social software tools such as Web 2.0 and the semantic web technologies (Web 3.0) into web-based educational systems for business administration processes are fundamental. Web 2.0 and Web 3.0 offer four basic characteristics that can help universities, namely, intelligence, personalisation, interoperability and virtualisation to the learning context (Lal 2011). These possibilities enable universities to provide quality education and to gain a competitive advantage over their counterparts (Arshad et al. 2011).

With the successful integration of these technological tools into educational systems, learners can definitely source and have easy access to educational resources and personnel (resource persons, mentors, experts, researchers, professionals and peers from all over the world) (Abousoliman 2017; Bonifacio 2013; Madhukar 2013; Moges 2013; Noor Ul Amin 2013; Yuen, Yaoyuneyong & Johnson 2011). The use of web technologies in teaching could improve teaching, administration and students' performance and develop relevant skills in disadvantaged communities. It also improves the quality of education through facilitation of learning by means of self-learning, problem-solving, information seeking and analysis, critical thinking, as well as the ability to communicate, collaborate and teach (Noor Ul Amin 2013).

Defining social software (Web 2.0) and semantic web (Web 3.0)

The evolution of the Web

The rise of the Internet in the 1990s gave impetus to web-based revolutions in education. Web 1.0 was the first generation of the web (O'Reilly 2005). During this phase, the focus was mainly on building the web, making it accessible and commercialising it for the first time. Web 1.0 was developed and built on a restrictive one-way communication platform (Kwanya, Stilwell & Underwood 2012), which means that in the Web 1.0 era, users could only browse, read and retrieve information. In an attempt to help users engage more collaboratively on the web, the second generation Web 2.0 was developed by O'Reilly in 2005. This afforded users a much more transformational platform on which they could read, write and execute functions.

Figure 1 is a representation of the evolution and trends of web technologies. Web 2.0 and Web 3.0 can be referred to by different names, which emerged because of their inherent nature and characteristics; some of these for Web 2.0 are 'social software', 'participatory media' (Chawinga & Zinn 2016), 'social digital technologies' and 'Web 2.0 technologies'. On the other hand, Web 3.0 is referred to as 'semantic web'. Interestingly, this study used the concepts of social software and Web 2.0 technologies interchangeably, while semantic web is used for Web 3.0 consistently.
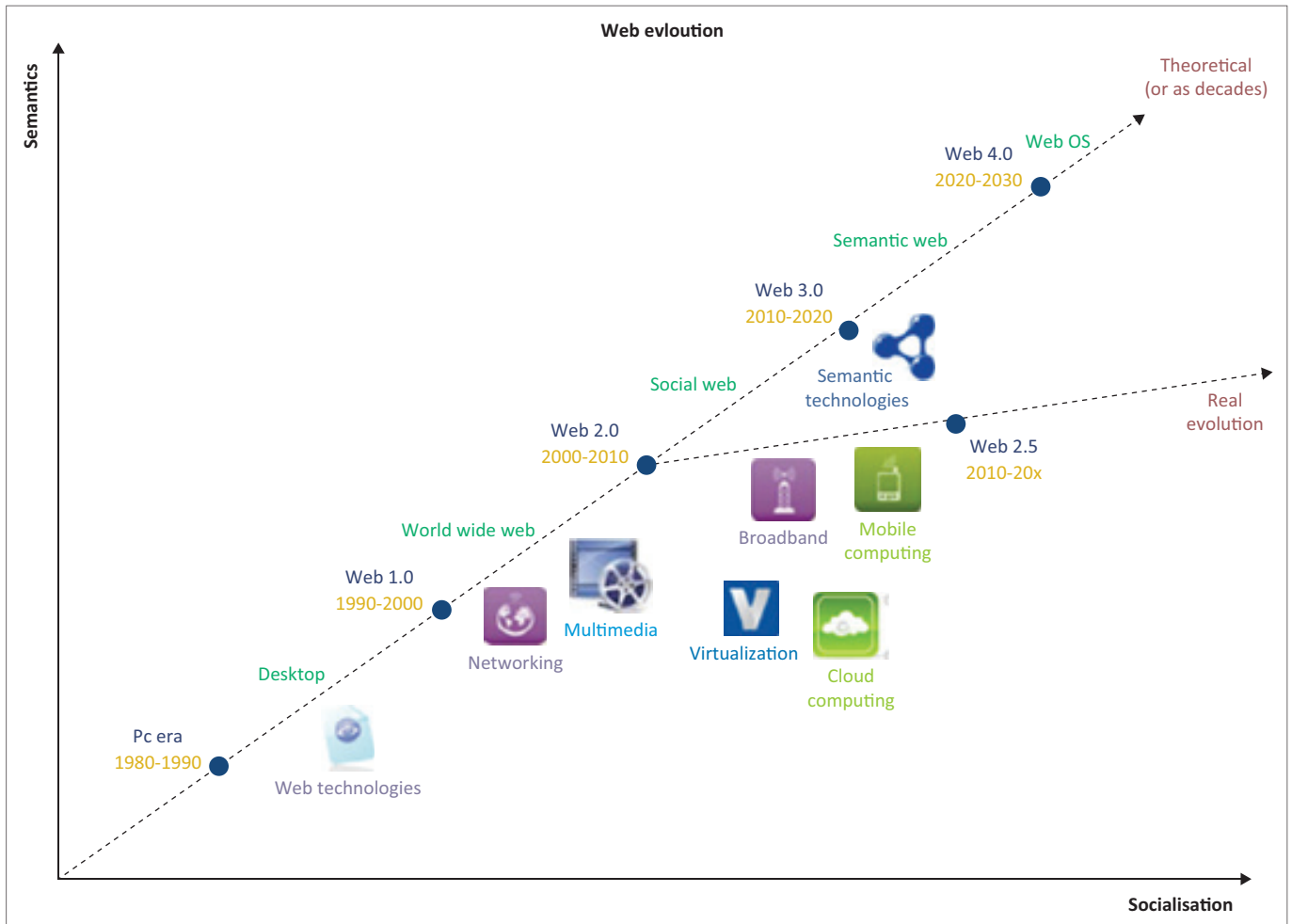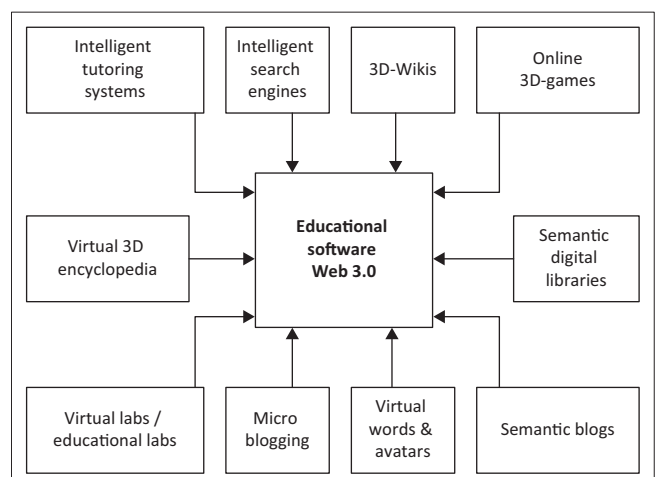
FIGURE 1: The evolution of the Web.

Over the past few decades, social software tools, specifically blogs, wikis, RSS feeds, YouTube, Flickr, Facebook, Twitter, Skype, podcasts, Google Apps, to list but a few, have gained strong awareness in education circles (Chawinga & Zinn 2016; Moges 2013). These tools are used for diverse learning groups, from primary and secondary education (Ching & Hsu 2011; Deng & Yuen 2011; Jimoyiannis et al. 2013; Remy 2018; Steen & Wache 2017; Tse et al. 2010; Woo et al. 2011; Yang 2018) to higher education (Bolliger & Shepherd 2010), vocational training (Marsden & Piggot-Irvine 2012) and teachers' professional development (Doherty 2011; Hadjerrouit 2014; Wopereis, Sloep & Poortman 2010).

Web 2.0 and Web 3.0 technologies have been categorised or characterised as a web platform that makes educational tools and the Internet more affable, sociable and tangible, and that is based on a framework through which social networking tools were developed (Chawinga & Zinn 2016). In the educational context, there are quite a number of characteristics that uniquely identify Web 2.0 and Web 3.0 technologies.

Web 2.0 and 3.0 technologies offer varieties of tools and services for educational tools as illustrated in Figure 2.

FIGURE 2: Educational web tools.

Characteristic features of Web 2.0 and Web 3.0 in higher education system

Web 2.0 and Web 3.0 technologies allow students the functionality to customise educational web content by altering, adding to and editing the pages that they browse or visit (Chawinga & Zinn 2016). This flexibility of Web 2.0 and

Web 3.0 technologies justify their classification as a read/write function, a characteristic feature and flexibility that Web 1.0 or a read-only lacked (Pillay & Maharaj 2014).

Furthermore, they offer platforms on which students are able to execute applications right from their web browsers. A student can, for example, use applications such as Dropbox, discussion forums, Google Drive and Myspace to modify, manage and control their own content (Chawinga & Zinn 2016).

These technologies afford students liberty and freedom of space, and the freedom to publish and share content and other resources at a minimal cost on the web. Web 2.0 technologies can be extended to small or community groups, with mutual interests or communities of practice (Chawinga & Zinn 2016). In other words, in the Web 2.0 and Web 3.0 era, knowledge can no longer be monopolised by its creators; rather, it should be classified as decentralisation of knowledge creation.

In a pedagogical setting, Web 2.0 and Web 3.0 technologies encourage quick feedback by educators to students and vice versa, improved reflective and collaborative learning and widespread choices of channels or mediums for knowledge construction and dissemination (Lal 2011).

The educational Web 2.0 and Web 3.0 technologies are used to create educational content that enables students to communicate and share information with other peers, mainly through networks (Kulakli & Mahony 2014). These tools have the ability to improve access and the methods through which education is offered so that learners are able to access information at any given point in time or place. This has a direct impact on the ways in which learning is transferred to learners (Bonifacio 2013; Madhukar 2013; Moges 2013; Noor Ul Amin 2013). Therefore, education supported by web tools will ultimately lead to the democratisation of education (Madhukar 2013). This in turn develops learners for lifelong learning.

Web 2.0 and Web 3.0 technologies in universities

Many universities have adopted these technological tools and applications as part of their teaching and learning.

Kulakli and Mahony (2014) are of the opinion that social software tools encourage a wider variety of expressive capability in the sense that they provide learners with new opportunities to be self-determined in their study and research. Herro (2014) mentions how the University of Warwick and Newport University in the UK have vigorously adopted both blogs and wikis for educational purposes. These media deliver an online learning environment for learners, giving accurate information about the university activities, study material, email, file storage, library resources and many more. Abousoliman (2017) reports on the use of Elgg at Athabasca University, Canada's Open University.

Against this background, Hamid et al. (2015) conclude that there can be no doubt that the learning process occurs in a sociocultural system within which students use diverse technological tools and several platforms to engage in and to produce collective activity, enabled by technology affordances. Hamid et al. (2015) speak positively about the potential benefits associated with the adoption of these tools in a learning environment. It is also vital to assess the factors that are associated with their use and educators' inability to integrate these tools for teaching and learning purposes.

Challenges in the use of Web 2.0 and Web 3.0 technologies in higher education system

Schroeder, Minocha and Schneider (2010) argue that the legal aspects associated with the use of Web 2.0 technologies in the public domain should be given careful consideration. Interacting with students in the public domain raises issues of data protection and privacy, as it is the duty of the institutions to protect students who have to use public tools for student assessment (Schroeder et al. 2010; Dotsika 2012).

Dotsika (2012) further identifies ethical and legal challenges such as anonymity, reputation, intellectual property ownership, patent violations, monetary function and trust. In support of this finding, Pereira, Baranauskas and Liu (2018) and Pereira, Baranauskas and Da Silva (2013) maintain that cultural issues, namely privacy, reputation and identity theft, have raised notable concerns among academic writers. Arguably, Pereira et al. (2013) and Chawinga and Zozie (2016) contend that the digital native lives with technology and does not just use it. This undoubtedly signifies that a wider set of dynamic factors will emerge. These can range from emotion, sociability and human values to challenges of security and safety. All these factors have an effect on how individuals interact with web technologies and applications.

Pereira et al. (2013) continue to justify the extent to which cultures and individuals' values may be affected. In addition, Pereira et al. (2018), Pereira et al. (2013) and Schwartz (2012) believe that human values are interlinked with culture, that cultures and individual values are intertwined and therefore differ in significance, status and priority according to the philosophy that is being analysed and the time and space concerned.

Enormous research evidence shows that effective educator preparation is an important factor for successful integration and sustainability of Web 2.0 and Web 3.0 tools usage in education (Albion & Tondeur 2018).

Asiri (2012) and Gil-Flores, Rodríguez-Santero and Torres-Gordillo (2017) mention that educators' inability to use these tools successfully is a result of a lack of confidence, resistance to accept change and a lack of competence. Other factors highlighted are the lack of time, lack of effective training, lack of accessibility to resources and lack of technical support.

Research methodology

This study applied mixed-methods research (MMR). The concurrent nested or embedded design was suitable for this study. This strategy (Creswell 2015) attempts to appreciate

and support the qualitative results by quantitative means. The concurrent nested or embedded design entails one stage of data collection that guides the study and that receives precedence (in this case qualitative). Therefore, the quantitative is entrenched or embedded in the study and acts as support. The researchers chose this strategy of enquiry as it employs the quantitative data to expound on the qualitative results.

To meet the requirement of being unbiased, the researchers applied the suitability sampling method to select the universities that would constitute a proper sample. These universities were from the 11 traditional universities offering a full range of courses that lead to internationally recognised qualifications. As these universities are traditional universities, they are more involved and spend time with their students and are more likely to use web technologies as part of their learning process. This also offered a better chance to obtain accurate results and to generalise.

In line with this, a purposive and snowball sampling technique was applied to selected academic staff members in three universities. A structured interview was used for these participants. A probability sampling approach was used for other respondents through questionnaires. These techniques were employed to collect data sets from educators and students from North-West University (NWU), which included the Mafikeng (MFK), Potchefstroom (POTCH) and Vaal Triangle (VAAL) campuses; the University of South Africa (UNISA) and the University of Pretoria (UP).

There were 15 interview participants (*n* = 15) consisting of educator staff and a total of 969 questionnaire respondents (*n* = 969) consisting of students (MFK 304, POTCH 166, VAAL 163; UNISA 182 and UP 154).
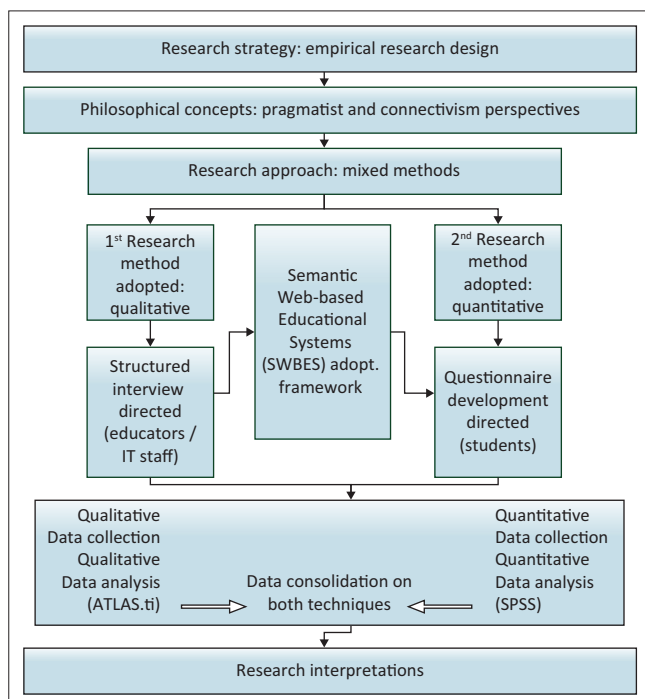

FIGURE 3: Top-level research strategy.

Figure 3 explains the analytical tools used in the study.

During data analysis, diverse software tools were employed. ATLAS.ti Version 7 was used as a qualitative data analysis instrument for analysing the interviews. The initial data analysis involved open coding and a process of defining the data, identifying categories, making summaries and accounting for every data segment. SPSS and Microsoft Excel (showing descriptive and inferential statistics such as frequencies, tables, Figures, percentages and Spearman correlation tests) were used to analyse the quantitative data.

Ethical consideration

This work was approved by obtaining permission through the appropriate ethical channels. An ethical approval certificate was issued by the research ethics regulatory committees of each university. Voluntary participation, anonymity and confidentiality were ensured throughout the study.

Results, discussion and findings
Demographics

This section provides the demographic variables from the questionnaire distributed. Analyses and representations of the results correspond with the research questions posed. Respondents' variables such as gender, institution and level of academic study are presented in the subsequent sections.

A total of 969 respondents completed the questionnaires. Male students had a slightly higher representation (52.1%) than female students (47.9%). The slight imbalance did not have any significant bearing.

The level of study and qualifications of respondents were determined. Of the 969 respondents, 645 (66.6%) were undergraduate students, 156 (16.1%) were postgraduate honours students, 142 (14.7%) were undergraduate diploma students, 20 (2.1%) were postgraduate master's students and 6 were postgraduate PhD (0.6%) students. This result implies that undergraduate students would be most likely to be more fascinated by Web 2.0 and Web 3.0 technologies in their teaching and learning experience than postgraduate students who have already been inducted into the educational system.

The adoption of Web 2.0 and Web 3.0 technologies in higher education system

This section provides answers to the first research question and sought to establish the usefulness of adopting web technologies in HES. In the interview guide and questionnaire, educators and students were asked about their level of awareness of and familiarity with the concepts of Web 2.0 and Web 3.0 technologies. This was intended to identify connections, contradictions and gaps in relation to the adoption of Web 2.0 and Web 3.0 in higher education, see Figure 4.
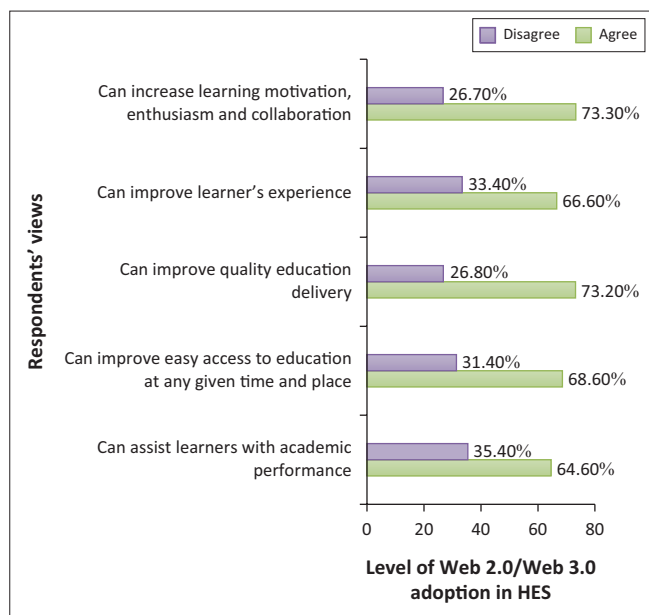
FIGURE 4: Responses regarding Web 2.0 and Web 3.0 adoption.

The findings show that the educators across these universities were accustomed to and conversant and comfortable with this concept of Web 2.0 tools. INT2 said:

'I am aware and I can apply these tools in my teaching, although, it might be a challenge for some few educators, I have colleagues in social work, who experiences a bit of a challenge.' (Interview number 2 [INT2], female, lecturer)

Another INT3 mentioned that:

'I think it's easy for us as educators, because we are in engineering IT and all of that …' (INT3, male, lecturer)

'I use web tools and applications on daily bases.' (INT 9, female, junior lecturer)

This was followed with INT4, who revealed that:

'I frequently use YouTube to post video contents and use it in class as well.' (INT 4, male, lecturer)

'I upload class material using these tools for students who want to look at it again in their own time.' (INT2, female, lecturer)

Also INT15, INT7 and many others stated that they had the necessary knowledge of and applied certain Web 2.0 and Web 3.0 technologies.

Students also indicated a high level of familiarity with these web technologies and their applications. The findings show that out of 304 respondents from MFK Campus, 261 (85.8%) agreed about their level of familiarity with and exposure to these web tools. At the NWU Potchefstroom Campus, 132 out of 166 answered positively, and at NWU Vaal Triangle Campus, 163 respondents (79.8%) confidently agreed. Of 182 respondents from UNISA, 146 (80.2%) affirmed that they are aware of these technological tools, while 78.6% respondents of 154 from the UP agreed with this statement.

In total, 81.6% affirmed a high level of familiarity with these social networking sites, such as Facebook and Twitter, as well as YouTube, blogs, wikis, Digital Library, podcasts, myUnisa, eFundi, Google Classroom, Blackboard and many more. The results of the findings also signify that the concepts of Web 2.0 and Web 3.0 are not new in the pedagogical environment (Hosein 2013). This is in line with Noor Ul Amin (2013), who asserts that the notion of adopting Web 2.0 and Web 3.0 technologies in the pedagogical context for teaching purposes has been professed by many academics.

There was consensus among most of the educators and students that Web 2.0 and Web 3.0 integration and adoption into HES has the potential to improve quality education. For clarity purposes, certain abbreviations will now be used and explained. INT represents interviewee and the number alongside is the interview number. University 1 represents NWU, university 2 is UNISA and university 3 is UP. According to INT1 and INT11-university 1 and INT2-university 2:

'Web 2.0 technologies in HES can complement quality education.' (INT1, male, senior lecturer; INT11, female, lecturer)

INT6-university 3 agreed but further ascertained that it:

'… can complement educational mode of delivery, by complementing the existing strategies, which still needs quality educators, quality researchers.' (INT6, female, lecturer)

INT9-university 1 did not think:

'… you can replace face-to-face physical contact with students with those technologies.' (INT9, female, lecturer)

INT1, INT10, INT12 and INT13-university 1, INT3, INT4 and INT12-university 2 and INT5, INT7 and INT6-university 3 confirmed that it:

'… will improve greatly in quality education and approach of delivery of educational contents.' (INT1, male, senior lecturer; INT10, male, lecturer/professor; INT12, male, lecturer/associate professor; INT13, female, senior lecturer; INT3, male, lecturer; INT4, male, lecturer; INT5, male, lecturer/associate professor; INT7, male, professor; INT6, female, lecturer; INT2, female, lecturer)

The findings show that educators and students support the adoption and integration of Web 2.0 and Web 3.0 technologies and their applications in HES. Figure 4 represents the responses derived from the respondents in relation to five questions asked.

Students believed that these web technologies and applications offered them additional liberties and platforms, such as choosing their learning space and the amount of time with other distance learners. They also encouraged diverse approaches to learning and engaging with peers. This result is in line with Hosein (2013), who claimed that web tools create avenues for information and knowledge dissemination. Aghaei, Nematbakhsh and Farsani (2012) maintained that ICT has the potential to improve easy access and the methods

used to provide education in that learners are able to access information at any given point in time or place. It has a direct effect on the approach to teaching (Abousoliman 2017).

The findings clearly justify the adoption of Web 2.0 and Web 3.0 technologies. Educators and students were optimistic about web technology capabilities, and collectively they agreed that web technologies are capable of encouraging active, collaborative, creative and integrative learning in educational systems (Badawood & Qureshi 2013; Lal 2011).

Educators' and students' perceived views of social software/semantic web and information and communication technology web technologies in higher education systems

This section is linked to the second research question, which attempted to gain an understanding of the views of educators and students regarding Web 2.0 and Web 3.0 technologies and the benefits associated with them for teaching and learning.

The responses from the educators suggested that they recognised Web 2.0 and Web 3.0 technologies as useful for student management and blended learning. Educators' perceptions of web tools were that they might be viewed as a channel for knowledge creation, in the sense that they increase educators' productivity and create room for change (Angeli et al. 2015).

Some educators viewed Web 2.0 and Web 3.0 tools as technological tools that enhance business processes and enable content personalisation and integrated learning, in line with the affordability of social presence. The educators were positive that Web 2.0 and Web 3.0 technologies should be incorporated in HES to coordinate students' learning activities and assessments. The collaborative nature of these tools in Web 2.0 and Web 3.0 and the blended learning approach allow students to work independently and at their own pace (Abousoliman 2017; Agustina 2015; Herro 2014), while having face-to-face contact with the educators and accessing all the necessary educational resources and support that students require to pursue their studies.

The educators gave examples of how Web 2.0 and Web 3.0 technologies incorporated in HES would benefit students in general. Abousoliman (2017) contends that these web tools offer learners the ability to bring together new concepts and innovative learning, allowing learners to assimilate new information with peers.

This finding is confirmed by Albion and Tondeur (2018) who stated that these tools could have a positive impact on learners. Educators surveyed claimed that the tools encourage students to be reflective in their learning process and that they offer improved collaboration among students. The findings show that such applications and instructional web tools enable educators to monitor their students in online space interactions and for individual contributions

(Wood 2011). The educators and students believed that the benefits of using ICT web technologies and applications in HES are interoperability, personalisation, virtualisation and intelligence (Dotsika 2012).

Participant INT2-university 2 said that:

'… the platform enables students to work independently; in so doing, the student will be able to create new concepts.' (INT2, female, lecturer)

This finding shows that discussion platforms, blogs and wikis, as part of a learning management system (LMS), can improve students' knowledge creation, while a few educators supported the idea of social networking sites; social bookmarking sites were encouraged for the learning process.

Information and communication technology confidence, readiness and willingness

This section explored the degree of educators' and students' ICT skill, confidence in and willingness to adopt these web tools in HES. The findings show that educators and students from universities 1, 2 and 3 did not lack ICT confidence. They all showed that they had basic computer skills, access and confidence. In other words, they were positive and readily able to incorporate these tools for teaching.

A few educators from the NWU stated that their current institution did not really provide them with platforms to successfully engage with these web tools compared with their previous institutions.

Participant INT6-university 3 said:

'I don't have any lack of confidence in using technology because I actually teach the design and implementation in technology so I don't have confident issue.' (INT6, female, lecturer)

These participants were selected from the Department of Information Systems, School of Computing/Computer Sciences and Informatics because of their exposure and knowledge areas, and thus would not have been likely to lack ICT confidence. The findings reveal that the students had basic computer skills and Internet access to computer facilities in these universities. The majority of respondents from NWU with 92% (NWU-Mafikeng Campus, discipline: Information Systems), 89.2% (NWU Potchefstroom Campus, discipline: Information Systems) and 89% (NWU Vaal Campus, discipline: Economics and Management Science – Information Systems), UP with 89.7% and UNISA with 79.1% agreed that they have Internet access. Overall, a comfortable 88.3% of participants agreed to this fact.

The researchers also attempted to understand whether gender plays a significant role in their responses. The findings reveal that as the p-values of whether students have basic computer skills and how/when, do they often access the Internet is $p < 0.05$ level of significance, the views of the respondents regarding Internet access are significantly dependent on their gender. The majority (125/246 = 51%) of

respondents who accessed the Internet every 2–3 days were women, whereas the majority (91/122 = 75%) of respondents who accessed the Internet once a week were men. More women were found to use the Internet for less than 1 h than men. The majority of the men used the Internet for about 1–2 h on a daily basis.

Furthermore, the researchers used Spearman's correlation coefficient to measure the strength of a monotonic relationship between paired data. The closer Spearman's rank-order correlation (rs) is to +1, the stronger the monotonic relationship. Correlation is an effect size; so the researchers can label the strength of the correlation (Mukaka 2012).

SPSS 22 was used to perform the correlation analysis between age and the views of respondents concerning frequency of accessing the Internet. The results show that as the *p*-value is less than 0.05, the correlation between age and the views of respondents is significant. A negative correlation coefficient (r = -0.071) implies that older respondents tend to access the Internet every day, whereas younger respondents tend to access the Internet rarely.

The respondents indicated that they used the Internet mostly for educational purposes, research activities, information searches and entertainment.

Having established that educators and students had ICT skills and confidence, educators were asked to indicate which of the web instructional technologies they used daily for teaching and learning purposes. Each university has adopted a specific LMS or virtual learning environment (VLE) for the facilitation of learning and business administration processes.

The respondents were asked whether they used some of the social networking sites such as Facebook and YouTube in the facilitation of learning. The findings show that educators from universities 2 and 3 frequently used YouTube to post video content and they used it in the class as well. These educators disclosed that they used blogs, wikis, discussion forums and many more technologies for educational purposes. At university 1, some educators surveyed revealed that some of these web instructional technologies were not often used in the facilitation of learning. Their reasons related to the lack of awareness and unavailability of content, such as discussion forums, blogs and wikis, on their learning management sites (eFundi).

The different responses were because of the differences in their demographics and mode of education delivery regarding myUnisa, eFundi or Blackboard.

When it comes to using these Web 2.0 and Web 3.0 technologies to deliver course content, UNISA was at the forefront of encouraging a high number of distance learners to use these technologies. Blogs, wikis, RSS feeds, YouTube, Flickr, Facebook, Twitter, Skype and podcasts were used for educational purposes. The same initiative of using web technologies to deliver course content to the learners has

been implemented at UP. Although the impact of these tools differs significantly, depending on what it is intended or used for, given the geographical landscape and the teaching methods from these universities, the impact of using such web tools at UNISA cannot be compared with UP, just as the impact at UP cannot be compared with NWU.

At UNISA and UP, the university policy frameworks support web instructional technologies in their teaching and learning. This entails using blogging, wikis and discussion platforms. This seems to be lacking at NWU. Some participants from university 1 admitted that the university's policy framework sometimes restricted them. Others mentioned that they were confined to using what the university provided. Some believed that a lack of awareness also played a part to some extent. In general, this limited their use of these tools.

The educators at NWU indicated that they had some experience with these tools in their previous institutions, but the fear of being on the wrong side of policy prevented them from engaging with students through such platforms. For this reason, they only used the tools made available to them. The educators indicated that web technology tools, such as semantic blogging and discussion forums, such as wikis, were not incorporated in their LMS/VLE e-Fundi. For that reason, educators were not able to integrate such applications in the facilitation of learning. Moges (2013), Dotsika (2010, 2012) and Zhu and Wang (2010) state that regulations and policies may sometimes prevent educators from using various ICT technologies. Therefore, Moges (2013) emphasises that existing policies or regulations that govern the adoption of Web 2.0 and Web 3.0 tools into educational systems ought to be revisited and amended so that the necessary participatory or collaborative platforms are permitted in HES.

Challenges associated with Web 2.0 and Web 3.0 adoption in higher education systems

The students believed that the following challenges may be associated with educators' inability to integrate web technologies in facilitating teaching and learning: 'difficult to integrate and use of web tools into teaching' (57.3%), 'insufficient educators' time' (57.2%), 'massive workloads' (67.7%), 'phobia towards web tools and its applications' (50.5%), 'attitudes/perceptions' (68.2%), 'lack of proper knowledge, skills and capacity' (60.9%), 'lack of confidence level' (61.2%), 'lack of willingness to accept change' (60.8%), 'lack of resources (computer facilities)' (54.1%) and 'technical assistance/training' (68%).

Educators also spoke extensively about issues of security (see Figure 5). The findings show that security, ethical and legal issues, human factors (e.g. culture, behavioural patterns, technophobia, attitude and beliefs) were identified as the prevailing issues linked with Web 2.0 and Web 3.0 adoption in HES. ICT infrastructure and ICT investments (costs, risk and benefit) are ongoing issues surrounding technology acceptance in the educational environment and thus cannot

be ignored. All of these issues could influence the adoption of Web 2.0 and Web 3.0 technologies in some way, either positively or negatively. Few issues pose severe concerns (Gil-Flores et al. 2017; Schroeder et al. 2010).

It is important to note that not all of these issues can be eliminated. Some, if not addressed, may interfere with the adoption process to some extent.

The educators from NWU, UNISA and UP believed that most of the controversies raised were unavoidable, but viewed the impact of these issues as minimal when compared to the benefits and educational impact of Web 2.0 and Web 3.0 technologies in HES. The educators suggested other possible challenges that may prevent Web 2.0 and Web 3.0 technology adoption, one of which is linked to students' lack of ICT exposure. The educators revealed that many students come from disadvantaged homes, who may not have the necessary privileges to own a computer or technological gadgets. While some may get to only access computer devices for the first time while at the university or tertiary level, such factors may limit their exposure to technology. This may pose challenges to their learning processes. These students' assimilation of content and use of ICT web technological applications are limited (Lefever & Currant 2010; Motala & Padayachee 2018; Ohei et al. 2015; Ohei & Lubbe 2013). In most cases, these students are not able to cope compared to those who are technologically advanced.

The findings captured from students' responses suggest that educators experience several hindrances when using ICT web technologies in education. Many of these hindrances are caused by incompatibility between the technology usage and the educational requirements, in other words, the policy framework for teaching and learning.

Strategies for preparing educators and students to use Web 2.0 and Web 3.0 technologies

The purpose of this section was to test educators' and students' ideas and suggest a development support programme that will better prepare educators and students with the right exposure required or skills needed.

Hooker, Mwiyeria and Verma (2011) highlight that educators ought to be able to integrate Web 2.0 and Web 3.0 technologies into the learning process as this will provide the students with the ICT skills necessary to pursue their careers. The educators from these institutions affirmed that their respective universities offered ICT training, workshops and seminars to support educators and those who struggle. Some educators insisted that workshops, training and seminars were not enough and that educators should change their attitudes towards and negative perceptions of Web 2.0 and Web 3.0 technologies. Some believed that practice makes perfect. Constant use of these web technologies in HES can actually improve educators' confidence.

From the students' perceptive, the findings suggest that learners who struggle should be referred to the university's academic support programme. Students suggested that an ICT module should be made compulsory for all students when they enrol at university. This will help them gain the required knowledge, skills and the ability to familiarise themselves with Web 2.0 and Web 3.0 technologies and applications.

Framework development for Web 2.0 and Web 3.0 technology adoption in higher education system

The framework was developed based on the research findings. There were five themes that emerged, as shown in Figure 5, which provided answers to the research questions. The first theme in the framework attempts to answer the first research question of whether Web 2.0 and Web 3.0 should be adopted. The second and third themes relate to the views of educators and students about the benefits and impacts of web technologies, thus answering the second research question. The fourth theme reveals the challenges experienced by educators and students concerning web technologies and whether or not to use them in HES.

This theme answered the third research question. The last theme in the framework deals with a support programme for those who have difficulties in absorbing web technologies in HES, answering the fourth research question.

Brief analysis and discussion

The framework indicates that the adoption of web instructional technologies and their applications for academic purposes is fundamental towards improving students' learning experience and engagements. Theme 1 shows that Web 2.0 and Web 3.0 technologies can improve students' easy access to educational content, deliver quality education, improve learning opportunities and motivate learners to learn. This will improve students' learning styles (interactive, reflective, collaborative, active and integrative learning). The dotted line in Figure 5 represents the link between the themes. Solid-edged arrows with specific colours were assigned to each theme. The arrows represent the contribution of each theme.

Theme 2 in green depicts the positive views of educators and students regarding the use of web instructional technologies in HES as supported by the existing literature. The framework illustrates that Web 2.0 and Web 3.0 in the educational context can be viewed as supportive, but it is important to note that web instructional technologies can only serve as complementary tools in the facilitation of quality education and administration processes (Dotsika 2010, 2012). They cannot replace the traditional learning (face-to-face) approach. The element of physical contact is vital, just as blended and integrated learning is essential for students' learning styles and development.

Theme 3 is somewhat directed at educational impact and benefits. The framework incorporates the fact that NWU, UNISA and UP use different kinds of LMSs/VLEs enabled
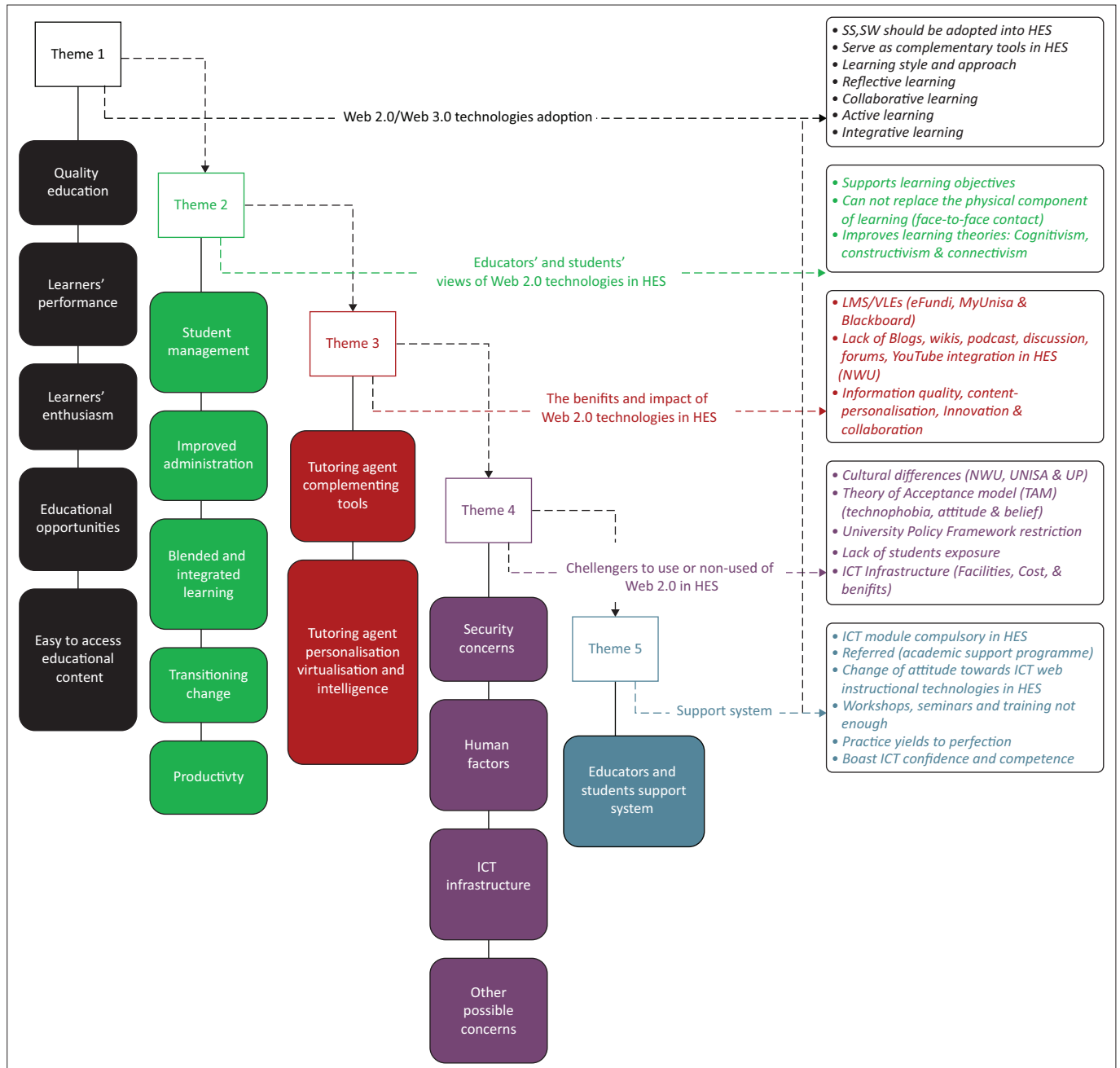
ICT, information communication technology.

FIGURE 5: Framework for Web 2.0 and Web 3.0 adoption in higher education system.

by Web 2.0 and Web 3.0 technologies for content creation and personalisation. Theme 3 demonstrates how UNISA and UP have adopted varied types of web technologies and applications extensively, compared to NWU. NWU has not fully integrated the use of blogs, discussion forums, wikis and podcasts/vodcasts in the LMS.

Theme 4 details the negative standpoints in relation to Web 2.0 and Web 3.0 technology adoption. There are challenging concerns that have to be addressed or issues that may hinder the adoption of Web 2.0 and Web 3.0 technologies in HES. These include security and ethical concerns, human factors, ICT infrastructure, ICT investment (costs, risks and benefits) and other possible concerns

(lack of student exposure and university policy framework restrictions). Some of these concerns pose hindrances or prevent the adoption of web instructional tools in education.

Theme 5 deals with the concept of an educator and student development programme. Educators should have the opportunity to attend workshops, training and seminars to equip them to use web instructional technologies. They should also receive the necessary support. Students should not be trailing behind. Participants recommended that an introductory ICT module be made compulsory for all students enrolled at any of these institutions. This will instil ICT confidence in students. Students who struggle should be referred for academic development.

The framework consolidates the results of the qualitative and quantitative research. The mixture of qualitative and quantitative data acquisition and inquiry delivers the essential richness in information systems research (Jogulu & Pansiri 2011). It further advances wider and better consolidation of the research findings and enhances the exactness of inferences and trustworthiness. The MMR approach expands the boundaries of a single research approach, incorporates several epistemological assumptions and offers better validity or relevance to multifaceted educational settings. Therefore, the development of a comprehensive framework and methodologies employed in this study make an original contribution to the academic body of knowledge by providing direction for Web 2.0 and Web 3.0 adoption in HES.

Recommendations and conclusion

This framework was developed based on the existing literature and the research findings. Notably, the combined use of qualitative and quantitative methods of data collection and analysis by means of MMR makes the research findings stronger, which advances the accuracy of inferences and enhances credibility.

Mavetera (2011) states that the development of a framework is grounded on the systematic result. Nevertheless, it is important to realise that this comprehensive framework developed for SS adoption in HES cannot serve as a 'one-size-fits-all' framework. Rather, this framework provides guidance to the adoption of web instructional technologies, tools and applications in HES and is fundamentally hypothetical in nature. It expands the body of knowledge.

In order to fully implement this framework in practice, the concerns raised in the framework ought to be addressed. It is further suggested that the NWU policy framework should be revisited so that it can be aligned and repositioned to allow the incorporation of ICT interactive web instructional technologies for achieving educational goals.

Adopting this framework in HES will suggest a new cohort of semantic web-based educational systems that enhance and improve business processes and the quality of service delivery with Web 2.0 and Web 3.0 technologies and applications. More specifically, the benefit of this framework is that it broadens the insight into the phenomena studied. The findings reveal that the educators and students surveyed were in the ICT discipline and, as such, they were conversant and accustomed to Web 2.0 and Web 3.0 technologies. However, educators in other disciplines may not be, and it could be valuable to investigate this in future research.

In conclusion, this article reports on the investigation of Web 2.0 and Web 3.0 technology adoption and the findings that emerged from a mixed qualitative and quantitative approach. The development of a comprehensive framework was based on the findings regarding Web 2.0 and Web 3.0 tool adoption in HES. The article made an original contribution to the academic body of knowledge. The research problem identified in this article was addressed and the objectives and questions have been achieved and answered. The ideas, concepts and views of the respondents were accurately articulated and supported by existing academic literature studies through which solutions were proposed in the form of a framework (Figure 5).

This article makes a significant impact as it identifies the factors that prevent the adoption of Web 2.0 and Web 3.0 instructional technologies in HES. Therefore, a new approach has been suggested in framework for Web 2.0 and Web 3.0 technologies in HES to serve as complementary technologies for teaching and learning purposes. These should not be used to replace the traditional approach to learning but rather should support as a blended and integrated learning process for achieving educational goals. Finally, the probable benefits that are associated with the use of Web 2.0 and Web 3.0 and their applications in HES have been justified.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Author's contributions

Both authors contributed equally to the final version of the manuscript.

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