Abstract
Sefako Makgatho Health Sciences University (SMU) in Gauteng Province, South Africa, established in 2015 mainly offers health sciences degree programmes. The School of Science and Technology (SST) is the only school (out of five) that offers non-health study programmes. The SST offers Computer Science (CS) among its subjects in the Bachelor of Science (BSc) Mathematical Sciences stream. The Department of CS (DCS) has applied to adapt and extend its curriculum to offer more courses and programmes. This adaptation is expected to include a BSc CS and Information Technology (IT) stream. However, the discipline of CS and IT is rapidly ever changing. Thus, SMU finds itself in a daunting position to have a CS curriculum (CSC), which is relevant to the current needs of the discipline and industry. In the 2017 round of BSc curriculum review at SMU, a CSC review was recommended. The review process requires the involvement of the faculty and a number of stakeholders to bring it to acceptance, accreditation and fruition. Several challenges have been encountered towards the realisation of the programme in CS and IT. This paper discusses the CSC development processes, the underpinning theories, guidelines that informed the review, as well as the challenges endured and prospects.

Keywords: Curriculum, curriculum development challenges, curriculum innovation, curriculum adaptation prospects.

1 INTRODUCTION
The Department of Computer Science (DCS) is under the School of Science and Technology (SST) at the Sefako Makgatho Health Sciences University (SMU), South Africa. At SMU, Computer Science Curriculum (CSC) courses are offered in the Mathematical Science stream of the Bachelor of Science (BSc) programme. In the current year, 2019, a BSc CS and Information Technology (IT) honours degree has enrolled its first group of students. The honours programme took five (5) years in process entailing development, approval, accreditation and implementation. It has actually been a gruesome experience of back and forth for the programme to materialise. There is a danger of such a long period to develop and implement a new programme, as some of the aspects of the programme could have been outdated. The reviewed undergraduate BSc programme would take effect as from year 2020 (thus the BSc Computer Science and Information Technology (CSIT)).

This paper investigates the challenges towards the offering of a new CSC at SMU. Discussions on best practices and new themes informing CSC development (CSCD) are discussed. Such themes include entrepreneurship and industry-specific training (IST). In the ever-changing higher education (HE) training landscape, new themes emerge, which require the attention of curriculum developers and implementers. Such new curriculum initiatives and themes have to be considered for the curriculum to maintain its relevancy. CSC is also one of the programmes, which requires such initiatives of integrating new themes, especially when CS is considered one of the drivers for the fourth industrial revolution (Xu, David & Kim, 2018). CS has to keep up with the emerging themes. However, the period through which the review or initiation of a new CSC has to go through leaves CSCD lagging behind.

What can be done for the CS and IT curricula to mitigate and accommodate the changing landscape of CS and IT? What then should be done to overcome such challenges in CSCD? How can CSCD process be shortened to suite the ever-changing CS and IT discipline?
This paper is a preliminary report that was developed from findings of the first phase of the empirical study, which used CS students on campus and outside campus. Two last phases will follow in a latter paper. These phases will entail gathering data from CS graduates who attended HE in South Africa and the last phase of interviewing CS lecturers.

2 LITERATURE REVIEW

This section covers the relevant topics addressing the paper title and the paper objectives. These topics are curriculum, curriculum development, and challenges of curriculum development, curriculum innovation and curriculum adaptation prospects.

3 CURRICULUM

Each formal study programme is guided by a curriculum, where several researchers (Kelly, 2009; Wiles, 2008) define curriculum as the entirety of student experiences occurring in the educational process. Curriculum is therefore a planned structure of instruction in order to channel the student's experiences in terms of the specified instructional goals. Reys, Reys, Lapan, Holliday and Wasman (2003) refer to curriculum as a set of learning goals expressed across educational levels that outline the intended subject content and process goals at particular points in time throughout the study program. There are a number of definitions on what curriculum is. Jackman (2005) quoting Bredekamp and Rosegrant (1992) define curriculum as “an organised framework that delineates the content children are to learn, the process through which children achieve the identified curricular goals, what teachers do to help children achieve these goals, and the context in which teaching and learning occurs”. Ornstein and Hunkins (2018) define curriculum by proposing four basic attributes, which are, plan, learners’ experiences, field of study and subject matter such as Computer Science, Mathematics and the like.

What resonates from most of the definitions is that curriculum is a road map, content, knowledge, skills, experience, and set of outcomes to be achieved and as a field of study on its own right (Jackman, 2005; Ornstein & Hunkins, 2018; Tanner & Tanner, 2007; Wood & Davis, 1978). Curriculum may add in the planned interaction of learners with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives. For realistic practice and effectiveness, curriculum is separated into at least four categories, namely; the explicit, the implicit that includes the hidden, the excluded, and the extracurricular.

The explicit curriculum is the core section that may be viewed as compulsory. The implicit curriculum reinforces meaning on the core, such as by applying meaningful examples to the learners to explain the core. The excluded section is an optional section which may be disregarded without reducing education quality, but which may be used to supplement the core. The extracurricular are additional academic and nonacademic learning that may be incorporated for enriching the learners’ knowledge power. Curricula may be firmly standardised, or may include a high level of academy autonomy. In South African HE, the institutions follow the autonomous approach. Hence, any institution may follow their own curriculum to suit the students they wish to attract.

“The driving force of curriculum is to ensure relevance of content and learning methods to students’ psychological, social, cultural and economic environment” (Fullan & Striegelbauer, 1991). Teaching and learning methods are principles, techniques, procedures and ways used to facilitate learning. The manner in which the CS subject is presented is one of the aspects which make the up the teaching method in the discipline. The teaching and learning takes place within a psychological, social and cultural setting or environment. The environment provides the facilities, artefacts and all other things related to the implementation of the curriculum. The economic environment provides aspects such as employment for the students who would have gone through the given curriculum. Therefore, the computer science curriculum and any other curriculum should provide a student or graduate who is economically functional and relevant to the world. More so, “Curriculum is more than notes on a page and radical transformation of teaching is required to broaden participation in computing” (Goode, Chapman, & Margolis, 2012).

3.1 Curriculum development

Departments in educational institutions of higher learning design (or develop) curricula in line with the choices that appeal to their students. According to Braslavsky and Halil (2005), curriculum
development is a process of developing the study program, which includes improving the curriculum. Various approaches are useful in developing curricula. Bilbao, Lucido, Iringan and Javier explain that ordinarily used approaches consist of analysis, design, selection, formation, and review. Analysis consists of ascertaining a need analysis, and task analysis. Design refers to objectively constructing the curriculum. Selection entails choosing suitable learning and teaching methods, and appropriate assessment methods. Then formation of the curriculum entails when an implementation committee or curriculum evaluation committee combines selected materials and include them in the content to be taught to the learners. Lastly, review is the part that requires constantly evaluating the curriculum in line with the trends and emerging requirements.

3.2 Challenges of curriculum development

To design a curriculum is a challenge that requires extensive subject knowledge and knowledge of the process of curriculum development. Also, knowing only one of subject knowledge or curriculum development is not enough while knowing both of these skills still requires quality assurance from other experts to ensure that the curriculum developed is worthy of presenting. Amadio (2014) points that one of the main challenges in educational curriculum is its standing relative to other institutions. Some curricula may be viewed as the relative or perceived curriculum inferiority of a curriculum when compared to other curricula, thus making the involved institution vulnerable to losing competition for best students. Other challenges are the trends that coerce change and adaptation in the curriculum to fit the changes. This therefore relates to the challenge of time and resources to embark on these activities. It is also a challenge to be in the forefront of best curriculum. This requires extensive research, which is generally scarce due to lack of training and focus in research. In order to match the leaders in curriculum development, there is high a level of innovation required from the developer. To be in the forefront, it requires that there be a continuous and constant adaptation and advancement of the curriculum based on emerging trends, and be part of the formation of these trends. It is a great challenge to lead, and a greater one to sustain the leadership. However, due to acceptance of improvement, being among the leaders is often considered enough to be equated to the leaders.

The challenges may also be caused by inadequacy of superiors, or subordinates (Hughes, Lee, Tian, Newman & Legood, 2018). When innovation lacks at the top tier of an organisation, subordinates may consider it as an irrelevant or unnecessary consideration for the organisation. On the other hand, when the innovative mind lacks at subordinate levels, the lacklustre subordinates who cannot implement the innovative ideas may frustrate any management idea targeted at innovating. It is therefore necessary for many organisational levels to be able to generate new ideas and thoughts, and to spot opportunities of innovation for teams in the organisation to use them in research and innovation.

3.3 Curriculum innovation

To innovate is to invent, and innovation may, therefore, be viewed as the pragmatic action of inventing. It may also be viewed as renewal, or revolutionizing. Edison, Ali and Torkara (2013) view innovation in its modern meaning as a new impression, creative ideas, and new thoughts such as device or method. In some instances, innovation may entail an application of better solution that meet new requirements, unstated needs, or existing market needs. Such innovation takes place through the provision of more-effective services or any items that are made available to the markets or users. An innovation is something original and more effective and, consequently, new, that "breaks into" the market or society. According to Frankelius (2009), innovation is related to invention, but is more appropriate to involve the practical implementation of an invention, leading to a new and improved capability to make a meaningful impact in the market or society. Innovation can also be the result of a process that combines several novel ideas to improve some aspect of society. In addition, innovations may be created and delivered from empirical approaches such as application and research, in order to meet expanding demand of the consumer. Therefore, innovation is critical to make the organization successful.

3.4 Curriculum adaptation prospects

Changes in the curriculum are inevitable when the future is envisioned. This is despite the previous form of the curriculum or the subject discipline involved. Curriculum is not static. It is dynamic and changes regularly. This is because the needs of society change swiftly. This shows that every new curriculum that is implemented needs to be considered a pilot phase that can be renewed and updated after reviews. CS is a subject that transforms quickly, much more than many other subjects.

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Therefore, when a new CS curriculum emerges, there is already a need to adapt new developments in order to safeguard the technology used. The prospects of adapting a CS curriculum therefore, are always on an urgent platform.

4 METHODOLOGY
The study is an action research kind that entails learning from the process in order to apply the results to influence a required change. The participants targeted include current students who envision their work situation, working former students who participated in HE CS studies, and lecturers who are experts with the CS subject knowledge. The input that the study would receive from these respondents serves as the basis for adapting the new CSC design.

5 RATIONALE
The students of SMU tend to believe that the BSc degrees of SMU do not provide jobs as expected. There was a protest from the students as a result, which resulted in a strike by students demanding a review of the curricula for the BSc programme. This was then followed by a formal expert review of the BSc degrees in SMU, which was undertaken by experts from other HE institutions and industry. The panel recommended the review of the subject disciplines in SMU. This study is one of the initiatives to address that recommendation.

6 SIGNIFICANCE OF THE STUDY
If the study becomes successful, then the CSC will be relevant to the job market while still enabling the CS graduates to follow CS up to higher degrees, including research ones. Thus, the quality of the graduates from CS will increase, and the fact that the industry content forms part of it increases the employability of the CS students graduating from the programme. It will thus be increasing the marketability of the CS graduates for the job market, and enabling entrepreneurship for those who wish to pursue independent careers.

7 INTENDED OUTCOMES
The study plans to introduce an enhanced CSC. The envisaged curriculum will probably be on par with the best CS curricula in the country, and will be relevant for industry. It will also be more appealing to students.

8 THEORETICAL FRAMEWORK
The development of CSC should be grounded in the futuristic curriculum (Saedah & Wye, 2015). Futuristic curriculum rationale provides the restructuring of existing curriculum to meet global changes and challenges in digital age, which cover current and future. Futuristic curriculum development and integration of IST and entrepreneurship in academia transforms how CSC can be developed to incorporate new and current ideas. Futuristic theory is also linked to the constructivist theory that entails that learners construct knowledge out of their experiences and with associated pedagogical approaches that promote active learning or learning by doing (Ormrod, 2003). This entails that such a curriculum is future-oriented while still serving the current needs. It has advantages of training new graduates for the future. Futuristic curriculum provides for flexibility and has a lasting lifespan, which go hand-in-hand with the ever-changing CS discipline.

9 EXPERIENCES AT SMU ON COMPUTER SCIENCE CURRICULUM DEVELOPMENT (CSCD)
The field of Computer Science and Information Technology is changing at a much faster rate as compared to other mature fields like Mathematics, which has been in existence for many centuries. CS as a field of study still in its infancy has drastically changed to incorporate other areas like IT in recent times. Due to this instant change in the field of computing, it is paramount that higher HEIs reflect this change in their programme offerings.
At SMU, the curriculum is supposed to be relooked to reflect these changes every three (3) to four (4) years. The process however, is a laborious one. It starts at the relevant department thus, in this case Computer Science department (CSD) where programme change is initiated based on the stipulated frameworks prescribed by the department of higher education and training (DHET). The prescribed categories to be considered for any programme change are A, B and C (CHE, 2011). Category A is where there is no change to the existing programme (implying expansion like a name change to the programme) and requires internal approval. Category B is change to existing programme requiring less than fifty percent change (this applies introduction of new modules) and requires internal and DHET approval. Category C is where there is more than fifty percent change to the existing programme or a complete introduction of a new programme and requires internal approval, DHET, council for higher education (CHE), and South African Qualification and Assessment (SAQA). Relevant forms from DHET are completed and approval sought firstly, from School Board. If approved by school board, submission is made to executive committee of senate (ECS) for consideration. If ECS approves, documents then serve at senate for further approval. Once approved by these internal structures of the university, the institutional planning and development (IPAD) department takes the process over to liaise with outside stakeholders like DHET, CHE, and SAQA.

Internal processes have their own challenges. One has to know the meeting times of the school boards as they meet only twice per semester. Hence, proper planning by the department making a submission is very critical. IPAD unit makes a University submission to the outside stakeholders which means there is no guarantee that a submission by a single department could be send as it comes, it might have to wait for other submissions from different departments of the university.

Outside stakeholders have their own challenges as well. Once IPAD submits university submission to DHET for scrutiny and approval, DHET often send respective departmental submission back for additional information or new submission due to changes with their own processes like new forms which they do not often inform the respective HEIs IPAD departments. Unfortunately, CHE only meets once at the beginning of the year to consider curriculum submissions for approval or disapproval. Once approved the qualification has to go through the South African Qualifications Authority (SAQA) for registration and approval. These processes can take a minimum of 18 months or more. By the time, the programme is returned to the HEI for implementation it might take another year to be implemented. Considering a minimum of four (4) years from the time of initiation of curriculum development to implementation, a number of new things would have evolved in the CS and IT landscape. However, “if academe is to preserve what is good in its traditions and also preserve its mission to develop knowledge and educate others, then the higher education system needs a more robust adaptive mechanism than it has had to develop hitherto” (Laurillard, 2002). This necessitates for a change towards a more agile and responsive curriculum development (CD) process. A CD process that moves with speed for the new programme developed to be relevant needs of the given discipline such as CS and IT.

In case DHET approves the programme, it is forwarded to CHE. At CHE, a committee of only six individuals meet to consider submissions from all universities in the country. This committee does not meet regularly, so if on a scheduled date, the members do not form a quorum, that meeting is adjourned until next date.

As earlier mentioned, on average, it takes 18 months to get a category C programme to be approved. By that time, technology in the case of CSIT has already changed, meaning what has been approved requires changes being considered soon after or requiring changes before programme implementation.

10 RATIONALISATION OF COMPUTER SCIENCE CURRICULUM DEVELOPMENT (QUICKENING)

Prevailing trends should be incorporated into CSC every time as new knowledge is availed. For instance, the fourth industrial revolution has already been expounded and as such, CSC should embrace such ideas. Little trenches of change can effect further development by over the years. This fits into category A adjustment or changes to the CSC which do not need a programme overall and as such does not require to go through external accreditation and approvals by statutory bodies such as SAQA, CHE and the DHET. Such additions only require faculty approvals. This overcomes the bottlenecks experienced in updating CSC. Peers and external examiners will do quality assurance internally.
11 DISCUSSION

Some benefits of the proposed approach are value addition, cost saving, empowerment and bridging the gap between theoretical knowledge and industry expertise. It also incorporates early mentorship of students into the world of work. Challenges may arise as curriculum development will require the use of people in the faculty who might not be experts in the new areas to be incorporated. Such faculty members may act against the implementation of changes to the curriculum. These may frustrate the progress in making changes required. Lack of understanding, conflict of interest might arise within the faculty members as they might not want to be exposed to their lack of expertise on the changes to be effected in the CSC. There could also be resistance to change due to such conflicts of interests and lack of expertise.

12 CONCLUSION

The discussions are based on one phase of a three-phased project. The participants lacked industrial experience but are exposed to CS techniques and applications on campus through the Information Communication Technology (ICT) department. ICT department is into supporting the academics and other relevant arms of the university such as human resources systems. Through the participants' communication with industry and as well as their limited exposure/experience through the ICT department, there seem to view the ideas of integrating IST and entrepreneurship in CSC as one of the noble implementation. The indications are that there is interest in the adaptations of curriculum integration of IST and entrepreneurship in the CSC.

REFERENCES


