A paper presented in the 16th International Conference on Sustainable Development at the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Bangkok, Thailand, 2022.

Enhancing Sustainable Development in Developing Countries with In-house Development of an Interactive Video Platform for Learning Programming Concepts

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OIDA International Journal of Sustainable Development, Ontario International Development Agency, Canada.
ISSN 1923-6654 (print) ISSN 1923-6662 (online) www.oidaijsd.com
Also available at http://www.ssrn.com/link/OIDA-Intl-Journal-Sustainable-Dev.html

Abstract: The impact of Information Systems towards development and sustainability in the world generally cannot be over-emphasized. Various advanced countries in different parts of the world have positively transformed their society with the use of Information Systems enabled with programming computers and related devices in the last few centuries. The net result was g progress to society, increasing the standard of living with benefits related to quality of life through the development of knowledge, products, and services with the ultimate goal of sustainable development. Notable areas and fields of works in which Information Systems development have undoubtedly contributed towards includes organizational payroll systems, e-commerce, online banking, online bookings of different services, communication systems, e-learning and virtual learning systems etc. Most of these systems are developed in advanced countries and developing countries purchase at exorbitant foreign currency-based prices. However, towards sustainability, developing countries have to get to a point where most of the needed systems are developed in-house. That would strive towards how it has now become well known for some countries that have leapfrogged towards development through progress in Information Systems development such that even advanced countries outsource some of their system development works to make use of their massive human talents at lower costs. Without doubt, that would increase employment rate and should serve a goal for many other developing countries that are especially low in financial fundings, plagued with high unemployment but yet buoyant with high human capital. But such laudable goal would involve developing countries seizing such opportunities and rigorously train programmers who will become the developers of the needed Information systems. We believe actions speaks louder than voice and there should thus be concerted efforts in teaching and learning programming to reach the level of bringing development and sustainability. However, learning programming is a complex task and is one of the subjects that students find challenging. This purpose of this paper is to ensure that our students face reduced difficulties in programming. Poorly designed course, students' weakness in English language, lack of practice and exercises feedback, and lecturers' insufficient skills in organizing the material and lack of support by the university were seen as possible factors related to the difficulties. Some of the difficulties involve comprehending learning materials in slide presentations from the lecturers, and low involvement in class interactive visualizations. This study emphasized the need, development and usability of interactive video platform method to enhance teaching and learning of programming. This is different from Learning Management Systems (LMS) in that it directly strives to automate the role of the lecturer or at least a summarized textbook in video form. Enhancing online Video is often attractive to capture lecture content and present direct instruction. The advantages of interactive video platform include benefits such as able to provide 24-hour service that can serve different time zones, able to have knowledge in multiple domains, and can be accessed anywhere by student to be able to learn. Video has become an important part of higher education. This study adopts a qualitative research approach using prototyping research and related method such as participatory design and the design science method. This adopt both single double-loop learning that promotes "doing things better" perspective as well

as double loop learning that promotes “doing things differently” perspective towards enabling sustainable development in that future Information Systems developers are able learn to do their work effectively in spite of some compromising situations.

Keywords: Enhancing teaching and learning, Interactive video platform, online systems, Programming learning systems, Video aided learning

Introduction

Information Systems development as the engine of information and communication technologies (ICTs) has been known to be capable of leading to development which can be in simple terms be understood to refer to a state of improvement. Mansell and Wehn (1998, p.11) explain that the former United Nations Secretary General Kofi Annan emphasises the enormous potential of information and communication technologies (ICTs) for development in the remarks to the first meeting of the United Nations Working Group on Informatics. Every nation would love to fully actualize this enormous potential. This is a desirable state for any society. This was desirable to be achieved without incurring major social costs. An important aspiration of people is to sustain the state of development they might be, and to continue to grow more into further developmental state. Brown (2017) explains that sustainable development (SD) is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. In this regard of Information Systems development, we have to plan ahead for ways that would ensure that future Information Systems developers are able learn to do their work effectively without any compromising situation. For example, the advent of the COVID-19 pandemic in 2019 has shown the world the need to plan ahead and be able to quickly overcome any compromising situation.

Due to the lockdown as a result of the COVID-19 pandemic, many institutions of higher learning were shot around March and April 2020 and the lockdown lasted for many months and years in some other countries. Many institutions resorted to using a combination of virtual communication systems like zoom with Learning Management Systems (LMS). However, the cost of streaming voice and video is very prohibitive especially for students in developing countries. Tshwane University of Technology is one of the universities that provided students with funds for data access to telecommunication platforms for most part of 2020. This however becomes unsustainable and was thus stopped in 2021. However, apart from the cost situation, even as the COVID situation subsided in South Africa, many lecturers are still wary of standing among the crowd of students while delivering lectures and consultations. It is therefore vital to seek other ways to facilitate and ease teaching and learning.

One of such ways to facilitate and ease teaching and learning could involve using and interactive video system. This is different from Learning Management Systems (LMS) in that it directly strives to automate the role of the lecturer or at least a summarized textbook in video form. Enhancing online Video is often attractive to capture lecture content and present direct instruction. The advantages of interactive video platform include benefits such as able to provide 24-hour service that can serve different time zones, able to have knowledge in multiple domains, and can be accessed anywhere by student to be able to learn. This could serve to strive towards sustainability even in the face of compromising situation such as the COVID-19 pandemic.

Such system would be in line with explanation by Alcaraz and Bell (2014) that sustainability includes social, ecological, and economic principles, which are connected to the quality of life of society, ecological and social justice, and economic opportunities. Quality of life of society refers to human development, social and ecological justice, as well as welfare economics. In this sense, it is vital that new products and services introduced to society should cover a social, ecological, and economic benefit for users. New products and services introduced to society enabled by technology and innovation have benefits related to quality of life through the development of knowledge enabling such products, and services. It is of further advantage for such innovation to overcome ecological, medical and social justice, and economic challenges due to new possibilities.

But for these innovation in technologies to work effectively, computer programming efforts are involved in converting data to more meaningful information leading to greater heights in Information Systems development. Programming is an aspect of computer science in universities which is perceived to be the challenging. Recent literature relating to computer science education implies the need for several ways of making computer science concepts accessible, engaging and fun, and more importantly, giving students a deep understanding of these concepts. In the last few years, technical developments in computer power and internet bandwidth have brought new possibilities to use the video tool for learning and teaching in more interactive ways. Internet made it easier to create an active learning with videos with training material that offers more possibilities for an intervention of the learner into the flow of the video. Higher interactivity has been shown to be beneficial for the motivation and learning outcome (Stephan, 2010).

Meanwhile, a major problem that university encounters these days is a high percentage of students having challenges with programming. In most cases the reasons include difficulties to understand course topics, difficulties with time management, and preference for other courses. Computer science lecturer's conceptions of studying were often content oriented. The teachers considered theory and concepts of computer science and the ability to apply knowledge to be the most difficult for the students. There is thus the need for solutions such as involving the use of videos that students can continuously watch to enhance learning not only when they in class but at any given time thus complementing lecturers' presentations.

The use of interactive video in higher educational settings is accelerating rapidly in departments across all discipline's curricula. Video can be used not only for teaching, but also for studying and learning in and outside the classroom enabling students to continue with the learning and practising using the online video. Introducing new content does not merely mean that lecturers have to equip themselves with new subject knowledge, which of course in many cases they do (Brown et al. 2013; Sentence et al. 2013; Thompson and Bell, 2013). Lecturers also need to learn appropriate pedagogies for delivering a new subject, particularly in those aspects of computer science that relate to algorithms, programming and the development of computational thinking skills.

An area of interest is the extent to which teachers provide a real-world context for learning and relating it to students' interests and understanding and the value of a rich discourse regarding concepts (Grover and Pea 2013). Access to web-based information and to communication tools allowing feedback and interaction with a tutor or with peers adds a dimension to the interactivity. It becomes a transactive type of interactive video (Rhodes & Azbell, 1985). This study is closest to a proactive type of interaction with the video. An additional feature used in this research is the addition of text into the video (captions). Using different information channels (video and text) in computer-based courses enhances learning and understanding. By drawing attention to a certain topic addressed in the video, and text, one can help the learner to organize the information towards assimilation.

This study also identifies several best practices to apply to the kinds of video you might produce as supportive material in relation to students' learning task to ensure that your video is as effective and engaging as possible. Video as a change agent in the classroom has undergone a unique cycle of adoption over time (Figure 1). Broadcast television and film were first used sparingly, primarily as out-of-the classroom forms of enrichment (assignments to supplement class work).

The purpose of this research is thus to implement an authoring tool for producing interactive video to be run on the browser. Access to web-based information and to communication tools allowing feedback and interaction with a tutor or with peers adds a dimension to the interactivity. The ultimate goal is to allow students to engage in learning more not only when they in class but at any given time. This research is expected to offer a solution to make students' study life easy by also allowing them to access the system at any given time to be able to practice and go through the video over and over till they understand.

The next section reviews the literature on how the previous researchers worked on the relationship between usage of interactive video platform with behaviour and perception of users towards the system. This is followed by the methodology section that discusses the methods used in this research to achieve the objectives and the system architecture. This is then followed by the section that explains the system results followed by the evaluation results and lastly the conclusion.

Literature Review

The flexibility and accessibility that comes along with web based applications have made them extremely standard in today's school systems (Yu, Kangas, and Brewster, 2003). This section presents related studies.

Flipped Learning platforms

Flipped learning, which is more commonly referred to as "the flipped classroom", is a growing teaching trend. In flipped learning, active and intentional transfer of some time to make better use of the face-to-face interaction in school (Bennett et al., 2012). This is often done with teacher created online videos (also referred to as screencasts or vodcasts). All students can re-watch the video as needed. This frees more class time for collaboration and discussions. Learners have immediate and easy access to any topic when they need it, leaving the teacher with more opportunities to expand on higher order thinking skills and enrichment. Time becomes available for students to collaborate with peers, engage more deeply with content, and receive immediate feedback from their instructor (Hamden, McKnight, McKnight, & Arfstrom, 2013). The most important feature of the flipped class model is to increase teacher to student and student to student interaction during class time.

Moodle Learning platform

Moodle is a free educational web application designed for e-learning (Dougiamas,1998; Wu, 2008). Moodle includes flexible features including the layout, course management, assessment strategy quizzes, and cooperative learning (Wu, 2008). Using the functional modules of the Moodle learning platform, teachers can guide interactive activities for online group discussion, examinations, and assessments. It provides a means to collect students' opinions and information on their learning process and helps teachers understand students' personal aptitudes and academic achievements to enhance teaching quality and efficiency. Students become active learners, rather than knowledge receivers (Baillie & Percoco, 2000; Chen, Lou, & Luo, 2001). Moodle had pedagogical advantages since it was built in accordance with the teaching approach which emphasizes the construction of knowledge through active and interactive learning and learning multi-sensory experience through multimedia. The design of Moodle was based on socio-constructivist pedagogy (Brandl, 2005; Palincsar, 1998; Shachar & Neumann).

Issues concerning learning programming

Introductory computer programming has been the subject of many research papers, focusing on a wide range of technical and educational aspects. Giangrande (2007) highlights that the issues include "which programming language should be used, which methodology should be taught, which topics should be included" (pg. 153). Debates over Structured versus Object Oriented driven curriculum still continue to divide computing educators. Lister et. al. (2006) says, "The SIGCSE community is currently sustaining a very vigorous debate on the teaching of programming, with particular regard to the question of objects first" (pg. 147). Research by Schulte and Bennedsen (2006) showed that 79% of surveyed universities covered Object Oriented concepts, with 52%, slightly over half, covering objects first. The debate also rages as to the appropriate choice of programming language, with many favouring widely used languages such as C++ and Java while others advocate 'conceptual' languages or alternate approaches such as the use of games or toolkits in order to focus on logical thinking and implementation.

Learning to program is a complex task. The students face real difficulties in programming. The students lack the ability for problem solving and design at its different stages, and general programming topics. Finally, one of the difficulties was the students' level of maturity. This category included students' conduct: need for hard work, class and lab attendance, solving home works and exercises, getting feedback from the lecturers, and involvement in class interactive visualizations.

Accessing Web-based interactive videos

A video is a program that is used to participate in conversations with humans. More sophisticated videos could learn from the user input. Nowadays they are used widely in web applications in order to provide feedback or information when it is asked by the users (Polatidis, 2014).

Below are possible benefits of interactive video:

- Grab a student's attention, spark curiosity, and provide value to the course content.
- Provide multiple perspectives of the same material rather than relying on a single viewpoint (Brunvand, 2010).
- Be reflective tools for learners as they work to integrate and apply new information into their pre-existing knowledge by allowing students to comment and respond to the videos they view (Brunvand, 2010).
- Used to provide instructional material as an alternative to in class live lecture. It makes use of the subject matter and expertise of the instructor while also allowing the instructor to be "a guide on the side" in an active learning environment. Note, this does not suggest digitizing an in-class lecture but redesigning a lecture to serve a new purpose
- Be reflective tools for learners as they work to integrate and apply new information into their pre-existing knowledge by allowing students to comment and respond to the videos they view (Brunvand, 2010).
- Be an archived resource that students can access anywhere and anytime from first exposure to review and remediation.

How Video enhances teaching and learning

It is important not to fall into the trap of considering that the use of technology or media is going to be the "silver bullet" that will make students learn or be more motivated. The learning activities that students perform with videos are a critical part of the learning outcomes and motivations (Boyle, 1997). That is, simply presenting information in a stimulating digital video format will not automatically nor necessarily lead to in-depth learning (Karppinen, 2005). Rather it is the pedagogy, the well crafted message, the whole approach, and design that are the critical elements, not

the media. It is the instructor's task "to create a coherent narrative path through the mediated instruction and activity set such that students are aware of the explicit and implicit learning goals and activities in which they participate" (Anderson et al., 2001, p.6).

Challenges on using video

- Video as direct instruction or lecture capture is a less active experience than other strategies. It does not guarantee in-depth learning and thus should be paired with a meaningful learning activity.
- Video can hinder students with higher prior knowledge who might benefit more with a different instructional format such as text or images. This is known as the expertise reversal effect (Kalyuga, 2007).

Teaching and learning sources

Nowadays classroom teaching makes use of many classical and more recent tools, such as blackboards, video, overhead and digital projectors connected to computers. A problem with presenting learning material this way is that learners cannot easily reproduce the lecture content and the lecturing sequence in the same way a teacher does during a lecture (Fransson et al., 2000), because the elements originate from different media sources and some. Also, it is well known from the educational practice that repetition of once performed activity is one of the key learning mechanisms. Certain lecture elements are available afterwards in the form of notes. But multimedia materials, like videos or simulations, usually are not easily accessible, and colourful slides shown by teachers are often given to the students as black and white paper copies instead. Or, if available, the content elements are sometimes given to the students in the form of file sets. This results in knowledge object fragmentation, which could make studying less efficient, because content structure, sequence and interconnections in such material are often unclear.

A remark from the said above is that the slide shows do not serve as well for students as they do for teachers, because teachers tend to use the slide-shows as a support for their own presentation sequence without much focus on the students' need of learning about topic details. A typical slide show contains keywords and headlines, and the rest of information is presented orally or on a blackboard. This presentation segmentation constitutes a considerable problem for students when they have to connect all the separate elements in one.

Other related studies on educational tools for learning towards development in South Africa

In further demonstrating the need for in-house development of systems especially those that could enhance collaborative Learning, Iwasokun and Dehinbo (2015) presents a prototype for a study on "A Web-Based Virtual Classroom System for Collaborative Learning". Collaborative Learning can further be enhanced with the use of a blog-based system. Thus, Mashishi, Dehinbo and Dehinbo (2015) presents the Development of a prototype Blog System to Enhance Interactive Communication towards Supporting Learning. This addresses the limitation of the Blackboard system used by then, which cannot be accessed by students not currently registered for a subject and does not include the pictures of students in identifying participants in an academic discussion. Thus, it is possible for participants in an academic discussion to meet outside the class and not recognize on another.

Mashishi, Dehinbo and Dehinbo (2015) thus ague that in solving those limitations, participants in an academic discussion can continue the discussion even outside the class and even when they have graduated or are no longer registered for the subject. Thus, on a blog-based discussion on array processing optimization, even past students that have passed the programming subject can pass knowledge to currently registered students. Akussah and Dehinbo (2018) discuss developing a prototype for a Marker-based Handheld Augmented Reality Application for Learning Mathematics.

Thinking of more ways to enhance learning, we note that the millennium generation are usually on social media on their phone. Therefore, why not exploit the possibility of learning using social media? Therefore, Dehinbo (2016) presents a study on using Facebook Social Network to Enhance Interactive Communication toward Supporting Learning in African Higher Institution. And we know that using social media involves abbreviating texts and using slangs to communicate within limited space available. It is thus important to normalize abbreviated texts and slangs. Therefore, Adedamola, Modupe and Dehinbo, presents a study on development and evaluation of a prototype system for normalizing Internet Slangs in Social Media Texts, so as to allow meaningful learning.

For sustainable development of the whole society, learning would not be limited to academic institutions. Business people and entrepreneurs also needs to learn more to enhance their productivity. Therefore, Maseko, Dehinbo and Dehinbo (2016) presents a study on the Development and Evaluation of an E-Learning System towards enhancing Entrepreneurial Skills. In not limiting learning to text-based systems only, Mdluli and Dehinbo (2016) presents a

prototype for a study on the development of an Audio-Visual Based E-Learning System to Enhance Interaction between Learners and Teachers. Msiza and Dehinbo (2019) presents a prototype system to Visually Demonstrate the Key Concepts of Multimedia Fundamentals for Undergraduates. Shabane and Dehinbo (2019) presents a study on Developing and Exploring the Use of Virtual Reality Learning System to Teach Mathematics Toward Minimizing Failure Rate.

Also, Montshiwa and Dehinbo (2018) presents a study on multimedia application to assist Elders' in learning to use e-banking services. This is in line with the statement for sustainable development, one has to spend equal amount on energy spent on making money on keeping the money. And still on sustainable development of the whole society, children and pre-scholars should not be left out, in view of the general saying "catch them young". Noting that they would respond more to interactive multimedia elements for learning, Letsoalo and Dehinbo (2016) present a prototype study on enhanced Interactive Multimedia System as an Additional Learning Tool for Pre-Scholars.

Uniqueness of the study

Towards closing the gaps identified above, this study focuses on the interactive video platform system for students that will enable students to learn programming step by step without having to wonder if the class will end soon. This is because they can also be able to access the system at any given time, in or outside the classroom and understand it better. The prototype developed in this study is different from Learning Management Systems (LMS) in that it directly strives to serve somehow in between automating the role of the lecturer and at least being an organized, summarized textbook in video form.

Research Design and Methodology

This study adopts a quantitative overall research strategy. This consists of prototyping as well as survey to gather data on evaluation that is revised and tabulated in numbers, which allows the data to be characterised by the use of statistical analysis (Hittleman and Simon, 1997, p. 31). Thus positivist research is used as a research approach of this study because is more objectives. In positivist research, researchers identify themselves and their research as independent. Conducting and gathering of quantifiable data are typical methods used in positivist research. Results are usually quantitatively analysed. Positivist research findings are objectively reported and may be generalised (Bhattacherjee, 2012; March & Storey, 2008; Myers, 2009:284).

Prototyping

Olivier (2009, p.51) explains that the term *prototype* refers to a simplified program or system that serves as a guide or example for the complete program or system. One presents the prototype to make the statement that it is also possible to implement certain concept in practice.

Prototyping methodology is now as fundamental to software development as it has been to systems development in other fields.The use of prototyping has been developed to the level of being the basis for software development methodologies, such as the Evolutionary Prototyping lifecycle model. Sommerville states that the evolutionary prototyping methodology "is now the normal technique used for web-site development and ecommerce applications (Zant, 2005) .

Starting with a prototype, modules are being tested with test users in three iterative cycles during which the prototypes and the testing tools are further refined and adapted to the observations made, focusing on efficiency, acceptability and effectiveness of the module.

System tools and architecture

The interactive video system is fully deployed and hosted on the cloud and no local resources are used. The Microsoft Azure cloud platform is used because it enables building, deploying, and managing services and applications on a single platform. This system is deployed as two Web applications running as shared App services on the cloud. One Web application is for the front-end and the other for the back-end. A document database is used to be able to have the scalability and flexibility with the querying and indexing needed. MongoDB is chosen because stores data in flexible, JSON-like documents, meaning fields can vary from document to document and data structure can be changed over time. This database is also hosted on the cloud and the back-end web application has access to the database as illustrated in figure 1 below.

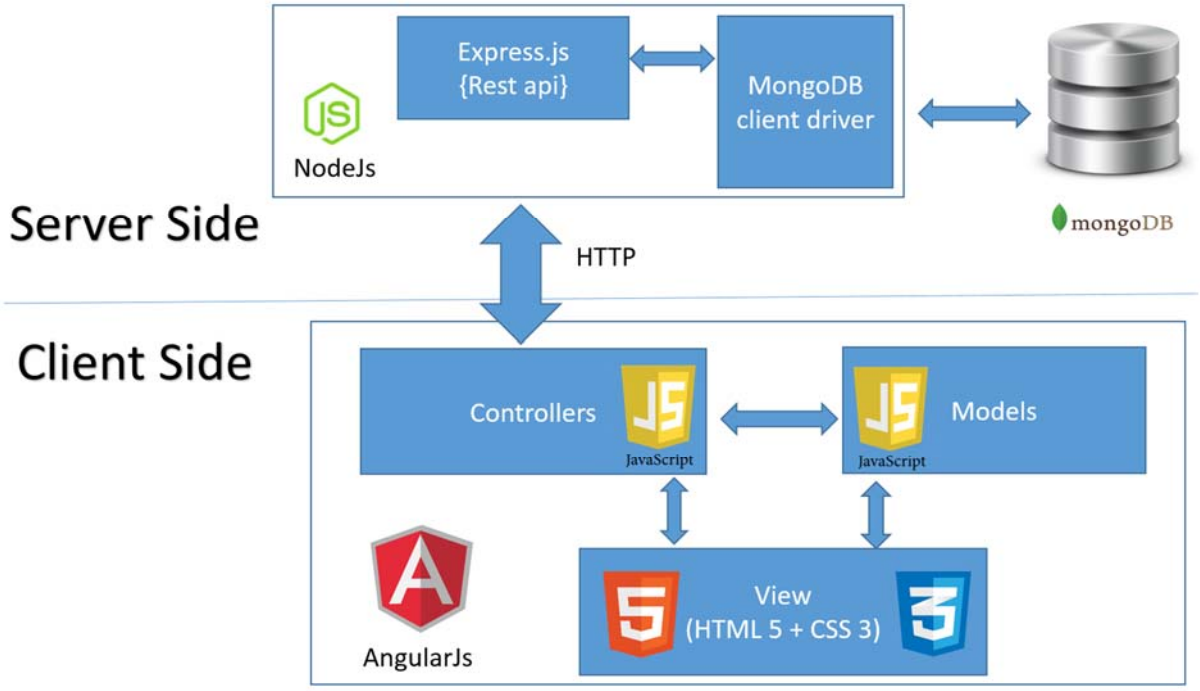

Figure 1: System Architecture Diagram

The backend web application is a Representational State Transfer (REST) web service application. REST is a the most used Web standard architecture and HTTP protocol. This REST application will be based on NodeJS. NodeJS is an asynchronous event driven JavaScript runtime, Node is designed to build scalable network applications. Through this technology, an Application interface (API) will be developed to enable to front-end application to consume.

The front-end application is based on Angular. Just like NodeJS, Angular is also based on JavaScript which may be an advantage and save learning time because whole technology stack is based on one language. Angular helps build modern applications for the web, mobile, or desktop. In our project, we will create a responsive Web application that is responsive to all desktop, tablet and mobile devices. IN addition to JavaScript, HTML and CSS are used for the presentation of content.

Survey

Survey is the method for the evaluation of the online system. Details are as follows: The ideal population for this study would consist of the students of an institution. According to Huysamen (1994:38), the populations of interest to social and behavioural scientists are so large that from a practical point of view it is simply impossible to conduct research on all of them. So the simple random sampling is used, which gave each member of the population the same chance of being included in the sample and each sample of a particular size the same probability of being the sample chosen (Huysamen, 1994:39) in the sample.

Statistical analyses are used as quantitative measures aimed to explain connecting relationships. Most often, in Information Technology research, these methods can only determine relationships between the different factors studied. (Creswell, 2003).

System Development Results

The system has been successfully designed and developed using HyperText Markup Language (HTML), JavaScript, Cascading Style Sheet (CSS), Node.js, Angular.js and Ajax and JQuery. The prototyping thus serves as for proof of solution development and problem solving. The application has been deployed and can be accessed with the following address https://interactivevideo.azurewebsites.net/login. The landing page allow students who have registered for programming to use their credintials to login to the system. The page also has a link for forget password for those

who wont remember their password. The menu also includes the 'remember' check box to stay logged on the system. Below are system screenshoot figures.

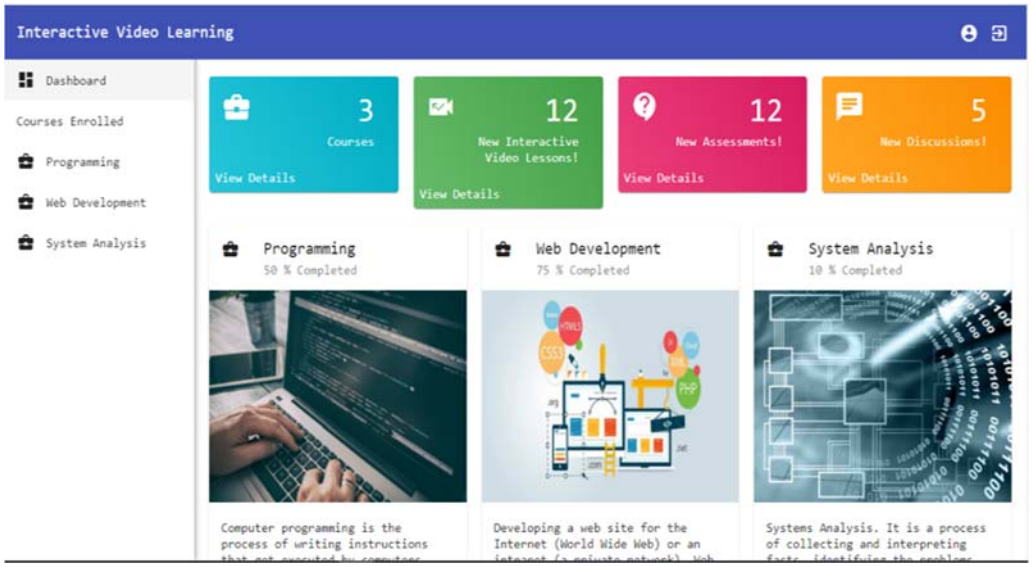

Figure 2: Landing page

One can access the dashboard which contains most of the links to access frequently used functions as shown in figure 2. As an example, a click on Programming lessons will lead to figure 3 below.

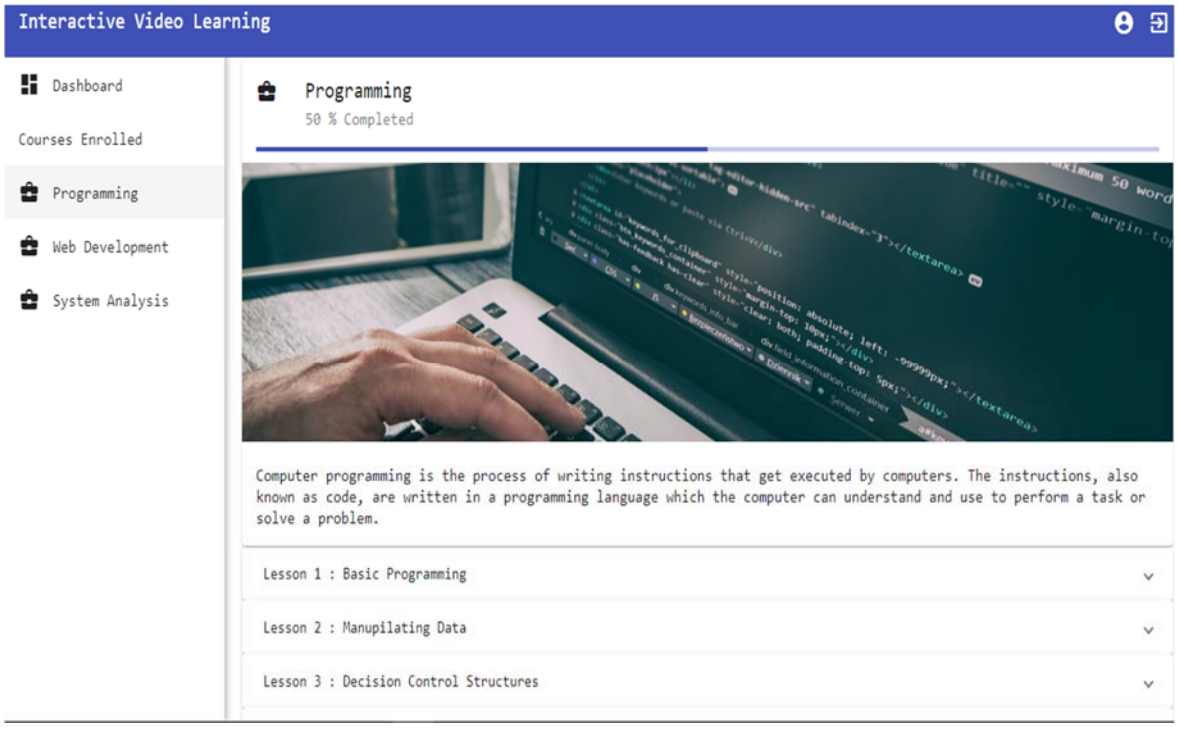

Figure 3: Course enrolled

Then one can click on the course enrolled to access the lesson. An example is given in figure 4 below.

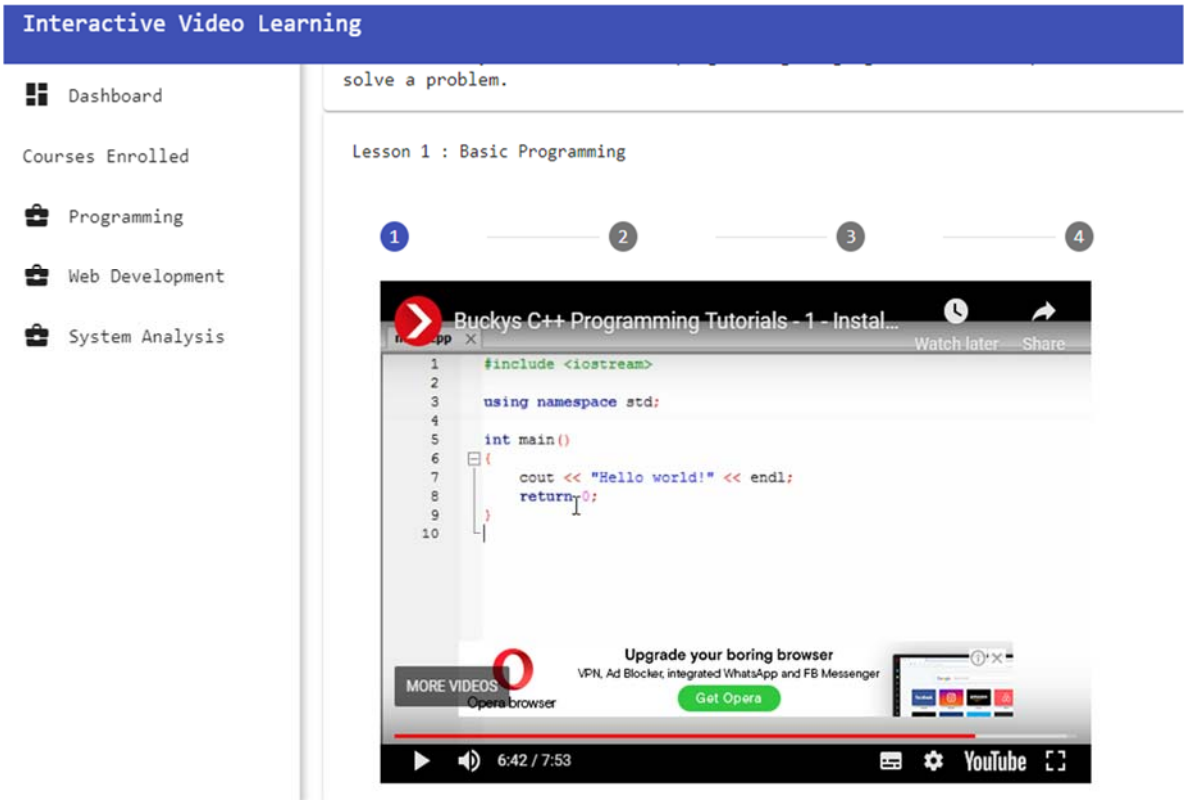

Figure 4: Video lesson

A click on the lesson would start the video tutorial. And there are questions and answers in figure 5 below. A question will pop after the lesson has ended. The student will have to answer the question correctly to be able to move to the next lesson. Figure 6 gives the list of lessons on programming.

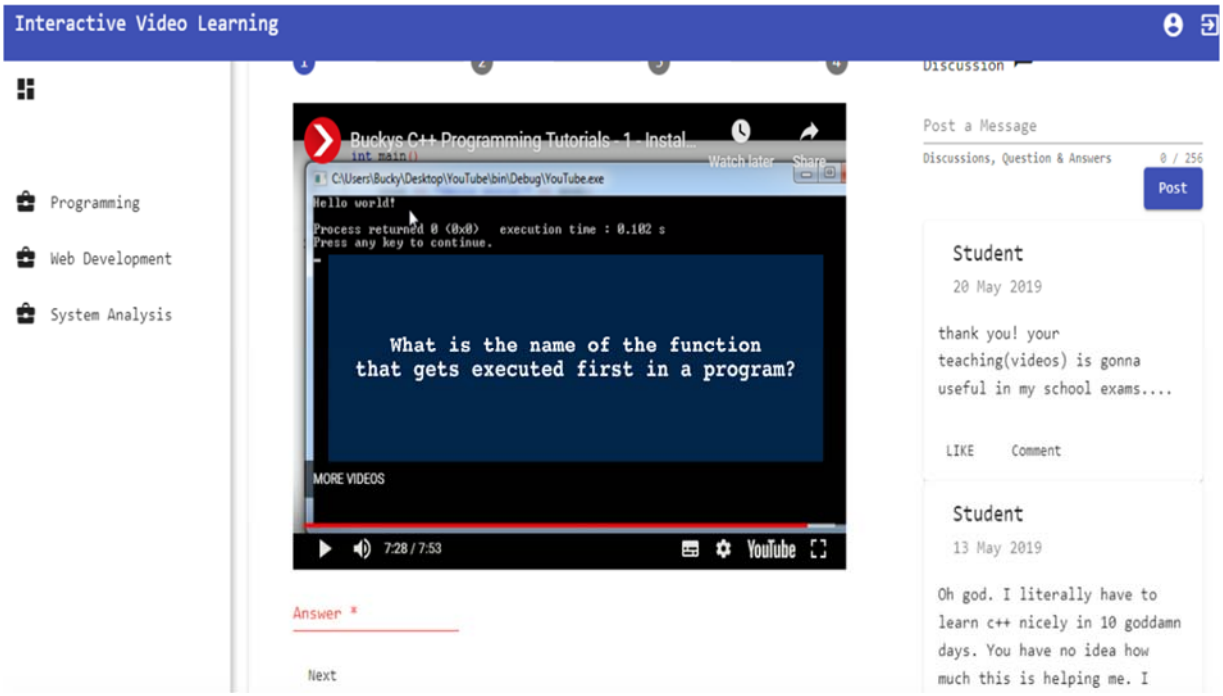

Figure 5: Questions and answers

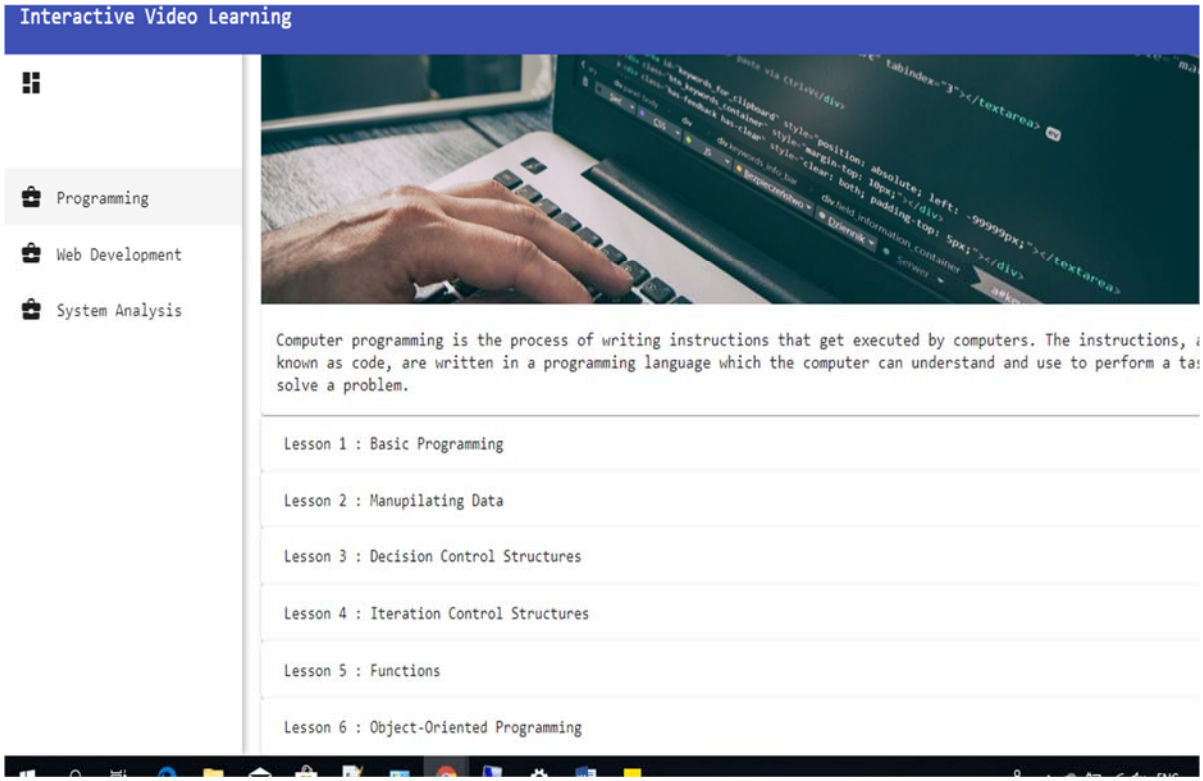

Figure 6: List of lessons

A student can learn each lesson based on how they understand and answering questions before moving to the next one. Figure 7 shows that students can post messages on discussion board. Student can add comments or further questions, and answers to communicate with the lecturer or other students, probably to discuss issues and be able to give solutions to each other.

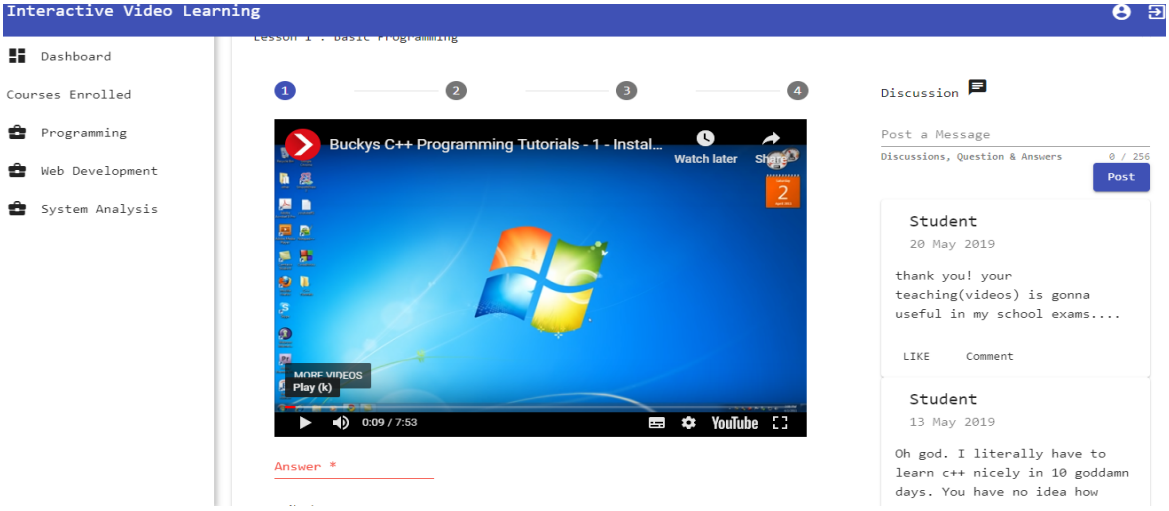

Figure 7: Discussion tab

System Evaluation Results

Survey is a suitable tool for the evaluation to be done. This is a situation where the questions are provided to the users of the prototype system to rate the functionality and features of the application. Evaluation is an important component of the research process because a system cannot be said to be successful until a reasonable sample of the users confirms that the system meets or exceeds their expectations and requirements. According to Hevner (2007) there are different ways in which IT objects can be evaluated. These ways include functionality, completeness, usability, consistency, accuracy, performance, reliability and how it fits within the context.

These are aimed at addressing research findings on the experience of users on the web based application for interactive video platform results of the system development. These involves giving access to the developed prototype application for all the participants and then admister the questionnaire to them to solicit their feedback or responses. The responents can also be further tested in the areas of prototype use and walkthroughs. The responses can then be carefully analyzed afterwards and tabulated into relevant information. The user experience allows the participants to suggest any changes they feel could improve the application design (Aggarwal, et al., 2000). However, the evaluation of the system is a separate study on its own with its own methodology. Therefore, the evaluation would not be presented in this article due to space limitations but evaluation would be presented in future articles.

Discussions and Conclusions

Learning programming is a complex task. The ultimate purpose of this paper is to ensure that our students face reduced difficulties in programming. Already, some students lack the ability to effect problem solving and design at different stages, as well as understanding of general programming topics. Most of the students lack skills even to analyze a short piece of code. Poorly designed course, students' weakness in English language, lack of practice and exercises feedback, and lecturers' insufficient skills in organizing the material and as well as lack of support by the university (large number of students in labs, and non-availability of assistant lecturers), are seen as possible factors related to the difficulties. Finally, some of the difficulties involve comprehending learning materials in slide presentations from the lecturers, and low involvement in class interactive visualizations.

This study emphasized the need, development and usability of interactive video platform method to enhance teaching and learning of programming. The first step is to encourage lecturers to transform their excellent classes and lectures (already prepared in presentation form) into interactive, provocative classes with an innovative format that includes pauses, challenges, group discussions, and precise presentations by the teacher (namely, an active and collaborative class).

Teczke, Bespayeva and Bugubayeva (2017) observes that training in skills and professional development of the IT workforce is critical and is an important driver of development. This study also actualizes the paperless drive (i.e., reducing the use of paper in business processes). Xiong (2021) indicates that the paperless office is perhaps one of the most tangible examples of digitalization that has a positive impact on the environment while also providing major business performance benefits. Reducing paper use means less costs and less demand for paper, and less trees fell for producing paper. Recall in elementary biology that trees block winds and reduce wind erosion, gives fruits, serves as shades from sunshine, and absorbs carbon dioxide that humans breathe out while exhaling oxygen that we human inhale. Therefore, saving trees means saving the environment, and that is good for future sustainability. That could be why Alcaraz and Bell (2014) explains that the creation of new knowledge should impact the three principles of sustainability (ecological, economic, and social). Thus, progress in the paperless drive is based on the potential to bring economic cost savings as we reduce printing costs. It also brings social benefits as soft copies can easily and quickly move around social circles like on social media thus forging social cohesion. And then, it also brings ecological benefits by resulting in less damage to the environment, as demands for papers reduce and less trees are used to produce papers, less water used in the bleaching process to produce papers thus also reducing environmental toxicity.

Added to the above was the lockdown as a result of the COVID-19 pandemic, in which many institutions of higher learning were shot around March and April 2020 and the lockdown lasted for many months and years in some other countries. Towards solution for the lockdown, many institutions resorted to using a combination of virtual communication systems like zoom with Learning Management Systems (LMS). However, the cost of streaming voice and video is very prohibitive especially for students in developing countries. Tshwane University of Technology is one of the universities that provided students with funds for data access to telecommunication platforms for most part of 2020. This however becomes unsustainable and was thus stopped in 2021. However, apart from the cost situation,

even as the COVID situation subsided in South Africa, many lecturers are still wary of standing among the crowd of students while delivering lectures and consultations. It therefore became vital to seek other ways to facilitate and ease teaching and learning.

One of such ways to facilitate and ease teaching and learning could involve using and interactive video system as proposed in this study. This is different from Learning Management Systems (LMS) in that it directly strives to automate the role of the lecturer or at least a summarized textbook in video form. Enhancing online Video is often attractive to capture lecture content and present direct instruction. The advantages of interactive video platform include benefits such as able to provide 24-hour service that can serve different time zones, able to have knowledge in multiple domains, and can be accessed anywhere by student to be able to learn.

Such system would be in line with explanation by Alcaraz and Bell (2014) that sustainability includes social, ecological, and economic principles, which are connected to the quality of life of society, ecological and social justice, and economic opportunities. In this sense, it is vital that new products and services introduced to society should cover a social, ecological, and economic benefit for users. New products and services introduced to society enabled by technology and innovation have benefits related to quality of life through the development of knowledge enabling such products, and services. It is of further advantage for such innovation to overcome ecological, medical and social justice, and economic challenges due to new possibilities. This could serve to strive towards sustainability even in the face of compromising situation such as the COVID-19 pandemic. And even if there were to be other ecological disaster such as fire, earthquake etc. in future, students can still continue learning with this type of system even at lower costs. This is a step in the direction of sustainable development enabled with the use of information systems.

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