

Coding Language-Based Multi-Platform Apps: Digital Learning Tools For Programming Language Courses

Brandon G. Sibbaluca, Vernon E. Avila, Sammy V. Militante

Abstract— In this digital era, students are needed to be engaged in classroom activities to be able for the teachers succeed to impart the right lessons they need to impart and ensure that the students have totally grasped the provided lectures. With this, teachers are needed also to learn and understand the concept of the twenty-first century teaching strategies since their students are called to be the twenty-first century learners. With this idea, the main author opted to come up with alternative teaching and learning application tools that address the needs of today's learners to be engaged in the courses which involve computer programming concepts and real-life applications for better appreciation. These multi-platform software applications will deliver assistance to the subject-teachers handling various computer programming courses to deepen the programming abilities and skills of their students by providing various digital learning activities on desktop, web, and mobile platforms during class discussions. Digital learning tools are designed and developed in different forms; it may serve as a form of a motivational activity, a recap of the previous lesson, or an interactive learning game. These programming language-based applications will also encourage student engagement to keep the students more focused and motivated to learn different computer programming courses. With the advancement of these multi-platform software applications, students taking computer programming courses will be fascinated to learn the programming concepts and the fundamentals of different programming languages.

Index Term — Programming, Multi-platform, Apps, Digital Learning

I. INTRODUCTION

IN this fast-digital age, learners tend to be more engaging in classrooms depending on the type of strategy that the educator implies with the educated. It is imperative, nowadays, that both the learner and the learned learn to adapt to certain changes in education [1]. The learner and the learned must aim for outcome-based goals that are set between them. Adapting them must have certain mindsets and skills to accomplish tasks, which would take them to the real, competitive world ahead [2, 3]. In order to adapt to these changes, the educator must be fully aware of the two types of students in today's classroom: proactive students and reactive students. Proactive students have the desire to learn from educators who have well-mastered the course subject and can establish and prolong rapport. Reactive students tend to be reactive in the sense that they do not see the importance of the subject and do not feel that they are included in the classroom during lecture – like in the old way of educating: teacher speaks, students listen [4]. By establishing these identifying marks of students, establishing outcome-based goals, and using technology as a means of boosting-up students' performance, there are several tools which we may consider in prolonging the participation of the students. These are digital learning tools. These tools have the potential to capture students' attention and be active during class discussion through activities, such as interactive games or

drills, which will then improve the students' critical thinking skills and elevate their motivation [2]. In addition, these also assist 21st century learners to engage in social skills with their fellow learners or even to their educators [5, 6]. Due to the complexity and difficulty of these programming languages, there are times when students lose interest in pursuing these. Thus, the implementation of digital learning tools is necessary to coexist with the present education through driven assistance from the educator [9]. For the development of these tools, Java, JavaScript, and C# programming languages are being considered.

Programming languages are vocabularies of instructions that, whenever encoded to a computer, can perform various tasks. Each of the programming languages has its own edge in a platform to be used. It provides wide areas of the solution—from complex algorithms to a mere computation of arithmetic, which can cater to specific needs. These programming languages offer different platforms where users would run into [7] Platforms, on the other hand, are areas where people commune with technology, such as a means of gathering and processing information and communicating with other people. In order to get that information, these platforms provide users' interactivity with different kinds of software, whether the desktop-based program, online interactive Web form, or standalone mobile application. Each platform has a device in which software will run into [7, 8]. Since it is evident that these platforms and programs exist due to the development and innovation of programming languages, incorporating these with students is of great challenge and responsibility [1]. There is also a need to establish a digital learning tool to tertiary schools that would greatly aid students in their learning and aid educators in assessing and deepening students' capability [2].

II. OBJECTIVES

This developmental project aims to achieve the following:

1. Application software by means of the programming language used in a computer programming course that will offer added learning resources to the students.
2. Multi-platform applications that will serve as innovative

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teaching tools for the teachers handling computer programming courses.

3. Promote the 21st century teaching strategies/techniques.

III. LITERATURE REVIEW

In this digital age, technology progresses to the extent of a few months with another milestone of discovery. In looking towards future perspective, these learners are equipped with broader insights, skills, and capabilities to drive themselves for further growth. One aspect of these is communication. From these learners, communication will play a vital role since they will interact and participate in group learning activities. Since then, as a fact, are more inclined to technology, it is a must that the educator uses technology as a sort of a weapon to promote learning interactivity, develop good moral character, and foster a deeper understanding within the subject matter. The 21st-century digital learners must be able to possess certain qualities and skills for them to survive for the real and competitive world [1, 9]. In order to show these skills to these types of learners, certain strategies must be fostered and adapted in this 21st century. Strategies are a plan of actions that specialize in critical thinking and proper action, leading to proper end goals. As a 21st century educator, she/he must have the capacity to teach and reach all his/her learners. According to the theory of Howard Gardner, there are multiple intelligences that a person possesses. One of which is the eagerness to teach all learners. Teaching all learners implies the readiness of the educator to extend his/her time and effort in implementing new technology, fostering healthy interpersonal relationship through social media or any communication platform media, implementing outcome-based teaching, and embracing the changing times to let the learner be ready for anything. She/he also has the responsibility of bringing those multiple intelligences out of the learner through a unique and techie way, while establishing rapport towards students and looking for outcomes and changes [17]. Through the educator's responsibility, methods are formed from these strategies to cater different range of learners. Digital learning methods are new ways of imbibing learning towards students within the graspable limits of technology. These promise tools to help the educator impart learning to students and the students to assess themselves in their personal learning through direct participation using digital learning. The trend that we are facing is that everyone is inclined with their computers, Smartphone, tablets, and other gadgetry. Therefore, schools and other institutions must be able to adapt to the certain changes in imparting knowledge, deepening understanding, and developing thinking skills [9, 10]. From these methodologies, certain tools are created for the learner.

Digital learning tools use an interactive platform to reinforce the student's learning practice with a mix of tools and practices, including online and formative assessment; an increase in the focus and quality of teaching resources and time; online content and courses; and applications of technology in the course curricula among others. Tools and simulators are considered learning tools that utilize technology or the Internet to facilitate the learning process, such as computers, mobile phones, tablet PCs, projectors, or electronic books. With these tools, we can develop the skills needed by 21st-century students in order to survive the competitive world [9]. From the creation of these tools, it can help boost the learners programming capability. These tools can cater learning from these selected programming

languages: Sun Microsystems developed Java as an object-oriented language for general purpose commercial applications and interactive applications. It is widely prevalent among proficient programmers because it can build visually interesting graphical user interface and Web-based applications. Some of the advantages, that make Java a popular language, are its security features and the fact that it is architecturally neutral where, unlike many other languages, you can use Java to write a program that runs on any operating system platform or devices (i.e., PCs, phones, and tablet computers). If we can dwell more in Java, we will have a deeper understanding of the concepts used in object-oriented programming [11]. C# is another current object-oriented, general-purpose programming language, developed by Microsoft. It has a wide variety of applications with the inclusion of .NET platforms like office applications, Web applications, websites, desktop applications, mobile applications, games, and many others. It is a high-level language that is like Java and C++, both of which are object-oriented. It is very simple and easy to learn, and it is suitable for beginners. It is still widely used in some industries with renowned companies, making it one of the greatest prevalent programming languages [12]. JavaScript, also known as the Internet language, is also one of the most common programming languages, since the browser understands JavaScript natively independent of any plug-ins installed. It is not a language that can only be used in the frontend, but it can also be treated for backend processing using Node.js. It can be used for mobile development and is one of the most popular frameworks in Apache, which is a mobile hybrid framework that allows developers to code using HTML, CSS, and JavaScript, and allows you to build an app and generate an APK file for Android and IPA file for Apple iOS [13]. Through these programming languages, learning must not be bounded inside the four corners of the classroom. Through the help of these digital learning tools, learning is extended through different devices in multiple platforms. Upon the development of programs, web pages, and applications, the programming can lead developers in creating platforms, systems, applications, and services. It may be in the form of an operating system, a desktop-based program, interactive web-based forms, mobile-based applications, and so on. Platforms are media of information processing—basically hardware and software—wherein it can host services or applications to a field of work or specialty. It can also be treated as an architecture where applications or services only runs on a platform considering both hardware and software specification. In today's rapid influx of technology, a single service or application can run into different platforms due to the programmers who had spent developing scripts, programming codes, and updates that could ease up exclusivity [14 – 16]. In bringing easy and motivated learning from studying programming languages, we can establish these tools to different platforms so that learning is not limited to a single medium only. Through the different platforms, learning must be continuous and should not be limited inside the four walls of the classroom to provide better engagement of students in learning programming languages. It is convenient in today's world to develop digital learning tools in the form of services or application for the betterment of these 21st-century learners and educators. While embracing change in this fast-paced technological world, education is something that we cannot discount for in both 21st-century learners and educators alike.

Therefore, it is up to us to use these digital learning tools and strategies so that it could hone multiple intelligences and bring out the best of students in this digital age. One of which we could start is by implementing these tools for all courses with computer programming subjects. These tools must be implemented in multiple platforms, so that learning is accessible and flexible.

IV. METHODOLOGY

A developmental approach is used in this project. Details used in the development of the multi-platform applications are derived from the courseware materials of the following computer programming courses: Advanced Java Programming, Web Programming, and Mobile Programming; all of which are developed by the IT and Engineering Academic Research Group. Through this, the department came up with an idea to develop digital learning tools that will address the objectives. The unmodified "waterfall model" was applied in developing the software applications.

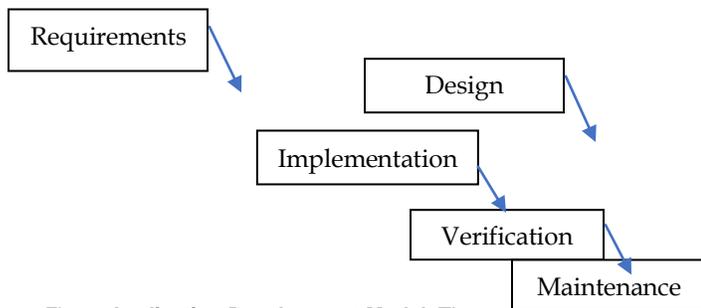


Fig. 1. **Application Development Model.** The

following stages were followed in order: 1) Software requirements: Took in a product requirements document; 2) Design: Resulting in the software architecture; 3) Implementation: The development, proving, and integration of software; 4) Verification: The systematic discovery and debugging of defects; and 5) Maintenance: The installation, migration, support, and maintenance of complete systems. Thus, the waterfall model keeps that one should move to a stage only when its preceding stage is reviewed and verified.

Below is the Block Diagram of the project:

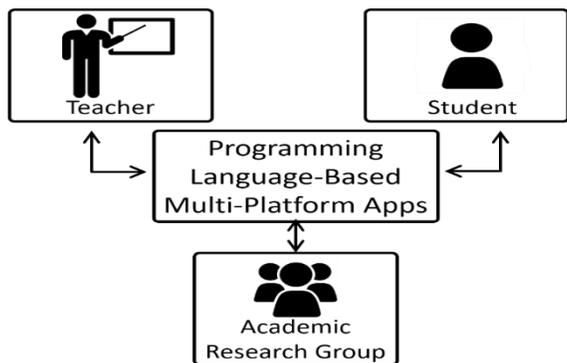


Fig. 2. **Block Diagram.** The Academic Research Group is in charge of developing courseware materials, including handouts for the students, instructional guides for the teachers, laboratory exercises, slide presentations, and digital learning tools, which will be used by the schools.

Below are some of the digital learning tools integrated in the computer programming courses:

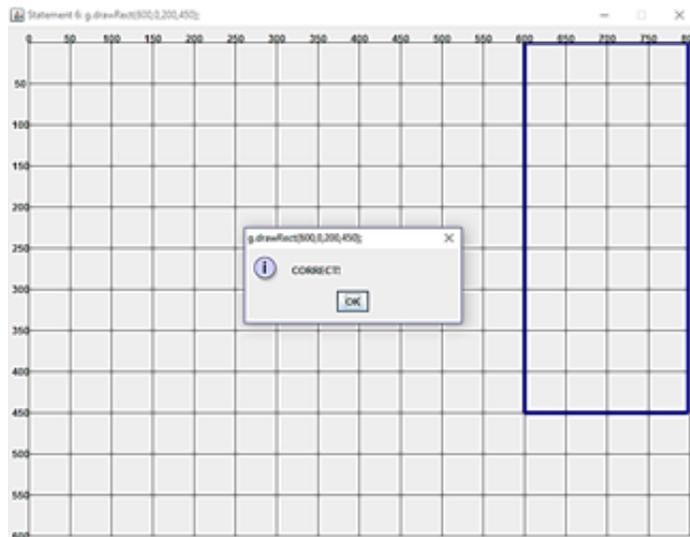


Fig. 3. **Java Lines and Rectangles.** This is a desktop game programmed in Java where students must draw the line, or a rectangle based on the given Java statement by dragging the mouse pointer.

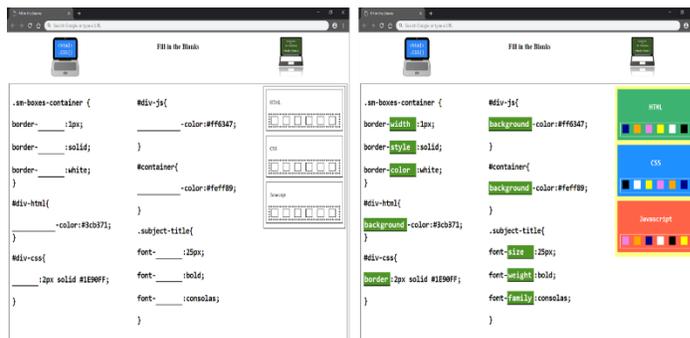


Fig. 4. **CSS Syntax Checker.** This is a Web-based game programmed in JavaScript where students have to type in the correct CSS syntax to complete the three different color palettes.



Fig. 5. **Bubble Tap App.** This is a mobile game programmed in C# where students must tap unique color bubbles to determine the secret mobile user interface component.

V. FINDINGS

Upon receipt of the complete courseware material package of the three computer programming courses, the six school officials and three teachers handling these courses have administered and facilitated these various digital learning activities in three different sections. It has also been observed

through the school's Electronic Learning Management System that one thirty-four student-respondents were motivated to learn new lessons in the courses are encouraged to participate in classroom discussions more actively. At the same time, these digital learning tools have helped them execute outcome-based education during class sessions and have brought them innovative ways to deliver up-to-date discussion. These developed tools were evaluated using the four-point Likert scale where 4; 3; 2; and 1 means strongly agree; agree; disagree; and strongly disagree, respectively. 3.26 – 4.00 as strongly agree; 2.51–3.25 as agree; 1.76 – 2.50 as disagree; and 1.00 – 1.75 as strongly disagree were used in interpreting the results. The **Weighted Mean** = $\frac{\sum wx}{\sum x}$ (where x is the total number of respondents and w is the equivalent weight of the responses of the respondents) was used to determine the overall mean value.

Statements	Students	Teachers	School Officials	Weighted Mean	Equivalent
Motivational tool for new lessons	3.65	4.00	4.00	3.67	Strongly Agree
Tool to recap the previous lesson	3.63	4.00	4.00	3.66	Strongly Agree
Increase students' engagements with the lessons	3.63	3.75	4.00	3.65	Strongly Agree
Average	3.64	3.92	4.00	3.66	Strongly Agree

Table 1. Mean Results Summary.

The data show that digital learning tools are evaluated by the students, teachers, and school officials on the following aspects: as a motivational tool for new lessons with a weighted mean of 3.67, as a tool to recap previous lessons with a weighted mean of 3.66, and increase students' engagements with the lessons with a weighted mean of 3.65, and are highly acceptable with an overall weighted mean of 3.66. This validates that the digital learning tools used in the three computer programming courses are relevant and very useful.

VI. CONCLUSION

Based on the evaluation results from the students, teachers, and school officials:

1. Digital learning tools highly encourage student engagements among students in various activities of the computer programming courses.
2. Teachers observe the usefulness of these digital learning tools in teaching computer programming courses.
3. The digital learning tools promote the 21st century teaching strategies essentials using multi-platform applications.

VII. RECOMMENDATIONS

Based on the preceding findings of the study, the following are proposed for further study and recommendations for change:

1. Integrate digital learning platforms in all courses—not only for select technology-related courses but also in the courses of other disciplines, as well as the general education.

2. Develop self-made digital learning tools using other programming languages other than Java, JavaScript, and C#.
3. Design an information system that will serve as a repository of these digital learning tools.

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