REALM OF ELEMENTS: A MULTI-USER EDUCATIONAL GAME BASED ON THE PERIODIC TABLE OF ELEMENTS USING MULTIPOINT MOUSE SDK FOR YOUNG FILIPINO LEARNERS

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ABSTRACT

Research relating to pedagogical practices indicated a positive impact of collaborative learning among students involved. However, current personal computer applications for collaborative learning are limited and poor. In most cases, these applications installed on personal computers can only serve one participating user at a time. In another way around, only few can participate and the rest are just mere onlookers—which means such learning applications lessens interactivity amongst its users, considering limited number of units available in the environment. Certainly, there are different kinds of game frameworks and technologies used for educational applications and games. The proponents shall utilize the Multipoint Mouse SDK offered by Microsoft to create a multi-user educational game, in Windows Presentation Foundation (WPF) format, which allows many students to interact with the same computer at the same time, to promote student engagement and participation as well as interactivity in learning the periodic table of elements. Evaluation and testing for the educational game's features, applicability, interactivity and usefulness factors were conducted with selected 20 student respondents and 3 teacher respondents. By comparing and analyzing test results when used in a single mouse versus in multiple mice, it showed significant difference in classroom engagement, student participation and collaboration. These results show a positive and encouraging impact by the multi-user educational game to the respondents' classroom environment.

Keywords:
Multipoint Mouse SDK, Educational Game, Collaborative Learning

1. BACKGROUND OF THE STUDY

In the recent years, technology continues to evolve and improves its capability, affecting every individual's daily routines. Technology has wedged the different faces of life and redefined the way we live. One of the most common technologies used by people is the computer. The users of computers vastly increased and prospered since it was invented. Nowadays, computers in any form become an integral part of our lives due to its functionality. The purpose of computers has engaged into complexity which made everything possible beyond our thoughts.

Now, the use of information and communications technology (ICT) for education is transforming the traditional classroom and encourages learners to progress outside of the

four walls of classroom, is more personalized and has become a powerful motivational tool. The use of ICT in education is significantly helping developing countries to catch up with the education race—becoming a great equalizer and providing more access.

The introduction of technology in the educational field has made the process of learning and knowledge sharing, an interactive and fun-filled activity. A positive and effective combination of education for children and technology could be a good impact on the advancement and preparation on young Filipino learner's learning process.

In advanced pedagogical practices, using Computer supported collaborative learning (CSCL) has become an essential part of the whole learning environment and the culture of learning. Children can find it fun to play with others and become engaged when they have the opportunity to share experiences with peers.

Microsoft's Multipoint Mouse SDK is one tool that we can utilize and leverage in developing an educational game based on the periodic table of elements that caters a collaborative experience to young Filipino learners. Multipoint Mouse SDK also greatly offers more interactivity on educational and e-learning tools, for it allows many learners to interact with the same computer at the same time.

2. TECHNOLOGY APPLICATION CONTEXT

There are a lot of educational games for young learners that exist in the market, but most of these games cater only one person per computer, and if multiplayer option is offered and allowed, it requires some special hardware and software requirements to achieve such. Educational games consist of various rules, complexity, and for some, storylines. Of course, all of these elements must be collaborated seamlessly to the desired area of learning to make the idea and concept of the game easy to learn and understand. To attract users and learners, multimedia elements should also be embedded in the game such as graphics, text, and some animations.

According to Microsoft, in a classroom of 30 children with only 3 PCs among them, 10 students' crowd around each machine, while one student takes center position and controls the mouse. Other students point, gesture and compete for the control of the mouse, but they really have no direct control of the PC and often lose interest and shift their attention elsewhere.

The proponents will try to solve this problem, by helping students to use a single PC to learn together versus having a "solo computer experience". Additionally, educational applications, integrated with Multipoint Mouse SDK, offer a practical way to decrease student-to-PC ratios, and provide a platform for Windows education software developers to create collaborative learning applications.

Our study seeks to create a multi-user educational game based on the periodic table of elements—without the hassle of intricate hardware and software requirements—that uses Microsoft's Multipoint Mouse SDK. The Multipoint SDK is mostly written to be programmed in Visual C#, an object-oriented programming language developed as part of the .NET platform. For that reason, most applications are written in that language. Using the Visual Studio that has an extension which supports the Windows Presentation

Foundation (WPF), it is possible to develop applications with Multipoint capability in other languages, like C++ with Visual C++ or Basic, or Visual Basic. In this research project, the graphical user interface and other graphical elements will be designed using Adobe Photoshop, which offers various useful applications in generating rich and appealing visuals suitable for the multi-user educational game.

3. OBJECTIVES OF THE STUDY

The general objective of the study is to develop multi-user educational game based in the periodic table of elements in integration with Microsoft Multipoint Mouse SDK.

The specific objectives are:

- To develop a multi-user educational game with integration of Microsoft Multipoint Mouse SDK to support multi-user mouse handling
- To develop the multi-user game in Windows Presentation Foundation (WPF) format with suitable and appropriate graphical elements
- To create controls in assigning teacher and student roles in using one's individual mouse
- To include content materials for the educational game applicable and conform to the lessons in periodic table of elements in the local context
- To determine the significance of the multi-user educational game when used in single mouse versus multiple mice by evaluation and testing (pre-test, post-test, UAT)
- To promote student participation, engagement, and interactivity using the developed multi-user educational game in a classroom setting

4. SIGNIFICANCE OF THE STUDY

The development of Multipoint Mouse SDK-integrated multi-user educational game based on the periodic table of elements will be beneficial to the students—particularly those in high school, as well as to their science teachers.

This study is significant for all young Filipino Learners who wish to learn the periodic table of elements in a much fun and interactive manner using our Multipoint Mouse SDK—integrated multi-user educational game. This study may help them enjoy the change in active peer learning, welcome the opportunity to work cooperatively in small cohesive groups, and be most enthusiastic about using computers in the classroom. Their participation in the classroom activities will enable them to increase their interest in the subject.

This study is also significant to teachers who wish to aid e-learning, specifically in the fundamentals of chemistry, in a fun, collaborating, and practical manner. The result of this

study may likewise challenge teachers to present a more engaging classroom experience that help pupils to work together and make the overcrowded classrooms feel smaller.

This study is also contributable in the information technology area, specifically to developers of educational tools and games. This research project would also encourage education publishers to build interactive applications that allow multi-mouse handling to simultaneously engage on a single computer with integration of Multipoint Mouse SDK. Further improvements for the SDK in terms of functionalities and features can also, one way or another, be determined and analyzed via this study.

Through collaborating Multipoint Mouse SDK with the educational game for basic chemistry, it enables one computer to serve many users simultaneously. Multipoint Mouse SDK does not only offer a more affordable and practical solution in the classroom environment, it also creates an active, collaborative learning experience that engages each and every learner. Furthermore, this research project is geared towards the better utilization of the abovementioned technology.

5. SCOPE AND LIMITATIONS OF THE STUDY

The study will generally focus on developing a multi-user educational game that offers and promotes an effective and interactive way of learning the basics of chemistry, particularly about the periodic table of elements. Topics beyond the periodic table of elements such as about matter, atoms, solving chemical equations, stoichiometry, and others are not included as content materials in the multi-user educational game. *Realm of Elements* is an educational game suitable for classroom setting and is not offered as a tool for assessing individual learning of each pupil, e.g. for grading purposes. Instead, the game will serve as a tool, as derived from one of the research objectives, to promote significant interactivity, peer-collaboration, participation, and learning engagement (not assessment) amongst students using the multi-user educational game towards the study of periodic table of elements.

There will be five (5) modules in the educational game which targets different areas of learning on the periodic table of elements. Since this is game application to be used on PCs, currently, this research project will only work in Windows Platform. All parts of this educational game are in English language. Other possible sensor techniques, market deployment, economic viability, and other privacy matters are not included in the scope of the study.

There are several functionality limitations of Multipoint Mouse SDK. Multipoint Mouse cursors cannot interact with standard Windows controls such as the windows message box, the minimize button, maximize button, close button, and composite controls such as in scroll bars and combo boxes. Multipoint Mouse can only be activated in one Window and cannot be disabled after it has been instantiated. Using the SDK in a multi-Window application will cause the mouse pointer to freeze or to be hidden. On the proponent's current Multipoint Mouse SDK version used, the functionality of getting mouse wheel scrolling state event was inadvertently disabled. Lastly, the SDK cannot return the same Device ID for the mouse when a mouse is unplugged or re-plugged.

6. REVIEW OF RELATED LITERATURE AND TECHNOLOGY APPLICATIONS

There have been set of applications developed using multiple devices within a collaborative context. The work of Villanueva et al. explains a development of a system in improving the collaboration possibilities among participants in face-to-face meetings and working groups. Participating users can collaborate through a shared zone using their own mobile devices, such as mobile phones, laptops, Personal Digital Assistant (PDA) devices, and the like. To be able to utilize the shared zone, the users have their own cursors so that they can identify themselves [Villanueva et al. 2010].

Shekhar et al. report their observations from an exercise conducted in India to help grades 9th and 10th teachers design games which promote collaborative learning. The authors have described a strategy for designing collaborative learning games, which is through active teacher participation. They present four key elements that are essential for teachers to successfully design games for learning: the affordances of the technology for which they are designing; a concept of how games will be incorporated in the teacher's daily lessons; the concept of games and its interactivity; and an understanding of the pedagogical goal [Shekhar et al. 2011].

In another work by Gohlke et al., the authors have built a set of wireless, mouse-like devices enhanced with rotating controllers that aims to integrate the flexibility and transparency of mouse interaction with the benefits of physical controllers. With the use of Microsoft Multipoint, their goal is to use such controllers for audio and video editing in a different environment, but with better flexibility [Gohlke et al. 2010].

Infante et al. present an application called Exchange—a collaborative learning application developed for wirelessly interconnected Pocket PCs. This application is devoted to engage students and their teacher in a face-to-face Computer Supported Collaborative Learning (CSCL) activity, in a Single Display Groupware mode. That is, three users interact on the same display using three different mouse devices being mediated by the technological network, while preserving the original collaborative interaction. When children work collaboratively together, they show increased participation in group discussions, demonstrate a more sophisticated level of discourse, and provide more intellectually valuable contributions to those discussions [Infante et al. 2009].

A study was conducted by Gupta R. et al. that evaluate single-mouse and multiple-mice configurations for computer-aided learning in schools wherein access to PCs is inadequate because of financial constraints. The proponents of this related work developed a single display groupware solution that allows multiple computer mice to be used on a single PC simultaneously. They compared the groupware with single-user-and-single-mouse and multiple-user-single-mouse scenarios. Experiments were conducted with 238 students in rural India. They found out that multiple mouse configurations were observed to be at par with the single-user scenarios which suggests that the value of a PC can be practically multiplied by employing a multiple input, shared use design. Lastly, addition, a comparison of the two multiple mouse scenarios—collaborative and competitive—showed a striking difference in learning outcomes and user behaviors that is possible due to slight variations in interaction designs for multiple-mice. [Gupta R. et al. 2007].

A study was done by Inkpen, et al. to address collaboration preference among children, via involving pairs of children through playing a puzzle-solving game using three various experimental set-ups: (1) a paper-based style of the game; (2) a computer-based style of the game using one mouse, and (3) a computer-based version of the game using two mice. The authors developed an application using C++ and Microsoft DirectX and utilized input from one or more USB mouse. The results of this study have shown that providing children with support for their collaborative interactions can enhance their performance of activity, engagement, and motivation [Inkpen et al. 1999].

Collazos, et al. presented a paper that proposes a model describing how to design socio-technical environments that will promote collaboration in group activities. A game was developed by the proponents of this paper based on this model. The tool was used to conduct experiments for studying the collaborative learning process. Testing with this system revealed some strength and weaknesses both in sociological and technological factors. Based on their obtained results, they have seen that it is not only important to design a tool supporting the collaboration process, but also to consider other aspects such as teacher's participation and learning goals, in order to have an effective collaborative learning environment (CLE). The use of the proposed indicators allowed the authors to identify strengths and weaknesses of the CLE they have designed [Collazos et al. 2007].

Bederson, et al. has looked at experiments using collaborative storytelling software with an aim to encourage and teach collaboration [Bederson et al. 1999]. The same software was used by Stanton and Neale, who studied the social interaction of the collaborations. These studies had children working together with independent cursor on a visual drawing and storytelling tool, but then the scenarios were limited to two children per PC. The applications studied were meant to enhance collaboration in classroom settings, and in most cases the educational goal was to teach collaboration itself among students [Neale et al. 2003].

Gupta A. et al. proposed a strategy for designing collaborative learning games with due consultations with pedagogical experts. In their paper, they specifically described a strategy for designing collaborative learning games through and with active teacher participation. Together with the teachers, they have developed a unique design methodology that helped the authors and the teachers to design and create collaborative learning games that supplement classroom teaching. After the final exercise of the workshop conducted, together with the participating chemistry teachers, they had formulated a game for students to construct a compound using the list of elements and balancing the equation—opening an opportunity of inciting discussions among students on which elements to be used. A game for secondary level chemistry was also then implemented to serve as a prototype for large scale development. With all these presented, the authors also composed four key elements that are essential to successfully design collaborative games for learning: (1) the affordances of the technology for which they are designing; (2) a vision of how the games will be incorporated in the teacher's daily lessons; (3) the concept of games and interactivity; and (4) an effective understanding of the pedagogical goal [Gupta A. et al. 2011].

7. PROJECT METHODOLOGY

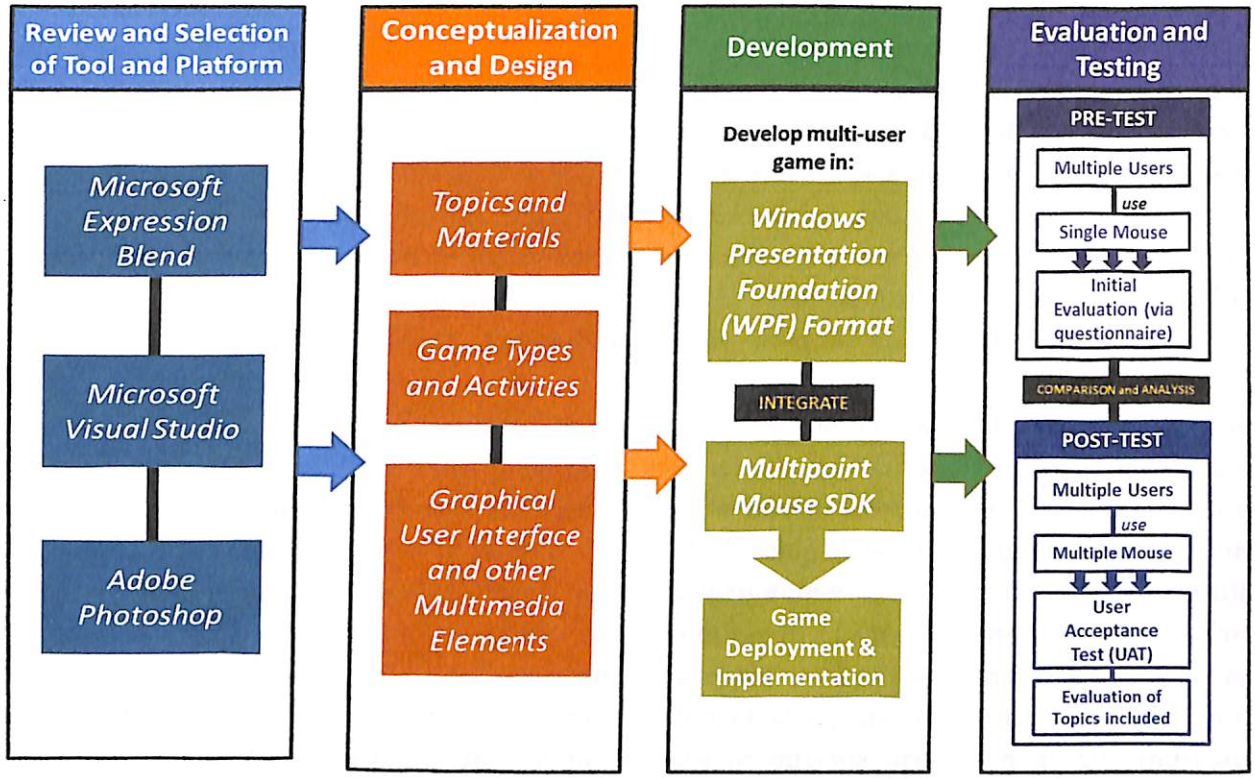

Figure 1: *Research Design Diagram*

This this study is divided into four (4) main parts namely: (1) Review and Selection of Tool and Platform, (2) Conceptualization and Design, (3) Development, and (4) Evaluation and Testing of the multi-user educational game (quantitative assessment on its features and functionalities) by selected student and teacher respondents.

7.1 Review and Selection of Tool and Platform

In this phase, the proponents shall review, evaluate, and select the tools and platforms necessary to develop the multi-user educational game with, of course, integration of Multipoint Mouse SDK. During this stage, the proponents considered a number of development environment to be utilized for the project such as using Adobe Flash Professional, Microsoft Visual Studio, and Microsoft Expression Blend. As we evaluated and reviewed each development applications, we decided to use Microsoft Visual Studio and Microsoft Expression Blend over other tools for the reason these development apps had more substantial documentations, are comparatively stable, and had more standardized processes in making Windows-based apps in light with the Multipoint Mouse SDK, for which we will ingrate in the course of developing our multi-user educational game. Graphics design and graphical interface and elements shall be made using Adobe Photoshop, a powerful multimedia application in creating rich visuals and graphics, suitable for our multi-user educational game.