



Work. Study. Play!

James R McCusker PhD, Wentworth Institute of Technology

James R. McCusker is an Associate Professor at Wentworth Institute of Technology in the Department of Electrical and Computer Engineering. Since joining Wentworth in 2010, he has been heavily involved with an array of interdisciplinary design courses that range from introductory to capstone courses.

Mr. Alex Spiro Burch

Ms. Jasmine Maya Andrade, Wentworth Institute of Technology

Work in Progress: WORK. STUDY. PLAY!

Does combining Work, Study, and Play into interactive games assist with making (Science, Technology, Engineering, Art, and Mathematics) STEAM appealing to students and easily deployable for educators?

**Jasmine Andrade~, Alex Burch~, James McCusker*
(Andradej3, Burcha2, McCuskerj) @wit.edu
Department of Interdisciplinary Engineering~
Department of Electrical and Computer Engineering*
Wentworth Institute of Technology**

Abstract

The field of STEM (Science Technology Engineering and Math) education is constrained by the teacher's interpretation of how they convey the course content to their students. Teachers overlook the application of art as an integral part of STEM education. STEAM (Science Technology Engineering Art and Math) is used as a new approach of guiding student dialogue and critical thinking to solve complex problems while incorporating art, music, and games. A challenge for educators is to implement an engaging and interactive way for students to gain interest in the STEM fields. To bridge this gap, *Work. Study. Play!* an online learning management system (LMS) combines interactive gaming and learning modules to introduce STEAM concepts. Although the modules are customizable to any grade level, the research and application targets 8th-12th grade students. *Work. Study. Play!* allows students to learn in-depth subject matter in the areas of physics such as sound and vibration. It also provides educators with an easily adaptable learning curriculum that meets the needs of the classroom. By utilizing STEAM, math learning standards and NGSS (Next Generation Science Standards); teachers can artistically and visually engage students to build a better understanding of physics models and theories. With *Work. Study. Play!* students analyze and interpret the data to draw solutions using mathematical and computational thinking. The authors aim to demonstrate the capabilities of this system by bridging the gap between STEAM, gamification and interactive education. Through this educational ecosystem, educators are empowered to engage students both inside and outside of the classroom.

Introduction

The nomenclature behind games can be misconstrued and can “provide some confusion for parents when it comes to technology and their children. How much technology should kids use, where can they learn it from, and how can parents help?” [1]. The perception of screen time and games can often be confused as restrictive for a student's innovation and learning. Prensky (2001) “pointed out that combining games with educational objectives could not only trigger students' learning motivation, but also provide them with interactive learning opportunities” [2]. Games introduced in the classroom entertain the idea of engaging students through an educational interactive learning tool. Games can introduce many skills including “flexibility, critical thinking, problem solving, collaboration and communication. Games also lead to a unique user experience in the learning environment when there is a seamless integration between learning and entertainment” [3]. The more students are exposed to these concepts, the better equipped they are to become future leaders in their respective fields. “The growing interest in using gamification in online learning has not yet found an adequate answer in the form of a LMS that would make it easy to incorporate gamification mechanisms of various kind in the courses” [4]. *Work. Study. Play!* (W.S.P!) is an

interactive LMS that tracks a student's academic progress. The website supplements student learning while the game engages the student physically in the given topic. By combining music and physics; the game offers topics that have not previously been explored before. The game is broken down into a time based format of two or more teams. An example of the game includes a question that generates a sine wave based on a song, that can be manipulated by the teacher to varying levels of difficulty. This allows users to think critically in a time based format. Students have to understand the question, think critically of a solution using formula cards and provide an answer to the question. Each team has four cards for each answer and has to compete with the other teams to place the correct answer onto the board in the time required. *Work. Study. Play!* attracts students and teachers alike in a way that combines work, study, and play into a mutually satisfying experience. The game bridges the gap between STEAM applications and an interactive education. *Work. Study. Play!* allows students to gain an interest in the STEAM fields while still providing a competitive game that students can engage with inside and outside of the classroom. The integration of work, study, and play into math and science topics is essential in the development of a product that is engaging for students. A panel report generated by the Smithsonian's Lemelson Center for the Study of Invention and Innovation was conducted to foster "innovation and creativity through play" [5], the concepts provided a discussion on what play is, which provides the team with a framework for the solution. The concluding remarks for the panel report states that "connection between play and invention is real but in order to see a correlation, students need to be allowed to flex their creativity through play" [5]. By providing educators with the understanding and value of *Work. Study. Play!* an integrative gamified LMS system, will guide students to become the next generation of inventors.

System Overview - *Work. Study. Play!*

Work. Study. Play! is an interactive learning management system with gamified interactive modules. Work is defined as the effort a student places into learning the educational material, study is learning how to retain that same material, and play is having fun and enjoying oneself through working and studying. The combination of these three complementary concepts into this product enhances hands-on learning and engages students. "Gamification mechanisms should be easily available when configuring all the key course elements, such as course progress, exercises, and assessment" [4]. The lessons and modules are adjustable and customizable based on the number of players and course content.



Figure 1: Game Board and Cards

Work. Study. Play! Components

The *Work. Study. Play!* online site allows for the deployment of game questions during the game session, the ability to track student progress and also serves as the primary mode for educators to

administrator and alter content. Another component is the physical game that is played in the classroom. Students interact with the questions while also getting physically engaged (Figures 1 & 2).



STUDENTS
The site allows for Students to easily access their work remotely.

Figure 2: Example of the Student Interface

Work. Study. Play! Modules

The modules (Figure 3) are divided into three sections: *Work*. (Figure 4) *Study*. (Figure 5) *Play!* (Figure 6). Students are provided a series of activities established to provide comfort with the subject. The *Work* contains pre-reading assignments. An example of a pre-reading assignment includes slideshows, videos, activities and pre-tests. The *Study* section is an interactive game study modules; the modules are based on the content of the course. The *Play* section is interactive *Work. Study. Play!* game board which is configurable for at home or in the classroom games.

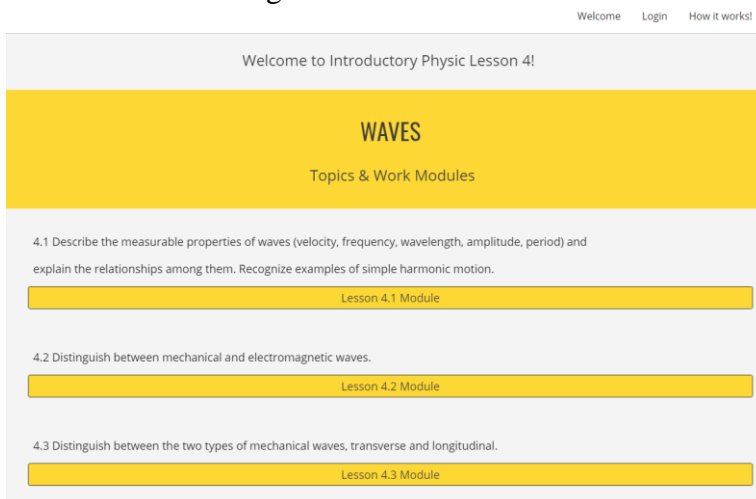


Figure 3: Topic & Module Example

Refer to the link, <https://sites.google.com/wit.edu/workstudyplay/work> to view the work modules provided on the W.S.P! site.

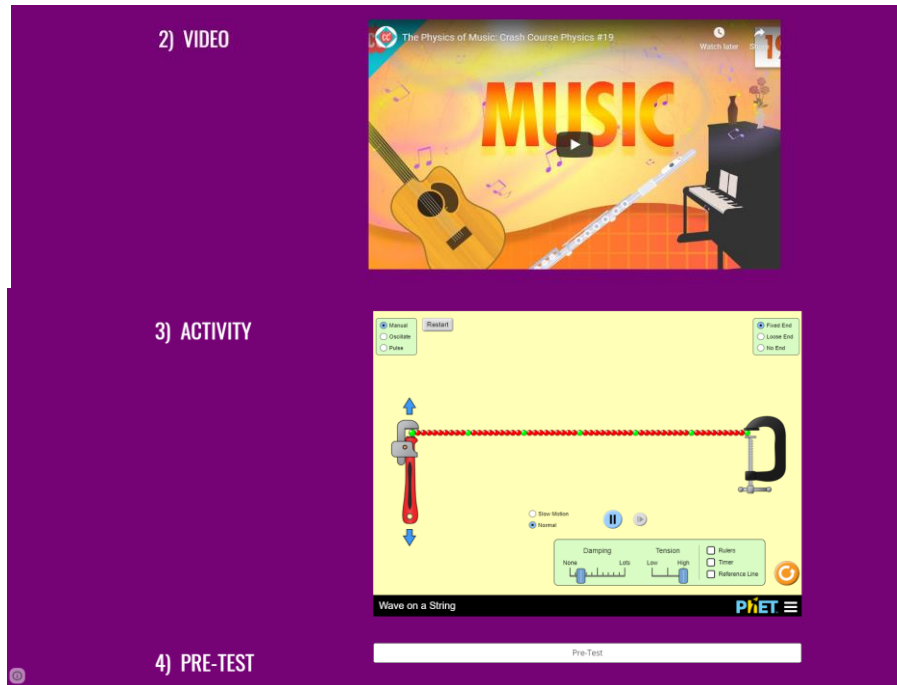


Figure 4: Lesson Example

Refer to the link, <https://sites.google.com/wit.edu/workstudyplay/lesson-4-1> to view the work modules provided on the W.S.P! site.

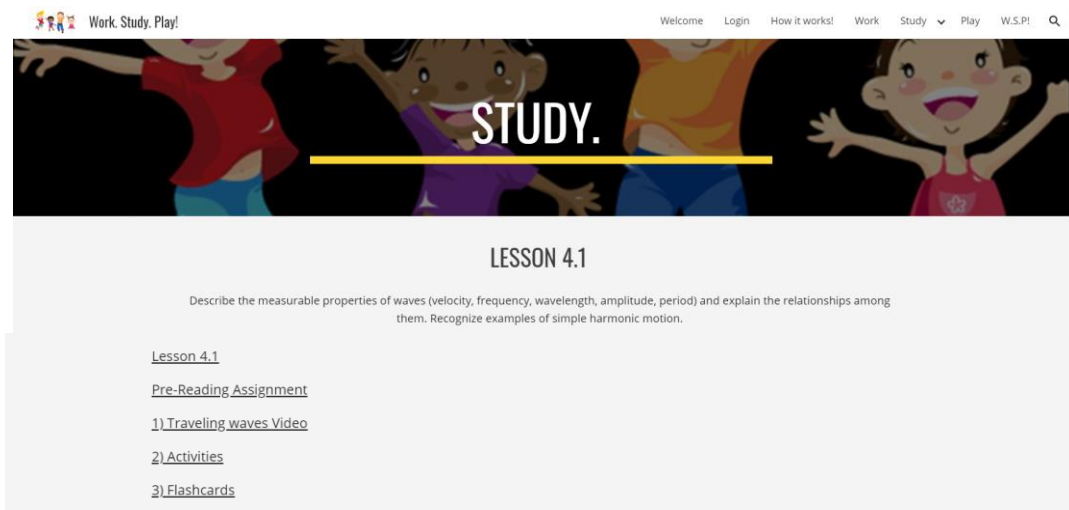


Figure 5: Study Section Example

Refer to the link, <https://sites.google.com/wit.edu/workstudyplay/study> to view the work modules provided on the W.S.P! site.

The Game & How to Play

The structure of the game revolves around a timed competition between users. Once the initial setup is complete, users select a difficulty, then a question will appear on the screen. An example of a question includes: A song playing in the background with a related question. Users race to

complete calculations in order to select the correct answer. The corresponding answer cards (A-D) are placed by a team member onto the game board card slot. At this point, the board will either flash red and make a continuous negative beeping noise to indicate that their selected answer is incorrect, or flash green with a positive noise feedback to indicate that the selected answer is correct. Based on whether the team answered correctly or incorrectly points will be added or subtracted until a team is declared a winner.

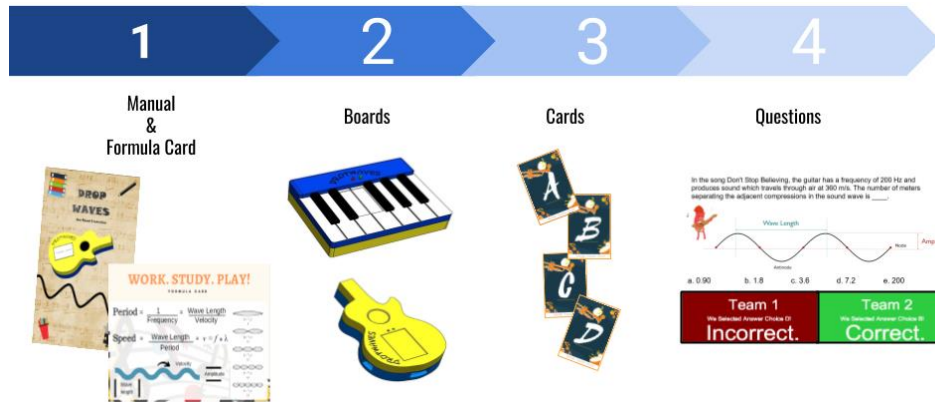


Figure 6: Play! Overview

Effectiveness Study

Work. Study. Play! evaluation was determined through the system’s effectiveness of creating an appealing STEAM educational platform for students, an easily deployable game system for educators and an avenue for parents to stay connected in their child’s education. A video and survey was deployed to gauge the interest levels from the three main stakeholders (students, teachers and educators) and to provide meaningful feedback on the product’s effectiveness.

Link to *Work. Study. Play!* video: https://www.youtube.com/watch?v=d_0bVesHes0.

Study Participants

The study participants provided feedback through answering several questions and providing feedback. The participants include 7 parents, 6 teachers and 68 students. Of the 68 Students participants surveyed, 72.1% of the students were within the research target grade level, High School. However, *Work. Study. Play!* can be modified for any age group and STEAM subject matter, therefore, the additional grade levels such as Middle school are important to analysis for future integrations.

Survey Results - Students

Table 1 includes the overall responses of both highschool and middle school students to the survey questions

Table 1: Students Survey Results

Category	Questions	High School	Middle School
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Student Interests	Do you like playing games? (Video Games, Board games, online games, puzzles) Do you like art? Do you like music?	100%	100%
Current Curriculum	Are games incorporated in your classes?	100%	66.6%
	Are music and art being integrated into your math and/or science curriculums?	16.67%	0%
Interest in Work. Study. Play!	Would you play <i>Work. Study. Play!</i> in your class?	90%	100%

High School

This signifies an opportunity for *Work. Study. Play!* to be integrated into High School's in order to bridge this gap between STEM and the arts.

Middle School

This displays a disconnect between STEM and the arts in middle school curricula. *Work. Study. Play!* creates an opportunity for students and STEM as a whole to integrate music and art into math and science curriculums. This also shows that our target audience isn't necessarily restricted to high school students. It can be adjusted based on the students grade level to fit the desired class.

Survey Results - Teachers & Parents

From the teachers surveyed 83.3% would deploy *Work. Study. Play!* in their classroom. One of the teacher's wrote that "This seems like something that would get and keep the interest of my students." From the parents survey 100% stated that *Work. Study. Play!* would be helpful in tracking their child's classwork/homework/study activity and 90.9% of parents stated that it would be beneficial for their child's success. The feedback received from this user group included allowing *Work. Study. Play!* to "start at elementary level and grow with them through High School". This is an insightful comment that could be a potential feature integrated into the LMS.

Future Product Development and Evaluation

The following is a list of future considerations to determine product effectiveness once the product has been deployed both inside and outside the classroom.

Students - The success of *Work. Study. Play!* is determined by students in a focus group. Three student metrics will be used to identify the learning outcomes. The first is student's academic skills and intellectual development (e.g., do students have sufficient background knowledge or academic skills to move onto the next topic?). The second is student's assessments of their own learning skills (e.g., do students feel prepared to learn new material from the textbook, without classroom review?). The third is student's reactions to various teaching methods, materials, and assignments (e.g., do students believe the exams fairly cover the material stressed in class?). In order to evaluate

this the team will provide a post and pre-test with lessons provided as well as a post and pre-survey of the work, study, and play features.

Educators - The success of the *Work. Study. Play!* for educators will be evaluated based on surveys and interviews with educators after utilizing the educator interface (Figure 7). The teacher will be provided questions that evaluate W.S.P.'s ability to meet the following criteria. Is it easily deployable in the classroom? Does it allow students to meet learning outcomes? Are teachers meeting classroom standards? Is there student engagement, and are they meeting diverse needs of the students. Are the classes well-structured units and lessons? Is there student motivation in a collaborative learning environment? Is there a variety of assessment methods? Is the teacher drawing analysis and conclusions and then sharing it with the students?

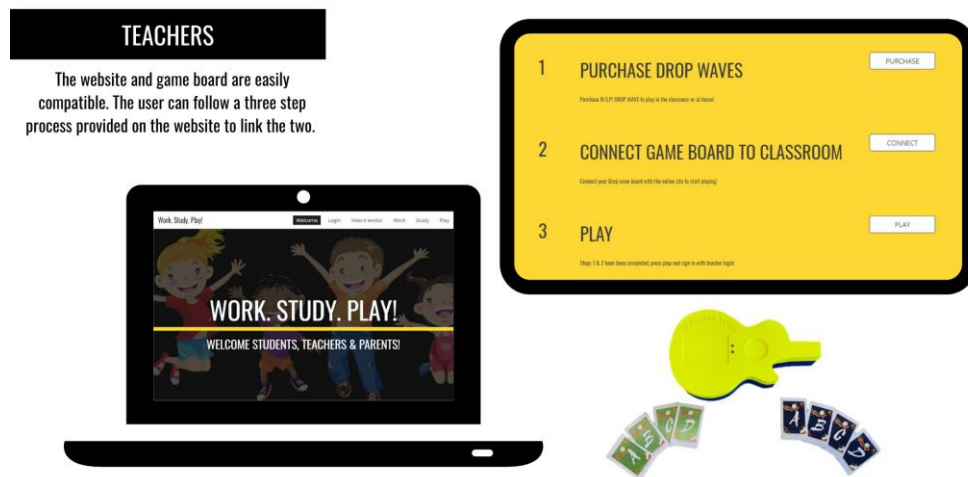


Figure 7: Educator Interface

Parents - Parental and guardian observation can be recorded during the study portion of *Work. Study. Play!*. The child's progress can be viewed remotely, allowing for the parent to view their child's interaction online (Figure 8). Different functions engage the parent to use the product at home with their child. The parents will be able to provide feedback through the LMS to report their interactions with the system.

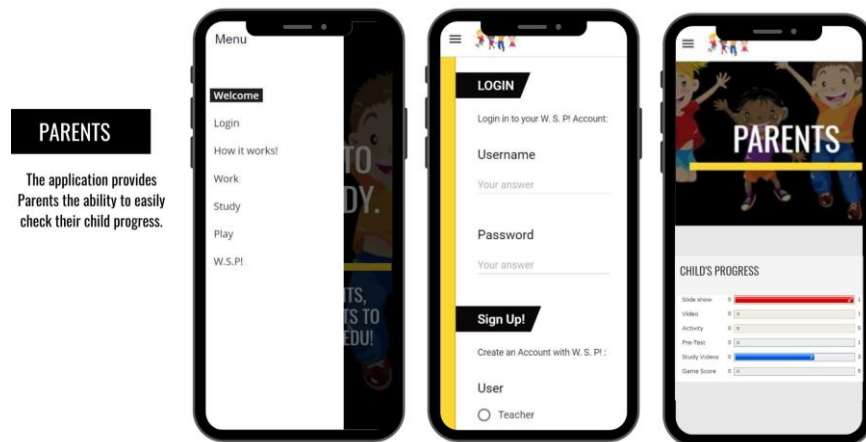


Figure 8: Parent Interface

Conclusion

The *Work. Study. Play!* team created an interactive LMS that combines the concept of working, studying, and playing through STEAM concepts. The research consists of utilizing a video of a mock-up LMS and electronic game board. The team evaluated the products usability with three user groups (Students, Teachers, and Parents), to determine if it is an appealing STEAM educational platform for students. Is it an easily deployable game system for educators? And is it an easily accessible avenue for parents to stay connected in their child's education? With the data collection focused on the students' experience the team found an interest in music and art with little to no applications that were integrated into the classroom. The students surveyed express an interest in *Work. Study. Play!* because it creates an engaging user experience for the students that encompasses what they do in the classroom and what they do at home into a mutually satisfying learning platform.

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