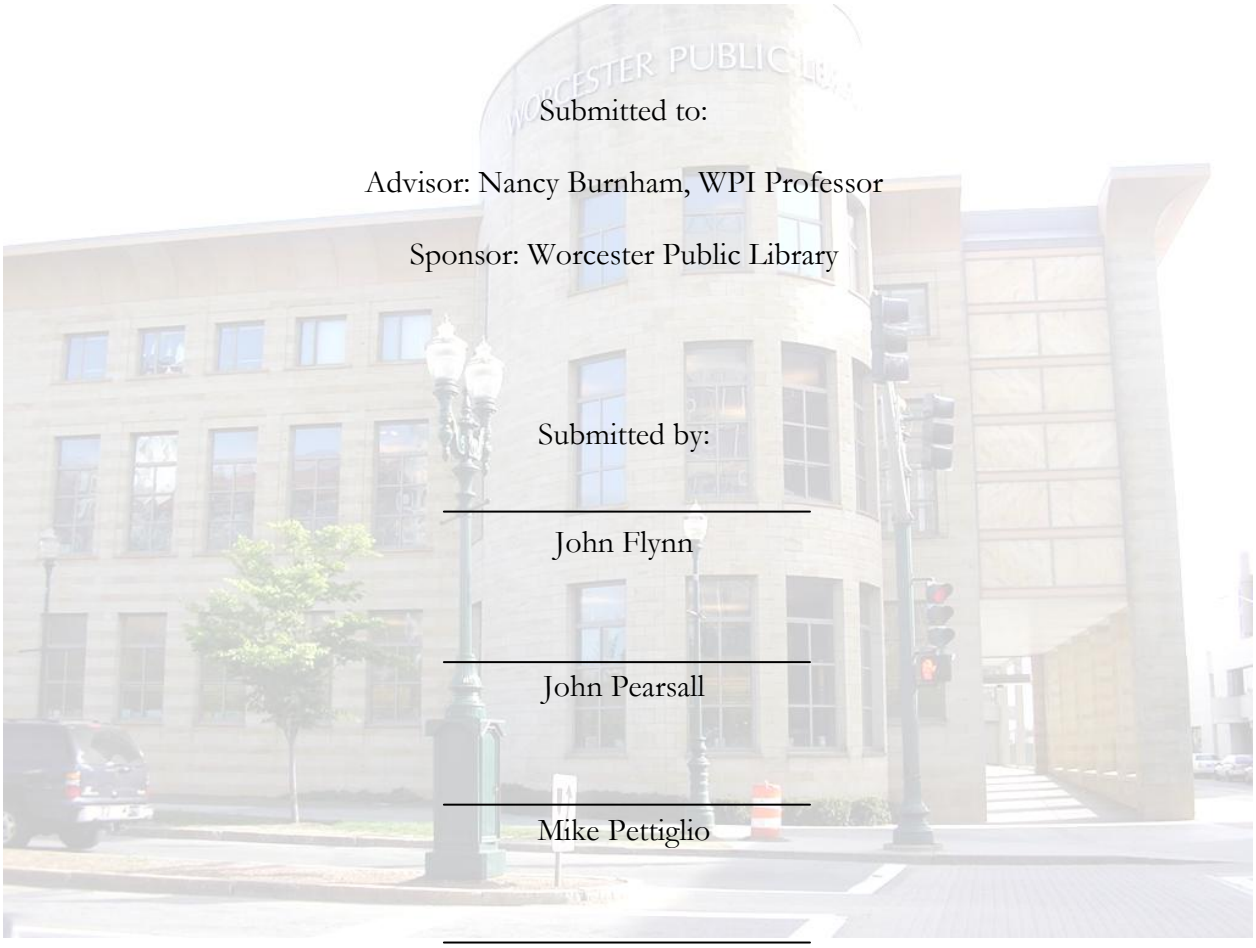
IQP NAB PC03

GAME DESIGN CURRICULUM FOR TEENS

AN INTERACTIVE QUALIFYING PROJECT REPORT
WORCESTER POLYTECHNIC INSTITUTE

March 2, 2011



Submitted to:

Advisor: Nancy Burnham, WPI Professor

Sponsor: Worcester Public Library

Submitted by:

John Flynn

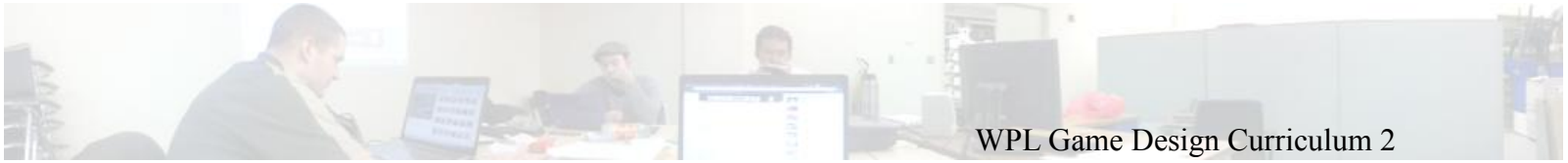
John Pearsall

Mike Pettiglio

Yiming Wu

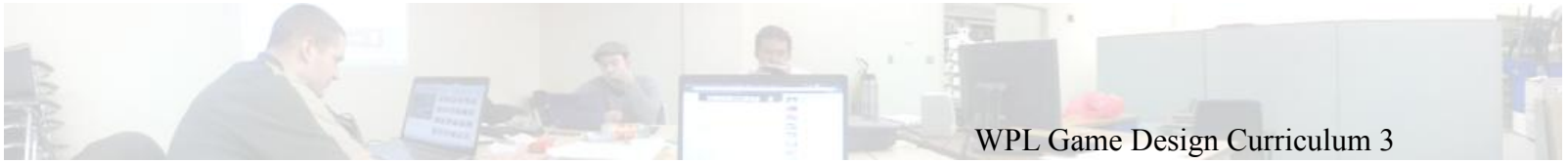
WORCESTER POLYTECHNIC INSTITUTE 1865 WPI

WORCESTER PUBLIC LIBRARY



ABSTRACT

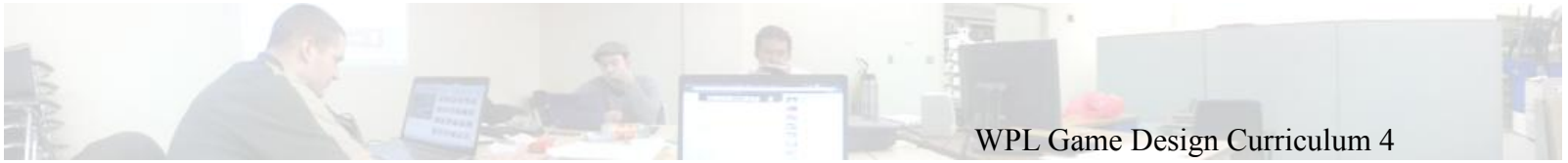
Our project team developed, planned, and piloted a computer game design program for teenagers at the Worcester Public Library. The project helps teenagers to understand and share visual information, as well as follow and create logical narrative. It will develop their media literacy skills so they can apply technology effectively in today's society. Surveys, interviews, and pilot programs were conducted to create three two-hour training sessions and study materials that will continue to serve the Worcester teens into the future.



EXECUTIVE SUMMARY

Video games have become popular among the young generation. It is so popular that it even becomes a cultural phenomenon of American society. It has brought broad controversy to educators, teachers, and parents because it attracts children and adolescents to spend excessive amounts of time on it rather than reading, excising, or doing school work. Researchers generally separate into two groups on this issue. One group believes that video games can lead to poor school performance, and aggressive behaviors of players. The other holds the positive perspectives on video games and tends to use it as a tool to motivate students. Regardless what perspectives researchers hold, video game playing is just an activity among youth. It can be good thing if our team uses it properly. The Worcester Public Library's hope is that the computers in the library will be used for learning activities and to diminish computer illiteracy. Their goal is to teach the teens that there is more to computers than just being able to play video games and surf the web.

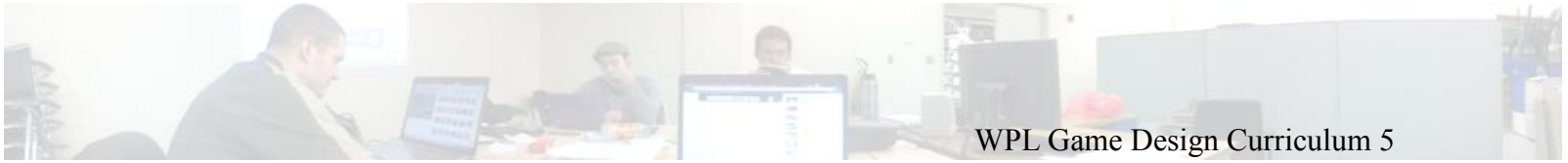
The Worcester Public Library provides many opportunities for local teens to develop their creativity and learn about unique topics. The library likes to provide a learning experience that is different than anything they may learn at school. Creating a game building program at the library is an ideal solution because it opens the teens' eyes to the many possibilities of computers and technology. In a society where technology fuels life, the power of technology and computers needs to be taught to as many people within the society as possible. A curriculum should be developed around the teens' need to learn this technology and how to use it effectively and efficiently. Making the curriculum fun and entertaining will give the teens an opportunity to express their creativity. Several libraries have successfully attracted teens' attention to join after-school activities by using game-based programming course. In those courses, the programming software Scratch from MIT Lifelong Learning Kindergarten Media Lab has been widely used. It is a network-based, media-rich programming environment designed for youth age from 8 to 18 to enhance the development of



their technological fluency, mathematical and problem solving skills, and justifiable self-confidence in interactions. Scratch employ the "building block" modeling in its user interface which allows user to build games as easy as to assemble LEGO bricks.

The goal of this Interactive Qualifying Project (IQP) was to provide the library with a sustainable game design curriculum. Our team has created a four-day workshop for the library to use and host. The workshop uses MIT's Scratch and consists of four classes that teach the teens the basic process to game design. The first workshop was taught by us during a school vacation week from February 22nd to February 25th. The first workshop was also taught to some of the staff at the library to perpetuate the knowledge. Our group provided the library with step-by-step presentations for each class as well as hand-out and reference material, video tutorials, game demos, and online resources. Our hope is that the material provided to the library will be able to sustain a legacy of workshops and further inspire teens to game design.

The team's research approach is ethnography to study the relationship among games, programming, and curriculum in the context of youth's culture. Our team chose ethnography because it is rooted in a cultural framework and it involves both the study of patterns and behaviors in human social activities, and the interpretation of these patterns and behaviors. These elements in the ethnographic approach provide us with the theoretical basis of our study. Surveys, group interviews, archival research, and pilot programs have been conducted to collect data. The program was given at the Worcester Public Library and the participants were frequent users of the library. Various teen groups have been asked to fill out a survey to gain a knowledge base of the teens and make the program geared toward them. After a pilot program was administered, there were informal interviews and surveys that were given to the participants. Also, observations of the participants have been taken during the pilot program. The observations completed by the team members gave feedback to the team based on interactions and body language, basically how the

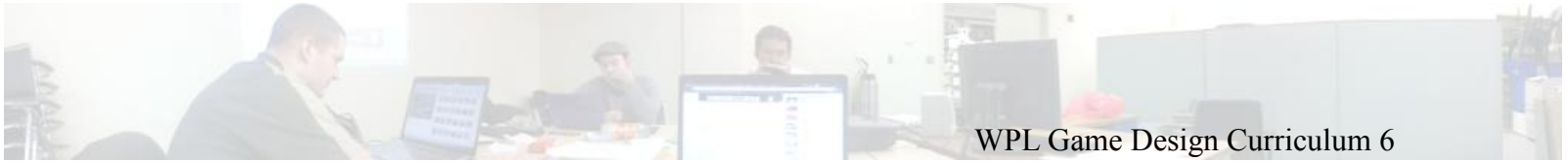


teens were reacting to the material. These data collection techniques created three data points, so main ideas could be triangulated through data analysis.

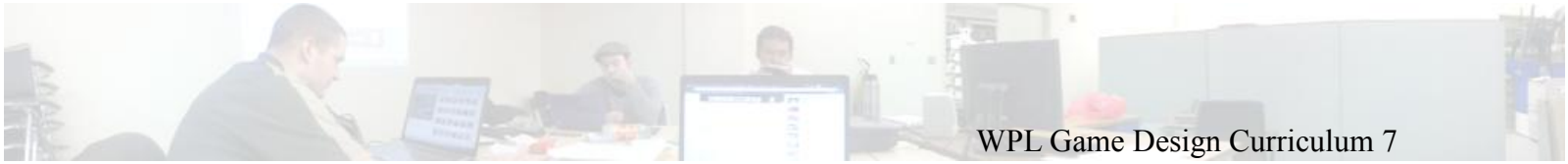
Preliminary surveys were analyzed for a base line skill level of the teens. Interviews of target audience and library management were used to find an overall scope of the project. The pilot program produced the class structure and course corrections for the curriculum. Participant observations of the staff and teens were analyzed for the effectiveness of the curriculum. Archival research was used to compare and contrast previous similar programs to improve our curriculum. All the data was analyzed to identify trends and tailor the curriculum to fit the target audience.

A pilot program was developed geared to the target audience. The pilot was given four different times, twice to a group of staff members from the Worcester Public Library and twice to teens from the Great Brook Valley Branch. Much feedback was recorded to refine the Pilot into a program for teens at the library. The Pilot contained a two hour lesson with a step-by-step PowerPoint walk through. Two more lessons were developed to round off three two hour sessions which will be molded into a four-day workshop, where on the last day the teens will be given the opportunity to work on any project they would like to. All of the materials created by the team will be posted on the Worcester Public Library website for all of the teens to be able to access them. Even if a teen did not make it to the workshop, they can watch a videos tutorial of the lessons created by the team and learn the Scratch Program with the help of the team's resources. Providing these materials for the library and the teens will ensure the continuity of the program.

The team crated a four-day workshop to be completed on Tuesday, February 22nd, 2011 through Friday, February 25th, 2011. Using the information gathered from the four different pilot programs run the workshop was modified to meet the needs of the teens at the Worcester Public Library. The workshop was set up just like the pilot program was, using the two displays to help the participants build their projects using the Scratch software. The workshop was filled up on the sign-



up sheet and there was a waiting list created. The waiting list contacts will be notified when the next Scratch workshop will be given at the library. The workshop was a great success having a high retention rate over the course of the four days. The original set-up of the workshop was to have three different lessons on the first three days and then on the fourth day have a free study hall type of class where the participants can ask questions and work on their own individual projects. The fourth day was later modified to have a short lesson on drawing followed by the free period. Each individual session had one hour for the participants to play with Scratch on their own and ask any member of the team questions. Most of the participant stayed after to work on their projects showing their interest level in the workshop.



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Mike Pettiglio
- I. INTRODUCTION
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- I. INTRODUCTION
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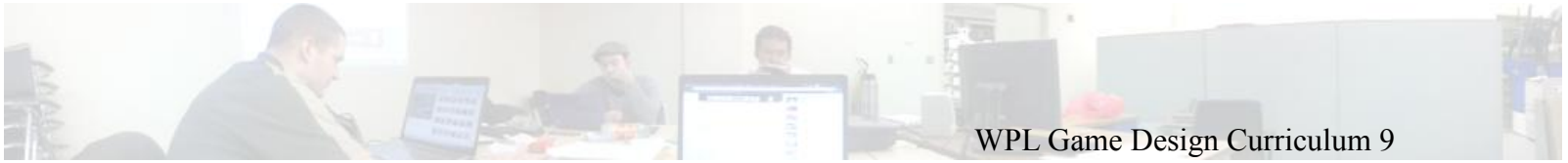

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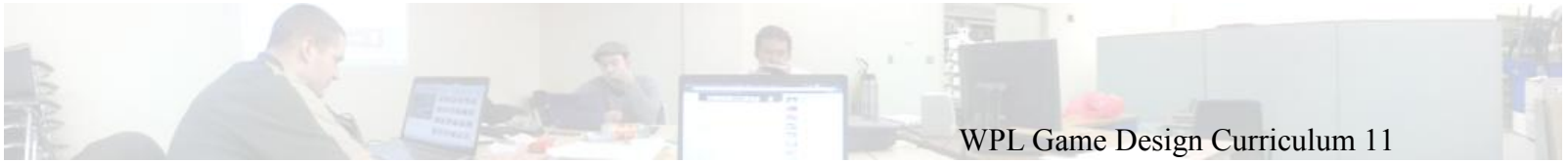

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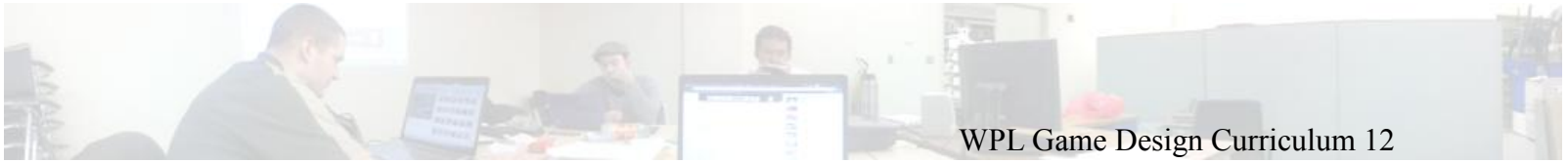

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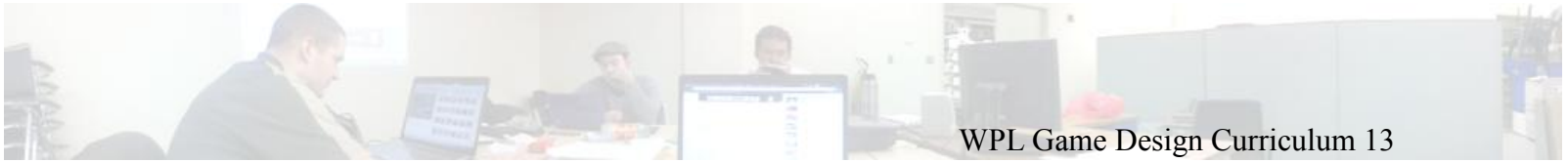


I. INTRODUCTION

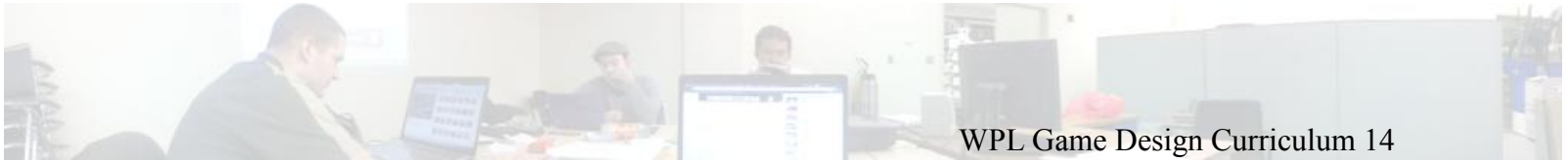
In the introduction chapter, the societal issue of playing video games and its negative effects, the practical issue of using game design curriculum to gain interests of teens, and the key issues of identifying the main elements in a successful curriculum are discussed. Along with the discussion of these issues, research of similar projects is discussed as well.

I.I. SOCIETAL ISSUE

Video and computer games have been popular among children and adolescents since the1970s[1]. They have brought broad controversy to educators, teachers, and parents because they attract children and adolescents to spend excessive amount of time on them rather than on reading, exercising, or doing school work (Dorman, 1997; Prensky, 2003). As Marc Prensky suggests, "a motivated learner can't be stopped (Prensky, 2003, p21)". In this case, "a motivated gamer can't be stopped". While video and computer games are so popular in the younger generation, they have become cultural phenomena in American society (Squire, 2003; Dorman, 1997). The phenomenon of popular video and computer game playing has caught the attention of many researchers and educators since the hostility, the aggressive behaviors, and the poor school performances of the players might become severe social problems. Researchers find that playing video and computer games has negative effects on players' school performance and aggressive attitudes and behaviors, but they also agree that "video game 'addiction' is a problem among adolescents", and that "addiction" is an association of the problem but not the cause (Hauge & Gentile, 2003; Gentile etc., 2004).

While researchers such as Gentile and Hauge believe that there are negative effects on children and adolescents from video game playing, other researcher argue about the validity of those

[1] PONG is one of the earliest video games. It was released by Atari Incorporated in 1972. Source: http://en.wikipedia.org/wiki/Pong

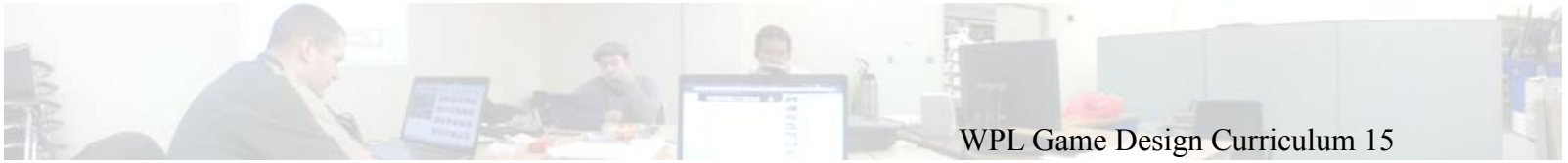


studies. In Squire's examination of the history of games in educational research, he points out that many studies on this issue fail to address the problem in a social context (Squire, 2003). Some researchers believe that video game playing experience is what students bring to school and share with their friends; it is a society-involved activity in most cases; and more importantly, it forms the culture among youth (Squire, 2003; Shaffer etc., 2004). These researchers generally have positive perspectives on video and computer games and tend to use them as a tool for motivation of students' learning. Regardless what perspectives researchers hold, our team sees that video game playing is just an activity of the youth. It can be good or bad. Our team has to make the choice to turn it into a fun activity that allows entertainment and education engagement. And before that, our group has to consider the cultural value and analyze this problem in the social context.

I.II. PRACTICAL ISSUE

Computers and video games have become more popular with kids, teens, and young adults; they have provided a large new media space. Public libraries around the country are no exception. In central Massachusetts, the Worcester Public Library has acknowledged this new media and increased the amount of computers in their "Teens Only" area. They have also created a computer lab in a section of the library for people to use for writing papers and to do assignments. The library's problem however is that the main function of these computers, for the teens, is to surf the internet and play video games. The library's hope is that the computers be used for learning activities and to diminish computer illiteracy. In efforts to meet the library's needs a game programming curriculum was devised.

The goal of the game programming curriculum is to teach the teens of the Worcester Public Library that there is more to computers than just being able to play video games and surf the internet. The Worcester Public Library wants the curriculum to be fun and creative as well as

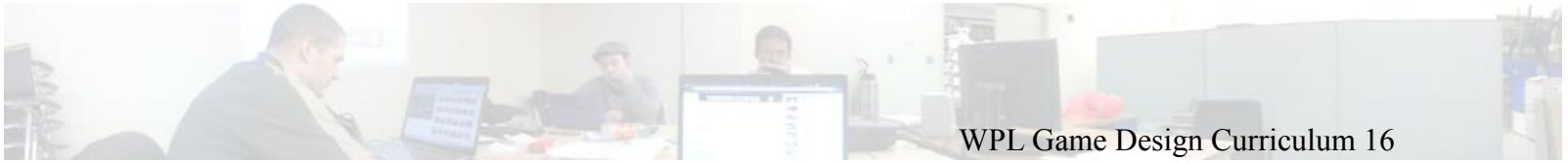


educational. Their role is as an after school aid program and not as a primary education facility; the library wants to be an addition to the schools' education program. The idea is that teens will become more interested in creating, playing, and sharing their own video games with their friends than just going to the library to play video games. Using video games, the curriculum uses the teen's interest to focus and inspire them. In making the teens interested in developing their own video games you create an environment for the kids to express their creativity. The class also shows them the thought process of how to program, and how they can take this new skill of theirs and use it later on in life.

The benefits of a video game design curriculum for the Worcester Public Library youths are great and numerous. Having the youths design video games creates an expressive outlet for them. In creating their own games and having a finished product to share with their friends, the youths will gain a wealth of self-satisfaction. Through the curriculum the youths learn the basic thought process for game programming. Taking this skill from the curriculum, the teens can see the options they have, that the video game industry is massive and growing. By taking the students' interest in video games and focusing that motivation into video game design, the negative side effects that researchers examine decrease because the students are now learning the basics to a useful life skill. Learning the thinking process of game design can open a lot of doors for the teens of the Worcester Public Library, but only if they are motivated.

I.III. KEY ISSUES

For the program to be successful the users need to be interested in the class. A problem may be the difficulty of the curriculum. The program may be too hard for the teens and the information goes over their heads. Another fear is that the information presented in the program is too easy and the users quickly get bored. The curriculum needs to be attainable with room to grow. After every



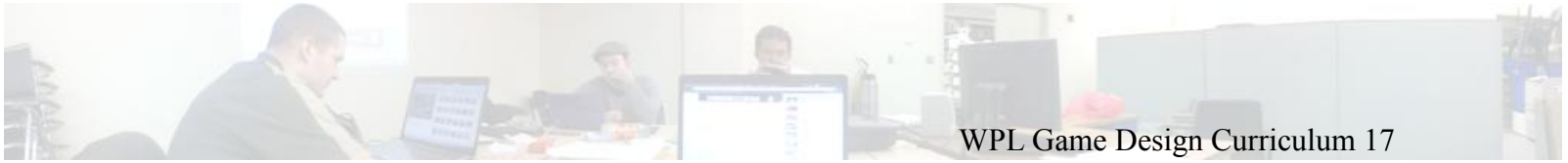
session of using the program the users should feel like they are unfinished. This way they have accomplished something but want to come back for more.

In talks with WPL librarians, we learned that a successful program is one that has longevity. The program may run smoothly while someone is there walking them through it. But it will truly be successful if the program is self propelling. The issue is that the Worcester Public Library does not have anyone on staff to teach a programming class. Therefore, the interface and curriculum must be comprehensive so that the staff available can guide the users through it efficiently. Ideally the program can run without much adult management and the teens will be able to monitor each other's work.

I.IV. RESEARCH

Through the research collected and data examined, it is known that teenagers enjoy computer games. The interaction between user and technology is a very high interest among this age group. According to a study completed in the *Science Daily,* over 500 adolescents were polled and on average 1 hour and 10 minutes of each day are spent playing video games (JAMA and Archives Journals, 2007). Along the same lines another study in the *Science Daily* completed by the University of Minnesota stated that adolescents are on the computer for around 12 and a half hours a week (University of Minnesota, 2007). This is the reason to develop a curriculum involving video games and computers. The combination of two highly used and enjoyed elements among teens are combined to form an educational tool to not just entertain the teens, but also teaches them useful skills and techniques that can and will be used in the future.

The target group needs to be more closely examined. The likes and dislikes of the student that are going to be involved in the curriculum have to collected to gear a curriculum towards the likes of the students to maintain their interest in the subject matter. A survey will be distributed to



teens currently participating in other programs at the Worcester Public Library to obtain this feedback. Once a curriculum is put into place at the Worcester Public Library, it will have to be critiqued and altered to fit the needs of the teens. The amount of time, the amount of information presented, and the number of student per class will all have to be examined upon implementation of the curriculum.

This is a study about the interface between science and technology conducted for an Interactive Qualifying Project (IQP) at the Worcester Polytechnic Institute (WPI). This data is being collected and analyzed because technology is an ever expanding field that continues to contribute to society. Learning how to integrate this new technology to increase the learning capabilities of students becomes essential in the 21st century. This project will examine ways to integrate computer programming into a curriculum for teenagers that is both educational and interesting, to grab the minds of the students and focus their intellectual power. Some of the data will be collected through surveys of the youths at the library. Other data will be collected through observations of the preliminary classes given to select members of the staff at the library, along with a beta test of the class given to a focus group of youths from the library. Adjustments will be made to fit the needs of the youths at the library. The analysis of the data collected from the Worcester Public Library was essential in order to mold a curriculum that best fits their target audience. The more information that can be collected about the youths at the library, the better suited the curriculum will be, to aid in the endeavors to expand their minds to the world of computer programming.

II. BACKGROUND

In the background chapter, general background information about the Worcester Public Library and its objectives, the five-step procedure for a good curriculum design, the theories on how students learn and how teachers teach, and the features of two programming software (Scratch and Alice) will be discussed.

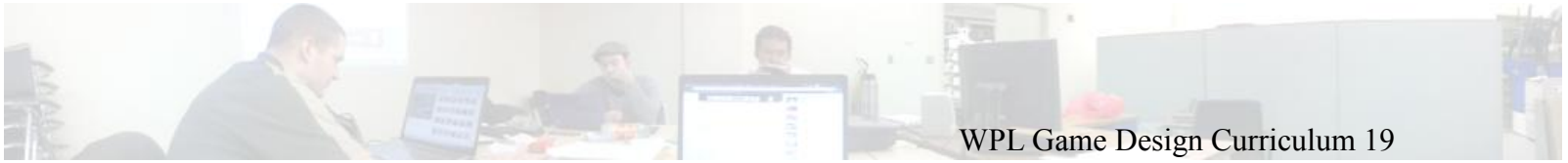
II.I. WORCESTER PUBLIC LIBRARY

II.I.I. History

The Interactive Qualifying Project is meant to combine the knowledge learned in the classroom with society. Using the skills learned in the classroom, students are to examine a certain problem in society. The Worcester Public Library (WPL) is an organization very involved in the "Worcester society". Libraries everywhere see people come in and out. Old people, young people, children, and teens use libraries every single day. Libraries interact with all the different parts of society, creating an exciting environment for an IQP type project.

The Worcester Public Library has been a prominent feature in the downtown area for over one hundred and fifty years. Founded in 1859, the WPL has been serving the people of Worcester

Figure 1: Worcester Public Library



with the books, media, and news that they need (Historic Milestones, 2010).The library started in1859 by a local man named John Green. Green was a local physician who donated the libraries first collection of books and an endowment for the future of the library (Agency-WPL, 2010). Over the next one hundred years Worcester grew into an important city in Massachusetts and New England. The library grew to meet the needs of the growing community with the addition of six branches. The library was supported by private and public funding and encountered some tough times in the early 1990s. Some funding was cut because of the economy in the early 90s, and the library was forced to close six of its seven branches. In the late 90s when the economy improved the Salem Square main library underwent a two year renovation and addition. The WPL had its grand re-opening in 2001 and is now fully capable of serving Worcester's 200,000 adults and children (Library Details, 2006). Now the library has a large collection of books and other media for the community to access; see Table 1 (Library Details, 2006).

Table 1: WPL Collection

Books and Volumes	634,661
Videos	15,594
Audio Materials	14,562
Subscriptions	1,167

Today there are three branches of the Worcester Public Library. The main branch is located at Salem Square in downtown Worcester. The other two branches are the Frances Perkins Branch and the Great Brook Valley Branch shown in Figures 2 and 3.

Figure 2: Frances Perkins Branch

Figure 3: Great Brook Valley Branch

II.I.II. Community Involvement

The Worcester Public Library takes pride in educating the community. Their mission statement is to serve:

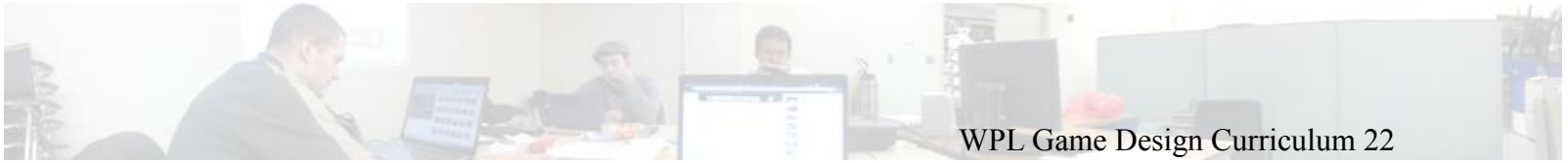
> "…as a gathering place that actively promotes the free exchange of ideas in our democratic society. The library makes information and services available to all people while fostering intellectual freedom, protecting privacy, encouraging personal growth and enrichment, and celebrating our diverse community heritage."(About the Library, 2010)

The WPL is extremely involved in teen creativity development. In the library the teens have their own "Teen Center" where they utilize computers for art, homework, browsing the internet, blogging, etc. The Teen Center also includes other teen related material such as books and magazines. In an age of video games, television, and dormant teens, the WPL is successfully encouraging involvement and education. The library provides various programs and groups for teens to get involved in (Figure 4: Teen involvement).

Figure 4: Teen involvement

The current programs are offered throughout the month, emphasizing topics that are interesting to the teens. Recent programs include: Manga for Teens, Anime Wings Club, and the Teen Writer's Club (Calendar of Events, 2010). WPL also seeks the teens input about the programs through the Young Adult Council and the Teen Advisory Group. YAC and TAG meet to discuss the programs they would like to have and how to organize these programs. The two groups also help to keep up the Teen Center and the teen popular sections of the library. The library emphasizes having fun in all of the programs that they offer, it is a place where students can explore and develop their creativity and storytelling skills.

WPL has made it a point to provide for teens because the amount of teen involvement in the library has increased dramatically over the last six years. Circulation of teen related material has grown 350% over the last six years. In 2004, teens checked out 8,858 items to 2009 where 31,388 teen items were loaned out by the library (Hrobsky, 2010).



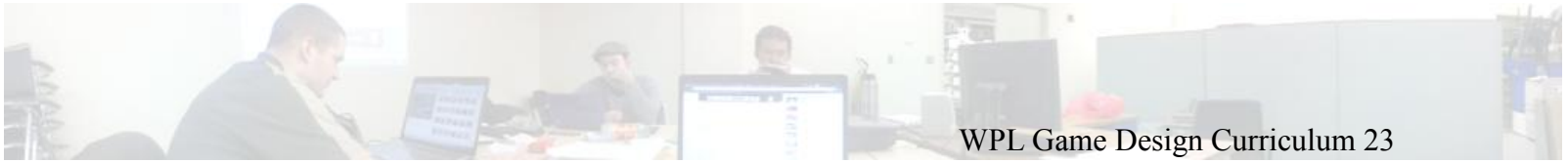
II.I.III. Problems and Issues

The dramatic increase of teen interest in the library creates a need for more interesting programs. The Worcester Public Library has need for a technology based program that will appeal to the increasingly large WPL teen population. The WPL envisions a program that will, ultimately, increase the Information, Communications, and Technology (ITC) literacy of the teens (Hrobsky, 2010). In a society where technology importance is ever increasing, it is important for teens to learn practical applications of the technology. Many teens know how to use computers for surfing the web and playing games, this program can open their eyes to see technology used in ways they have never explored. At the same time, the WPL wants to promote creativity through this program. The new program will give teens the ability to create their own games and animations. It is the hope that these individual creations will ignite social interactions between the different teens.

The goals of this project are to develop, coordinate, and pilot a game programming curriculum for teens 12-17 years of age. A successful program portrays the information in a way that is interesting to the audience. A well-rounded curriculum is important because the user is going to be more intrigued if the program is well run with stepping stones, goals, and achievements. Finally the program needs to be presented in a way that is conducive to the audiences learning style. Students learn differently today, in a technology based society, than they did thirty years ago. It is important to understand the audience's interests and how they learn.

II.II. CURRICULUM

In a society where technology fuels life, the power of technology and computers needs to be taught to as many people within the society as possible. The technology and the learning setting should be combined to teach students about technology. A curriculum should be a combination of tools recourses and a mode of teaching to the students. Many people today think that adding

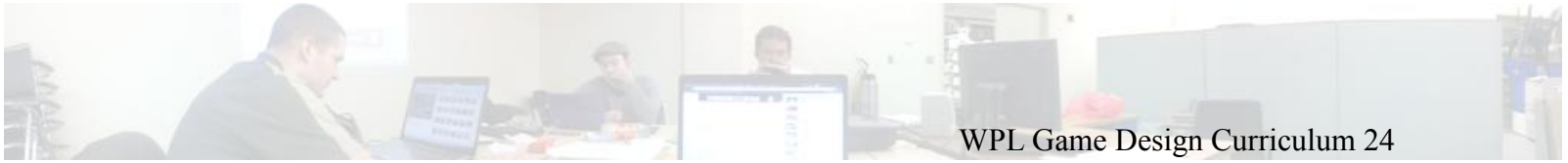


computers to the classroom will teach student about technology. This is not the case. Stephen Petrina in the *Journal of Technology Education* broke down how to learn technology into 5 simple steps:

1. **Participation-There is consent, power sharing, negotiation, and joint responsibility by co participants. It is essentially no authoritarian and not unilateral.**
2. **Integration-There is interaction, interpenetration, and integration of thinking, feeling, and action.**
3. **Relevance-The subject matter is related to the basic needs and lives of the participants and is significant to them, both emotionally and intellectually.**
4. **Self-The self is a legitimate object of learning.**
5. **Goal-The social goal or purpose is to develop the whole person within a human society.**

Many students when sat in front of a computer only know a hand full of resources available to them. They do not utilize the five step basis to completely learn about the technology they are using. They will open up the first video game and begin to play, surf the web, or use social media sites. These are all superficial benefits of computers. Computers are used in everyday life by people all over the world. Most of these people do not utilize the power of computers to their own benefit.

A curriculum to teach students and teens about computers and all that they can do must be developed. With a sound curriculum, students who have not been formally taught about computers are able to learn the extent of computers and how to use them effectively and efficiently. Computers should not just simply be added into a classroom setting, they should be accompanied by someone who is able to pass on their own knowledge to the students. Technology integration should be utilized. Technology integration is the addition of computers or some form of technology with a purpose to teach. Student should not just be taught how to use a specific program, but also



what it is used for and how they can use it in their everyday life (Dockstader, 1999). This will show the student there is more to computers than video games.

Using these 5 steps a strong curriculum can be formed to help students learn the wide range of tools that can be used on computers to make everyday life easier. Students, especially ones in their teens, will be given the opportunity to express their individual creativity. The curriculum that will be instated will optimize the idea of individuality. Playing to the interest of the students will increase the participation from the students. Integration of gaming into the curriculum will spark the interest of the students. The idea of using gaming as a tool to teach about computers as a whole will be a subtle way to influence computer learning. If the students are interested and engaged in the subject matter they will be more willing to participate and the goal of learning the technology being taught will be achieved.

A study completed and recorded in *Computers and Classrooms: The Status of Technology in U.S. Schools* stated that, "among fourth and eighth graders, playing games (presumably at home) was the most prevalent computer use" (Coley, 1997). Many of the students of the teenage group using computers are playing games the most. Table 2 shows the percentage of students using computers on a daily basis to complete their homework. Although computers are readily available to teens for any use, most teens are using them for the video game aspect. Since computer gaming is a high interest among students a curriculum must be formed around that interest to teach students the wider range of computers.

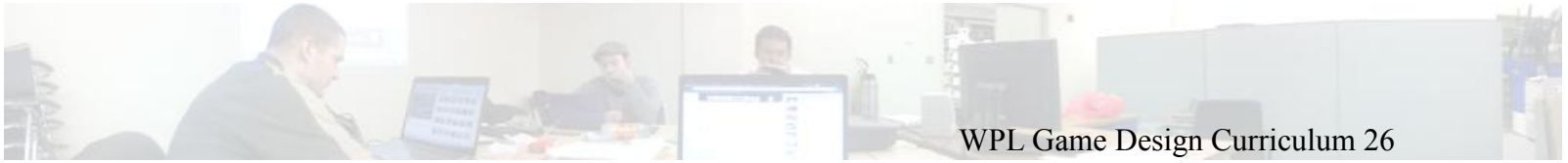
Table 2: Teens Using Computers for Daily Homework

Percentage	**Grade Level**
9%	4th Grade
10%	8th Grade
19%	12th Grade

II.III. EDUCATION

While developing a curriculum for any course, it is important to understand the ways in which people learn and the ways in which people teach. Even though the Worcester Public Library wants this curriculum to be fun and creative, our group needs to understand how to teach the students to use the selected design environment. The objective of this section is to learn about how students learn, how teachers teach, how students use technology in today's society and how this technology can be used to help students learn. These are key issues that need to be understood in order to create an effective learning program.

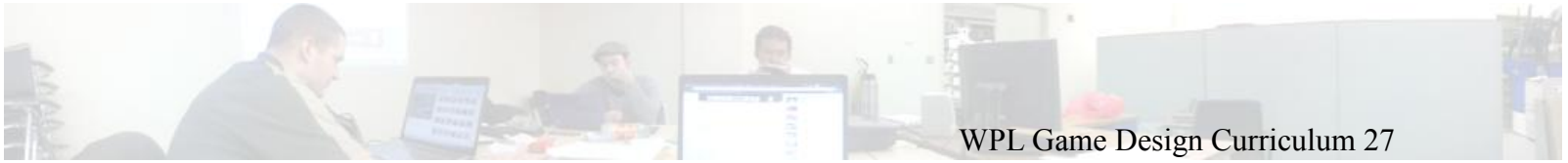
There are many different theories about how people learn in general but all of the different theories agree that there are several different learning styles (Miller, 2001). One theory of learning is Howard Gardner's theory of multiple intelligences in which he describes seven separate intelligences consisting of linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal. Gardner states that every person has these intelligences and that each person develops every style of intelligence to an adequate level (Miller, 2001). These intelligences work in very complex ways together to form how each person learns. Because people can develop each style of intelligence to a different level every person learns differently.



Another theory of how people learn is based on the personality. The Myers-Briggs Type Indicator categorizes people into 16 different archetypes based on the way they view their environment, make decisions, whether they focus on things as a whole, or whether they focus analytically in parts (Miller, 2001). This suggests again that there are many different categories in which people learn in but those categories are a bit broader in the content of people in each archetype. Although there is more specificity in the multiple intelligences theory, the conclusion drawn is the same; people learn in many different ways.

Because they are so many different ways people learn it is safe to say teachers have to teach in a broader style that combines some of the key elements of each style of intelligence. To quote Pamela Miller in *Learning Styles: The multimedia of the Mind*, "While all of the models discussed here vary in their methodology, they all concur on the diversity of learners and the need to address that diversity in classroom instruction to improve student performance. (Miller, 2001)" It is important that teachers be able to connect, the subject material, to the students. This is because if the student is not engaged in what is being taught, they will not learn about the subject matter. In developing the curriculum our team must consider the teens of the Worcester Public Library and understand the way that they learn and figure out the best way to connect them to the subject material.

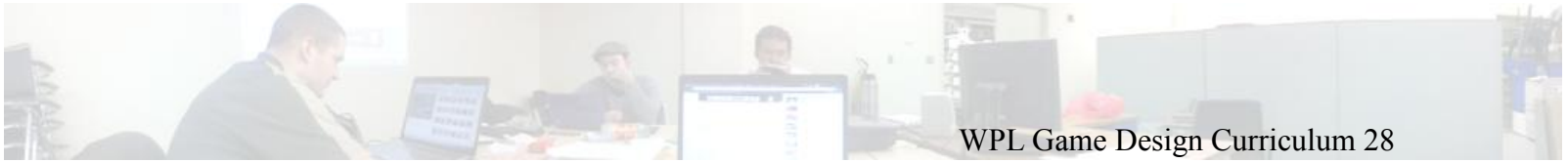
Along with understanding how people learn and how teachers teach, the team should look at the tools used for learning. With the focus of the curriculum material being on computers the team needs to understand how computers are used by the Worcester Public library teens. In *Living and Learning with New Media: Summary Findings from the Digital Youth Project* by the John D. and Catherine T. MacArthur Foundation, learning with new media is broken into three parts; hanging out, messing around and 'geeking out' (MacArthur Foundation, 2008). Using these three groups to break down the interactions between teens and new media helps us understand how to use new media to teach these teens.



Teachers and parents tend to see the practices involved with hanging out as a waste of time and tend to subvert teens hanging out with school work or choirs (MacArthur Foundation, 2008). Teens in response make a means to hang out and communicate and tend to use new media to hang out in settings either online or offline. This tends to get teens involved with input methods such as texting and typing normally in chat rooms. The goal is to turn hanging out at the library into a learning experience where students come together socially to share their new video game they have made with their friends, in turn turning their friends on to the prospects of video game programming.

Messing around is the next step from hanging out, this is still characterized as hanging out but this is more interest driven (MacArthur Foundation, 2008). The goals for messing around are that the teens will be interested in game programming so they will spend their time exploring the possibilities; whether that be exploring new things that can do in game development or searching for new games more so as inspiration for themselves to take and build on. Our team wants to peak the teens' interests into the messing around stage so that they will go ahead and perpetuate their own learning.

The next phase is 'geeking out'. In 'geeking out' more knowledge is known about the subject matter and an intense passion is made to the material (MacArthur Foundation, 2008). As the teens progress through the subject material they will hit a point where their hunger for their interests can only be filled by an expert in the field. The goal of the curriculum is to push the teens into the messing around genre and as some progress into the 'geeking out' genre they will be able to help out the other teens or new teens with the subject matter. Having a program that is self-perpetuated and self-sustainable is the ultimate goal. The knowledge of how to teach these teens and grab their interest then becomes the lynch pin, because if the students are not interested in the subject matter they will not push into the messing around phase to want to learn more.

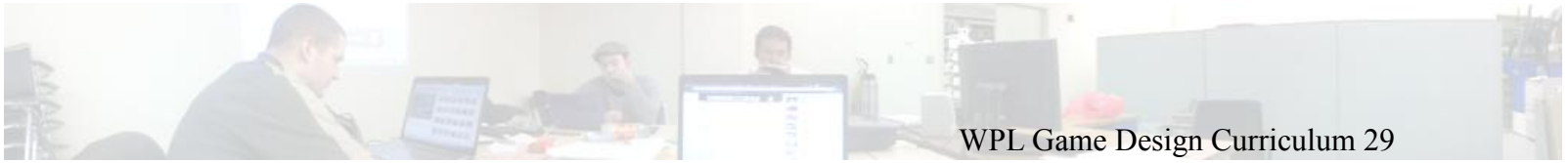


Using these phases our group can place the children at the Worcester Public library into a general phase and track their progress into other stages. Knowing which phase to start in will help mold the starting curriculum and let us assess the educational value of the curriculum. Keeping in mind these stages to track the teens' growth and using these stages along with the much different intelligence it becomes a hard task to create a curriculum to encompass all styles of learning. Now aware of these challenges, the team can mold a curriculum that best suites the Library's teens.

II.IV. PROGRAMMING

The societal issue on teens was discussed in the introduction chapter and the team tried to find a way to enhance teens' learning experience with video games and technology. At the same time, our team realized that the goal of Worcester Public Library is to encourage teens' involvement in after-school programs and their creativity in those programs. Thus, the team used Malone's research on video games as a clue to the success of the project. He argues that video games are popular because they provide teens with "challenge, fantasy, and curiosity" (Malone, 1981). If our team can find a way to integrate challenge, fantasy, and curiosity in our project, our team can find a way to improve teens' engagement in after-school programs as well. As Shaffer points out, "games integrate knowing and doing (Shaffer, 2005)." In the video games, players situate themselves on the role they are playing and try to act their roles in the virtual world. If they were a soldier in the game, they would act like they perceive soldier's act and they would think like they perceive soldier's think. The interaction and role playing in games will allow teens' creativity to blossom. Through the discussion on video games, the team will leverage the interest in videogames to encourage students' involvement in after-school programs.

What can we use to bridge the gap between video games and after-school program? A game programming curriculum, as many scholars suggests, would be a good choice (Resnick, Maloney,



etc., 2009). On one hand, games are entertaining. On the other hand, programming requires much hands-on practice. Why programming? Even introductory programming course is frustrating. And many teachers try to avoid giving their students first computer lectures by programming (Dann, Cooper, Pausch, 2006). Thus the answer to this question can be ambiguous. Researchers like Resnick, Maloney, etc., try to explain this in a different way. They list all essential skills for the 21st century: mathematical skill, computational skill, creative thinking, systematic reasoning, collaborative working, and point out that all the skills listed above can be learned or improved by learning programming. Then the only problem left is how to choose a simple programming language that allows novice programmer to program their games without frustration.

Through the team's research, two different programming languages were found that will provide the users with fantasy, challenge, and curiosity – the key elements that motivate teens' engagement. One is Scratch from Massachusetts Institute of Technology. The other is Alice from Carnegie Mellon University. They both have a user-friendly development environment which allows users' full creativity without frustration. They also help users in the learning process to develop skills such as mathematical skill, logical thinking technique, etc. In the following sections, these two programs will be examined and evaluated to gain an understanding on the difference of them.

II.IV.I. Scratch Background

Scratch (Figure 5) is a network-based, media-rich programming environment designed for youth age 8-16 to enhance the development of their technological fluency, mathematical and problem solving skills, and justifiable self-confidence in interaction. The program deeply rooted in the idea of LEGO building bricks that allow user to build animated stories, games, and interactive art by using the "building blocks" in Scratch (Maloney, Burd, Kafai, Rusk, Silverman, Resnick, 2004).

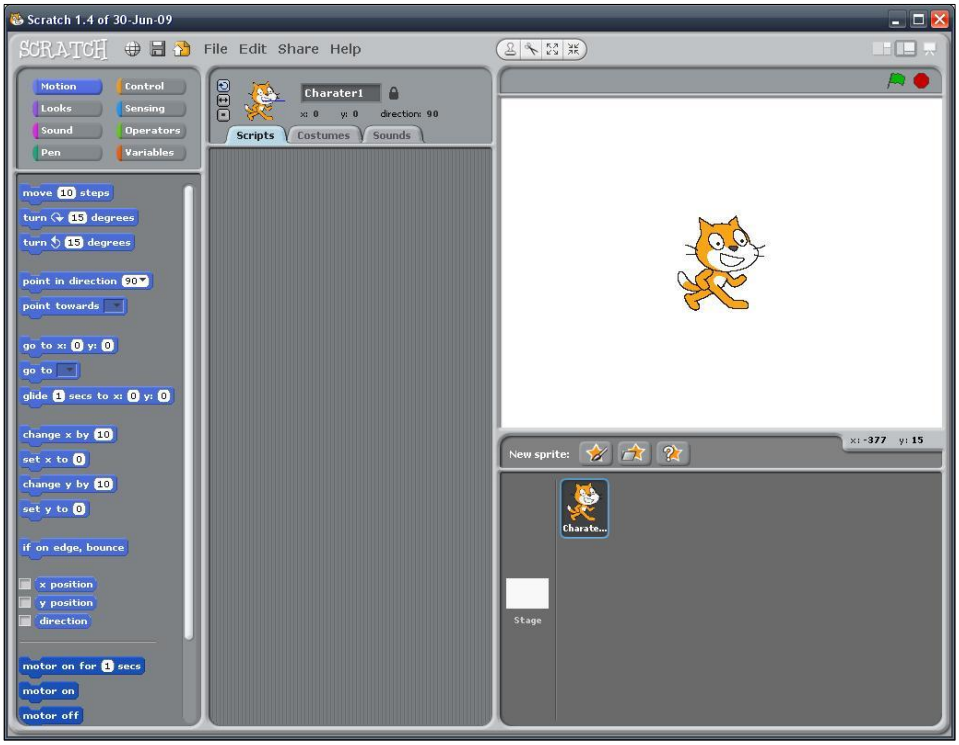


Figure 5: Screenshot of Scratch

II.IV.II. Core features of Scratch

Building-block programming: "Building-block" is the "language" that a user uses to communicate with the computer in Scratch. Different shapes of blocks represent different commands and data types. This approach eliminates syntax[2] errors and allows youth to focus on their creativity.

Programmable manipulation of rich media: Instead of manipulating numbers, strings, simple graphics, Scratch manipulates images, animations, movies, and sound. This approach raises the interests of youth.

Deep share-ability: The objects at all levels can be exported freely. Youth can upload their projects online and check others' project, which allows ideas trading and techniques sharing. This approach encourages community interaction.

[2] Rules of the programming language

Integration with physical world: The behavior of Scratch program can be controlled by a physical sensor (such as motion sensors, sound sensors). This approach helps the youth to connect the digital world with the physical world.

Support for multiple languages: Scratch is a multi-language, multi-cultural environment, which allows youth people to communicate in a global community. This approach fosters cross-cultural collaboration among youth.

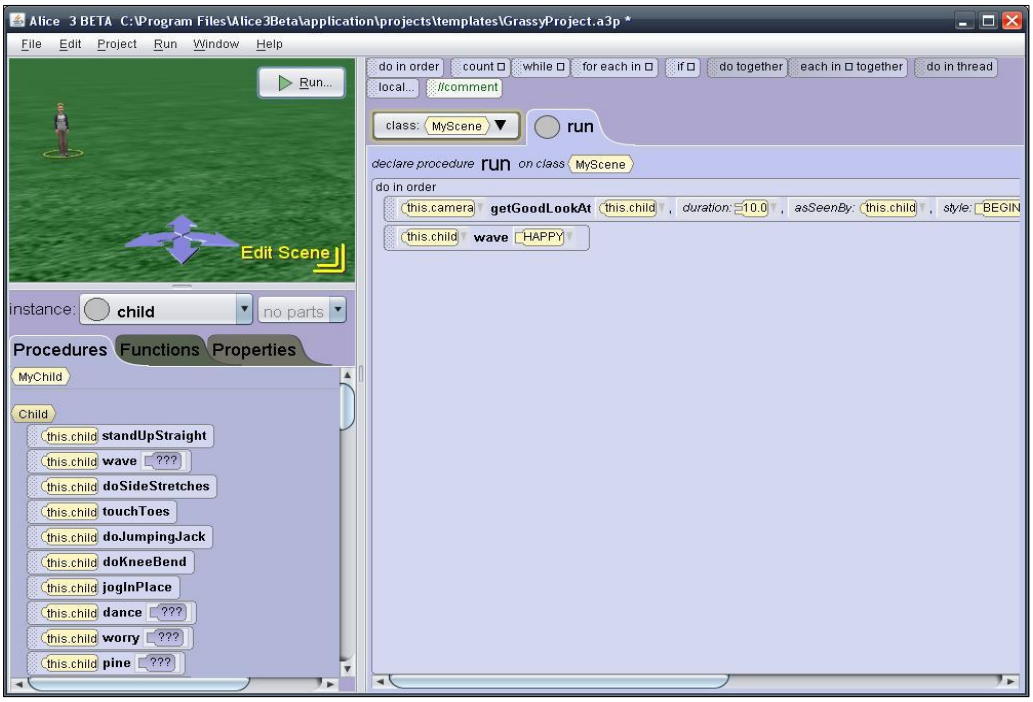
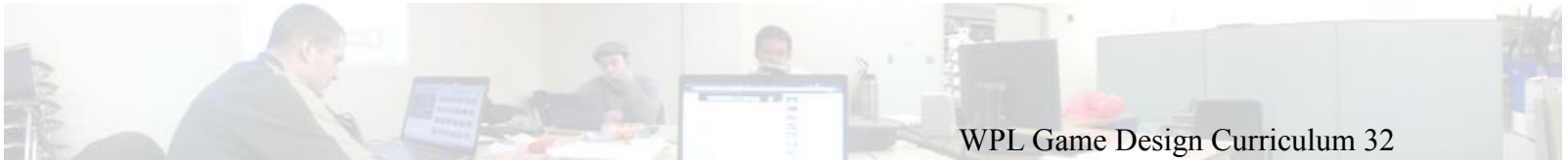


Figure 6: Screenshot of Alice

II.IV.III. Alice Background

Alice (Figure 6) is a 3-D interactive graphics programming environment designed for high school or college students who are novices at programming. Alice is an educational programming environment that helps students overcome obstacles in the introductory programming course (Dann, Cooper, Pausch, 2006). It uses a drag-and-drop 3-D model interface to allow users to control the program freely and get highly visual feedback (Dann, Cooper, Pausch, 2000).



II.IV.IV. Core features of Alice

Action Commands: There are two types of action commands: those that tell an object to perform a motion (moving, rotating) and those that change the physical nature of an object (size, shape, physical state). This approach helps users to understand different behaviors of an object.

Named instructions: This feature allows user to name a sequence of instructions with intuitive and meaningful name. This approach helps user simplify the program and make sense of instructions.

Functions: This feature allows user to implement recursion/looping, interaction, and computation. This feature is similar to regular programming language, but these functions are named intuitively. This approach helps user understand the function more intuitively.

Decisions: This feature is similar to logical/conditional operations of regular programming, but it provides immediate visual feedback on the decision statement. This approach helps user to find their mistakes instantly.

Recursion/Looping: This will be also a major part in a regular programming language, but in Alice, it simplifies the entire loop and allows the loop flow in a simple logic.

Events/Interactions: This feature allows users to create a graphical user interface for their application. Events usually allow users to interact with the program.

II.IV.V. System Requirements[3]

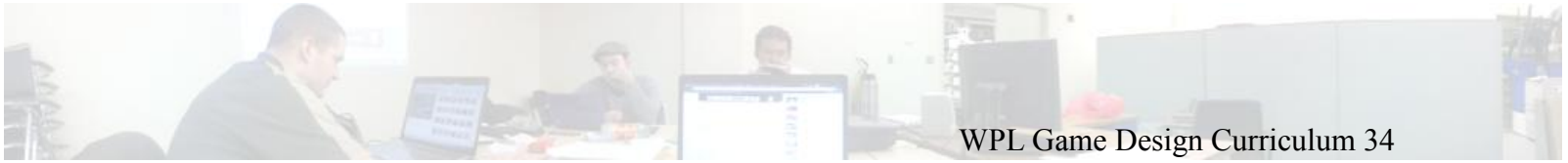
Table 3: System Requirements

System Requirements	Scratch	Alice
Operating System	• Windows XP, 2000, Vista • Mac OS X 10.4 or later • Linux	• WindowsXP,Vista, 7 • Mac OS X 10.4 or later • Linux
Hardware	• CPU: 1GHz or above • RAM: 256MB or above • Hard disk space: 120MB	• CPU: 1GHz or above • RAM: 1GB or above • Hard disk space: 600MB

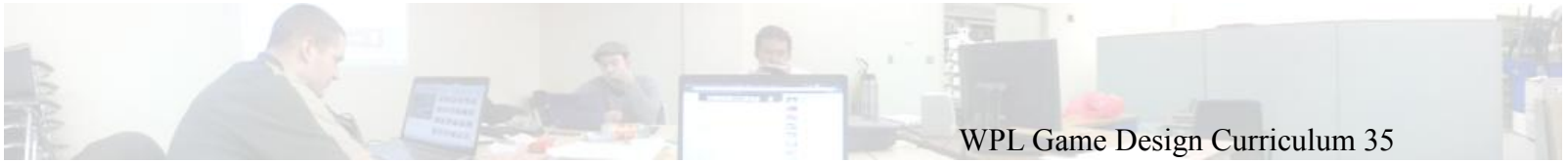
II.IV.VI. Scratch vs. Alice

The system requirements of both programs were taken into account but could not find significant difference between their requirements. With today's high performance personal computers, these two programs will run smoothly. These two programs aim to gain interests from youth through using graphical user interface, "no-typing" syntax, and immediate response, simple program structure. The major difference between these two programs is the user target group. Scratch focuses on kid's age from 8 to 18 while Alice focuses on high school students or freshmen-year college students. Thus, Alice requires students to have a higher level of knowledge. The objects in Scratch are two-dimensional[4] while the objects in Alice are three-dimensional[5]. Both of these two programs are entertaining and educational, but through further investigation, it was found that

[3] System Requirements are derived from Apple, Scratch, and Alice official website
[4] Two-dimensional: the computer graphics are generated in two geometric dimensions, e.g. length and width
[5] Three-dimensional: the computer graphics are generated in three geometric dimensions, e.g. length, width, and depth



Scratch has more features on the entertaining side while Alice has more features on the educational side. Scratch has many more features such as its very well-developed online community for sharing the projects that were created using Scratch, while Alice has less support on sharing the projects. At the current stage, Scratch and Alice are comparable to each other in terms of their features. Further discussion about the programming software will be in the Accomplishments and Discussion Chapter.



III. METHODS

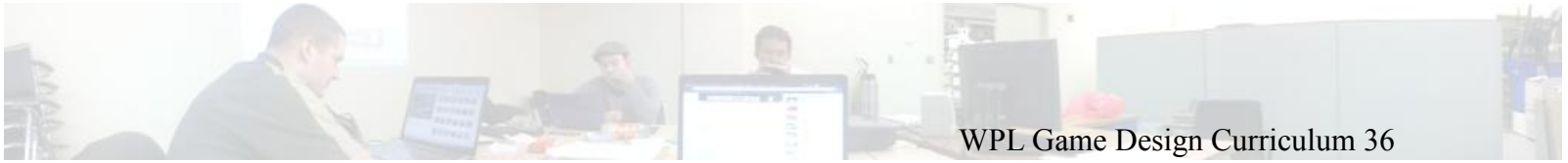
In the methods chapter, the research approach is classified as ethnographic which is focused on looking at the issue through a cultural lens. This chapter will also discuss the ways of collecting data and how the data will be analyzed and sorted by trends that are observed.

III.I. GUIDING QUESTIONS

1. What is the meaning of playing video games from the perspective of the youth? (linked to target group survey/interview)
2. What is the experience of the youth who participate in the programming course? (linked to observation/target group survey)
3. How do different programs appeal to certain age groups/audiences? (linked to interview/target group survey/observation)
4. How do different programming curricula affect the performance of teachers and students? (linked to observation/archival research)

III.II. OVERALL APPROACH AND RATIONALE

As Schram (2003) suggests, establishing the appropriateness of a particular research approach, the following aspects have to be taken into consideration – definition of the problem, the clarity of purpose and perspective, and the focus of questions. In choosing a research approach, it has been distinguished between the natures of different approaches. For example, ethnography, narrative inquiry, and case studies are all research approaches, but they also fall into different categories. The ethnography is a research tradition, while case studies are research methods and narrative inquiry is an analytic framework. Ethnography research approach was selected for this project because it is rooted in a cultural framework and it involves both a process, by which a researcher comes to discern patterns and behaviors in human social activities, and a product which



indicates how these patterns and behaviors are interpreted or portrayed. For a study to be ethnographic, two important concepts are necessary (culture and holism) since it "must provide the kind of account of human social activity out of which cultural patterning can be discerned" and make connections between parts and between parts and the whole to show completeness of ethnography. (Schram, 2003; Wolcott, 1999) Four data collection techniques: survey, interview, archival research, and participant observation will be used to ensure the completeness of an ethnographic research. This research approach will allow us to study the relationship among games, programming, and curriculum in the context of youth's culture.

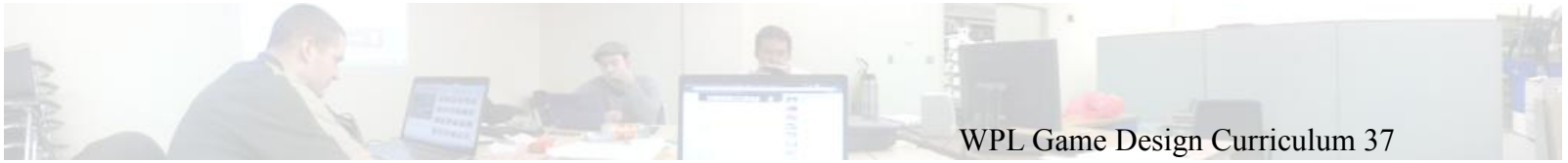
III.III: TRADITION'S METHODS

Selection: The WPL serves a broad community of 200,000 adults and children. They are a library dedicated to, not only providing information, but also teaching information. The WPL strives to provide information that will encourage personal and intellectual growth (WPL, 2010). WPL offers several programs for teens during the year that encourage creativity and interaction. In addition to their current programs the WPL would like to offer a computer game programming curriculum to the teens. This type of technology based program will offer a creative and practical way of encouraging computer use in a heavily technology based society.

III.IV: DATA COLLECTION TECHNIQUES

III.IV.I. Target group survey

The first data collection technique will be a target group survey of the audience that our program is intended to teach. The group taking the survey will consist of teens involved in the various teen groups at the library. The library has groups such as the Young Adult Council and the Teen Advisory; as well as, Manga for Teens, Anime Wings Club, and the Teen Writer's Club. These groups meet at different times throughout the month and will provide a large sample size of our



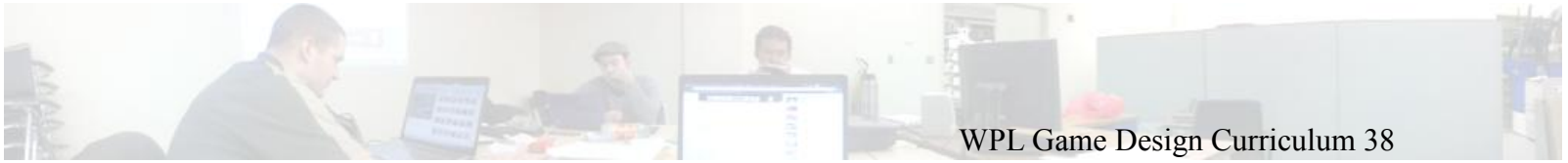
target audience. The teens involved in the current groups and clubs at the library are the types of teens that are most likely to attend our program. This is why it is important to survey these teens and not just random teens that sporadically visit the library. The survey will include questions to gain knowledge about what types of games the target group likes, why they like playing games, and what type of experience they have with computers (Appendix A). The information given from these questions will help us determine how to develop a program that appeals to our target audience.

III.IV.II. Interview of target audience and library management

The second data collection technique will be talking with the prospective teens and the library management, specifically, Anne Hrobsky (director of the Youth Services Division at the Worcester Public Library). Since the teen groups meet throughout the month at the library the opportunity will be given to sit down and talk to them about what they enjoy about computers and games. The main question that will be asked both the management and the teens is what they want to get out of this program. Our team wants to hear from them, how they see this type of program being beneficial. It will be important to understand how they envision this program being successful in an educational way.

III.IV.III. Focus group and pilot program observation

The third data collection technique will include observation of the teens testing a pilot of the gaming program. Observing the teens interacting with the program will be very beneficial to use for seeing what works and what does not work. The program may be uninteresting to them or the subject matter maybe to hard or easy. The most important observation for us is seeing how the teens interact with each other while using the program. It will be interesting to observe whether the teens get more out of the program by helping each other or working by themselves. After the pilot is



completed an evaluation form will be passed out to gain feedback about the pilot. The feedback will provide pros and cons of the initial pilot. General conversation will also be conducted with the audience at the end of the pilot to collect their reaction to the program.

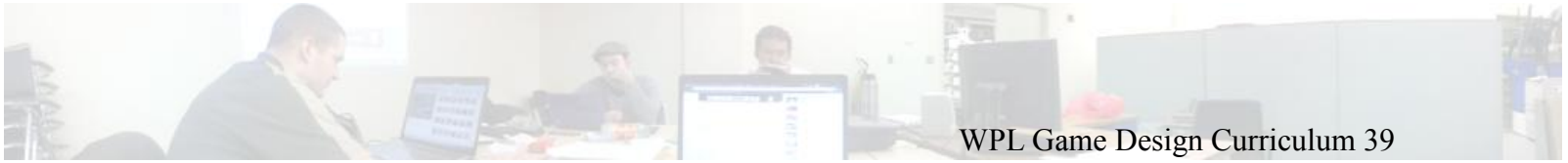
III.IV.IV. Archival research

The fourth data collection technique will be archival research on how similar programs have been conducted. Programs such as the one the team is designing have already been successful at libraries in Minneapolis and Seattle. Through our research, the team will look into the successes and the failures of their programs to gain a better understanding of how our program should be designed and delivered.

III.V: PROTOCOLS

Setting: All students and participants that will a part of the game programming curriculum will be an active member of the Worcester Public Library; also the curriculum will be based out of the library. All surveys, interviews, and observations will take place in the Worcester Public Library.

Subject Selection Criteria: Every teen group at the Worcester Public Library (eg. TAG and YAC) will be asked to fill out a survey. This will include any other teens that are interested in participating in the game programming curriculum. The more data that is able to be collected, the better the curriculum will be. With this information a more geared curricula will be able to be developed for the teens. The interviews will be of the staff in the library and a selected number of participants. This interview will consist of, but not limited to how the students and staff members enjoy the class, and what they would like to see added, changed, and/or omitted. The observations will be conducted during class by the team member to see if anything needs to be altered to improve the class.

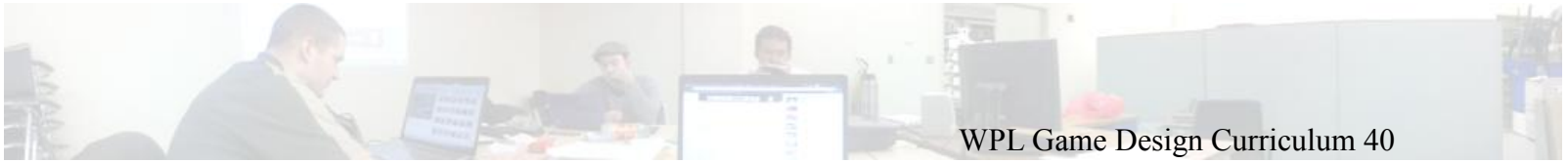


Triangulation: Three data points will be created (surveys, interviews, and observations) to be used in improving the game programming curriculum. This information will be collected before and during the course. This will allow for development to be sped up and the curriculum to be improved at a more rapid rate. Using the three data points trends will be arise and the course can be modified to meet the needs of the students and of the library staff. The surveys provided to the teens will offer some insight into the minds of the students and create and alter the curriculum to fit their wants and needs.

The interviews with staff members directly related to the curriculum and students participating in the curriculum will be ways for them to have a hand in helping the curriculum grow into a more effective one. Also, the observations completed by the team members will give feedback to the team based on interactions and body language, basically how the teens are reacting to the material.

III.VI: DATA ANALYSIS

Target group surveys will be analyzed to draw trends in the students' knowledge of the subject matter. Interviews with the target audience during the pilot programs will help compound the codes drawn from the surveys. The observations of the pilot programs will be used to adjust the curriculum for misunderstood codes and help finalize the curriculum. Assessment surveys and evaluations forms will be used to measure the effectiveness of the lessons. Archival research will be analyzed to compare the curriculum to other curricula used at different libraries and to obtain foresight into the finalized curriculum. All the data will be analyzed to identify codes and tailor the curriculum to fit the target audience. To make sure all our data collection is completed on time our team created a schedule to layout the whole term in advance. The schedule was set up to show how much time will be allowed for each item of work and what day it had to be completed by. The types

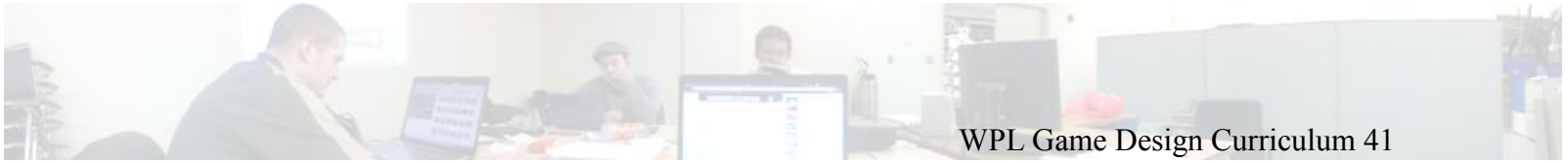


of work in the schedule included our milestones, writing deadlines, and developing program materials. An example of the look ahead and milestones schedule can be found in Appendix B.

III.VI.I. Research Agenda

Table 4: Research Agenda

Data Collection Tool	**Amount**	**Additional Info.**
Target group survey	One for each member of the teen groups	Use created survey to collect data
Focus group and pilot program observation	2-3 pilot groups	Take notes and observe how the teens react to and interact with the program
Interview of target audience and library management	Approximately 10 half hour interviews	Semi-structured Conversations during and after focus groups and pilot programs
Evaluation Form	One for each member of pilot/focus group	Used to evaluate the teaching skills of the lessons
Assessment Survey	One for each member of pilot/focus group	Used to evaluate the amount the students learned
Archival research	2-3 libraries with similar programs	Pros and Cons of previous similar programs



IV. ACCOMPLISHMENTS AND DISCUSSION

The accomplishments of the team will be discussed in this chapter. These accomplishments include a preliminary survey, interviews with library staff, four pilot programs, and a curriculum. The survey was used to identify the target audience at the early stage of the curriculum design. The interviews were used to understand the needs of the library and the target audience at the intermediate stage of the curriculum design. The pilot programs are used to evaluate the effectiveness of the curriculum at the final stage of the curriculum design. Based on the results of the survey, interviews, and pilot programs, a creative course will optimize the game design curriculum.

IV.I. PRELIMINARY SURVEY

The preliminary survey[6] is conducted for gaining basic information of youth users in the library. The team has collected 31 copies of survey from library program participants. These participants are in the age group of 12 to 18 (Figure 7). Inside this group there are more males than females, but their numbers are comparable, which are 17 and 14 respectively. Twenty-four out of thirty-one participants own video game consoles. The rest participants play games on their computers or mobile devices. The game type these participants like to play the most is shooter game. There are ten participants enjoying role playing game. And there are also comparable numbers of participants like game types such as sport, fighting, racing, and online. Thirty participants speak English. In terms of programming experience, twenty-three participants have only few months experience or less (Figure 8). Within these twenty-three participants, there are twenty participants having little experience or no experience. In the questions about programming languages used, twenty-one participants never use any specific programming software. There are eleven participants

[6] More details on Appendix A: Survey &Results

knowing a specific programming language such as Java or C. This survey provides us with the fundamental basics in determination of programming software and in design of curriculum.

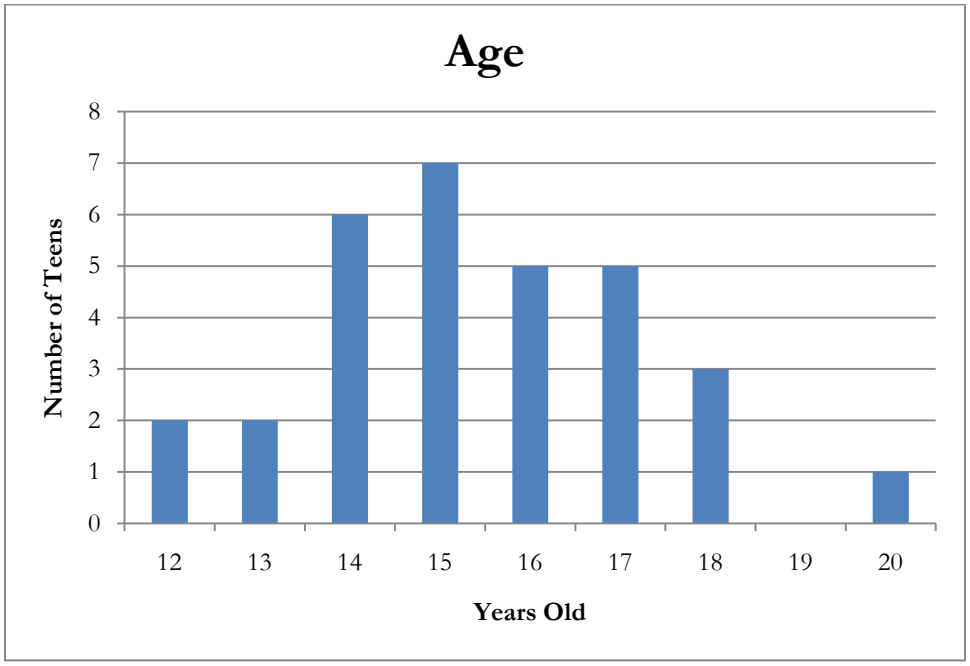


Figure 7: Audience Age

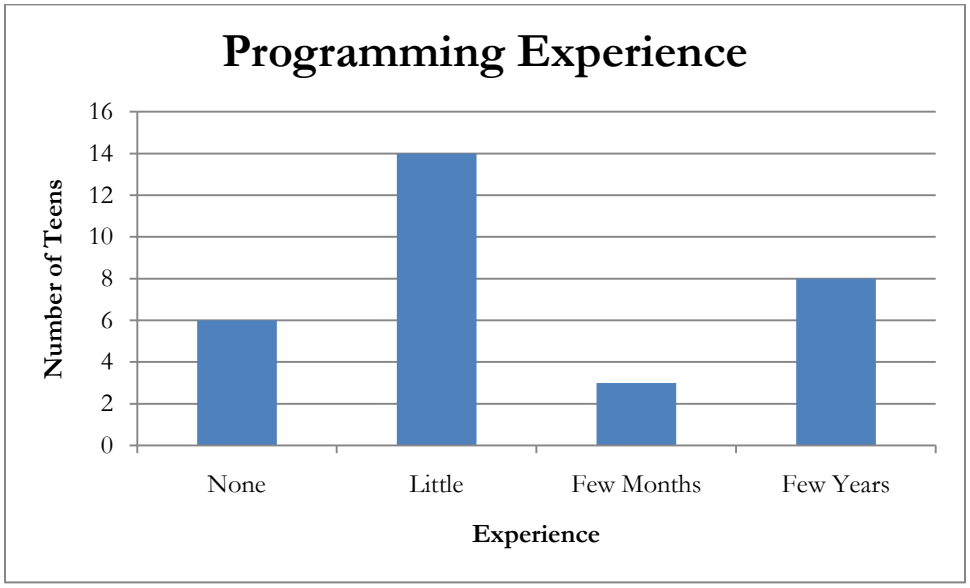
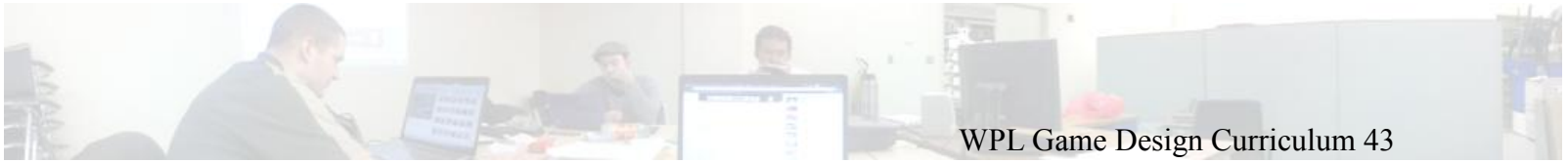


Figure 8: Programming Experience

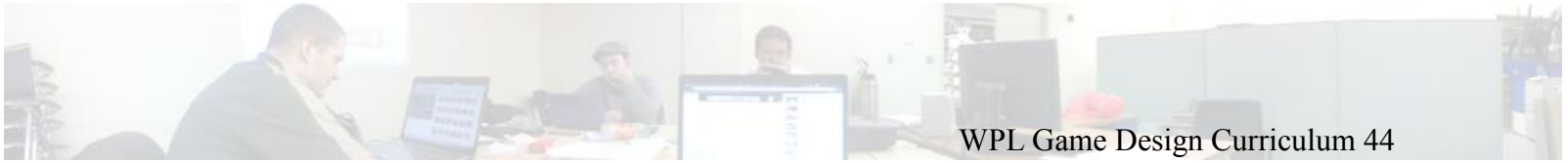
In the selection process of the programming software, there are two important factors that will be considered. One is the user age group, and the other is difficulty level of the programming



language. The age group of the after-school program is anticipated at teens aging from 12 to 18. The data collected shows that the assumption was correct. From the research on programming languages, the two programs of Scratch and Alice are to be compared. Scratch is developed specifically for age from 8 to 18, and Alice is often used by high school students or freshmen college students. Comparing to Alice, Scratch has users in a wider age range. It fits the after-school program in the library the most because it allows more teens from different ages to participate in the program when users of the library are in wide range of ages. With Scratch, it is expected to see not only high school students in the program, but also younger users. While considering what difficulty level of the programming language should be, it is shown through the data that most participants are lacking of programming experience and there are only around one third of participants knowing some programming languages in the survey. Thus, the programming language must be easy to use. Both Scratch and Alice has a user-friendly graphical interface, but since Scratch is designed for a younger age group, it was often used by informal educators in after-school programs while Alice was developed for formal programming introductory course. Scratch has a user interface that is easy to be adapted by younger users, and to be used for manipulating multimedia such as picture, music, animation, and game. Scratch also has a huge and well-developed online community that helps the users to learn this program. Through the analysis of survey data and comparison of the desired features in Scratch and Alice, Scratch was chosen to be the program used I the team's game design curriculum.

IV.II. INTERVIEW OF LIBRARY MANAGEMENT

Informal interviews were conducted with library management. Interviews were conversations had before the pilot programs were in creation. This was so each of the team members could get information from the staff as to any thoughts or concerns. The library



management was interviewed to understand what they wanted to see as a finished product. The staff gave a clear emphasis that the workshop had to focus on the teens' creativity. They saw the workshop as being a gateway to the programming world but wanted the teens to be expressive. It was learned that the staff envisions this workshop progressing towards other classes at the library, which Scratch could be of use elsewhere in the library. There is an art class and a Lego class in which the instructors believe Scratch, and the workshop, could be of use to their programs. The staff sees the Scratch workshop as a great outlet for the teens' creativity and wants to see it utilized wherever it can be fit into other programs.

IV.III. PILOT STUDIES

IV.III.I. Lesson 1 WPL Staff pilot

The first Pilot that was given was the first lesson. It was given to six of the staff members from the teen department of the library. During this lesson, two projectors were used, one displaying a step-by-step walk through of the project and the other the Scratch interface. Two projects were to give the viewer all of the resources need to create the project. The step-by-step walkthrough was use to display what to do and the actual Scratch window was used to show the techniques of how to do it. The teaching technique for this lesson was more of a lecture style, where the presenter gave the whole lesson without stopping. This was later changed in the other Pilot, due to participants falling behind and not being able to catch up.

Figure 9: Lesson 1 Screenshot

IV.III.II. Great Brook Valley pilots

For our second and third Pilots, the team was able to have teens and kids participate. This was helpful in refining our program by gaining feedback from participants closer to our target audience for the four-day workshop. These Pilots were given at the Great Brook Valley branch of the Worcester Public Library to an audience of 8 to 10 teens and kids. The space was small, but our team was able to work around it, setting up one projector. Figure 10 show the space used by the team to give Pilot 2 and 3. This time was a little bit different because only one projector was used, so one team member gave the lecture and another worked the computer flipping back and forth between the step-by-step walk through and Scratch. During this lesson time was give after main point for the kids to "mess around" and do their own thing for a little while. Figure 9 shows a screenshot of what was being taught in the first lesson of the pilot.

Figure 10: Great Brook Valley pilot

IV.III.III. Lesson 2 WPL Staff pilot

The team was given another opportunity to work with the same group of staff member as in Pilot one to give another Pilot. So, the team gave lesson two for their fourth Pilot. This was set up exactly the same as Pilot one with two projectors at the Worcester Public Library main branch in the computer lab. This lesson moved into some more advanced concepts and technique deeper into Scratch, Figure 11 show what was being taught in lesson 2. Also, the teaching style was modified by explaining why each block was put in place that way and why each block was used, so the thought process was being taught along with the technique. Some time was added into the lesson for little breaks for the participants to catch up and play around with what they had created.

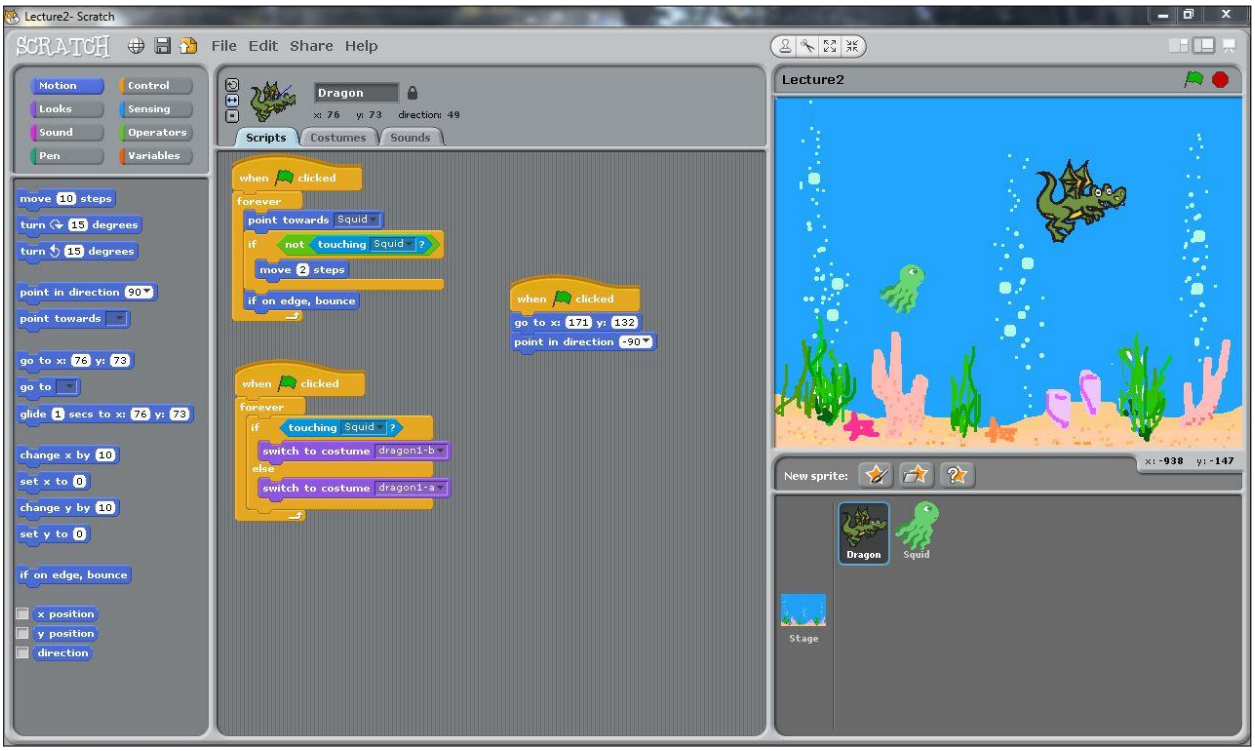
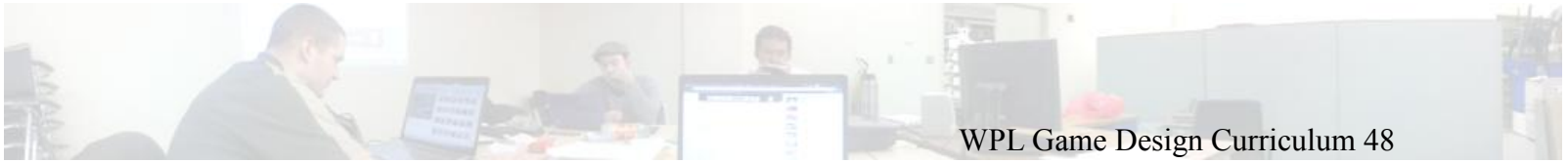


Figure 11: Lesson 2 Screenshot

The pilot program was developed to gain some feedback from a focus group. The goal of the pilot program was to see the overall progress of the team and the ability to give a multi-day workshop and to test our first lesson on a group that was able and willing to offer some feedback and critique the class structure, lesson difficulty, and teaching approaches.

The group was comprised of members of the Worcester Public Library staff. Some participants are involved in the teen department of the library, a portion of the Information Technology department, and also some staff member who were just interested in the Scratch program. The first pilot consisted of an introduction into Scratch and a walk through of a basic project that the group would be able to complete. The group was not left to figure out the Scratch program on their own; a 30 minute lecture was given to guide the group through a sample project created by the Worcester Public Library Programming IQP team. A simple project was used for the



group to make that would not only be entertaining in the end, but also teach the basic skills that can be used in most ever project. Some examples of the techniques taught are adding Sprites (characters), changing the background, simple movement and animation, and changing effects.

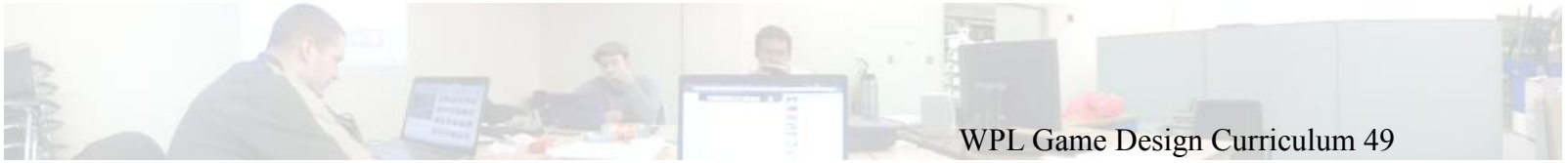
At the end of the lecture the group was given time to "mess around" with Scratch on their own. Many making edits to the project that they had just created and other trying to find out more about the program. Since Scratch is color coded, it makes learn how to program very simple and intuitive. The knowledge that participants will need are a creative mind and logic skills. The three lesson work shop is to show the participants some of the techniques and gives them some ideas of projects to get started on; the rest is up to the individual to create.

Many materials were used in the first pilot, a video tutorial of the lesson was created with audio, and a PowerPoint presentation was used for the step-by-step walk through with pictures of the item to use in each step. The class was set up using two main projectors, one displaying a step-by-step outline of the lesson and the other showing the actual scratch program, run by a team member. Once the class was in session, a brief introduction was given and then the basic techniques were taught.

IV.IV. FINDINGS FROM PILOT STUDIES

IV.IV.I. Lesson 1 WPL Staff Pilot

Observations and feedback was recorded during the pilots programs, the programs were given to the staff and teens at the library. The staff and the teens were in different pilot programs to get a specific feedback pertaining to each group. What the team learned from our first pilot with the staff is that the presenter needs to slow down the presentation. The staff members felt as if the teens taking the workshop would lose interest and ignore the instructor. Also some of the staff that fell behind the instructions and needed help never was able to catch up to the instructor. The staff felt

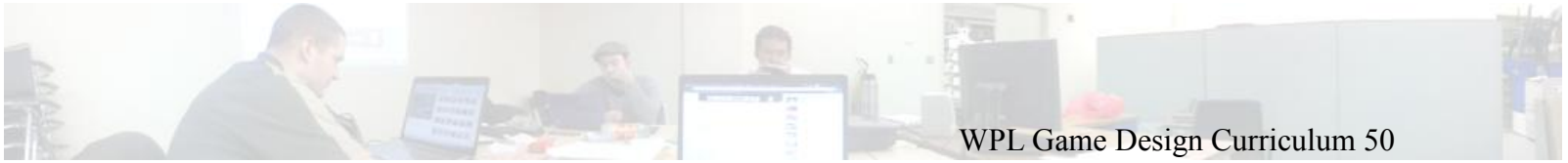


that breaks were necessary for the workshop so that the teens could catch up and also work on their own project. Under these considerations changes were made to the lessons to include breaks for the teens to get caught up and explore the part of the lesson just taught to them. We also made the change from two instructors, one for the presentation and one for the demonstration, to one instructor combining the presentation and demonstration. Having one instructor affectively slows down the lessons so it is easier to keep teens from falling behind. The last change that was made included slides into the beginning of the presentation that explained what Scratch is along with a definitions page. A link to a video about Scratch was implanted on the introduction slide.

IV.IV.II. Great Brook Valley Pilots

The next two pilot programs were given to the teens at the Great Brook Valley Branch of the library. These pilots were given one right after the other to two different groups of teens. The first group of teens consisted of teens in junior high school and some kids a bit younger than them. The next group of students had mostly younger kids in the group. From the first group of students the team saw that the video on the introduction slide of the presentation was way too long and lost the teens' interest. The length that the video was showed in the second pilot was shortened because of this and the team agrees that another shorter video might be better than the abbreviated longer video.

One projector was used for these pilots programs off the consideration of the first pilot program. This time the presentation took a back seat to the demonstration and the presenter rarely went back to the presentation and kept the display on the demonstration. The same thing occurred in both the second and third pilots and the team saw the benefits of having the two displays, one for the presentation and the other for the demonstration. This would be kept in mind for any other programs conducted at the Great Brook Valley branch.

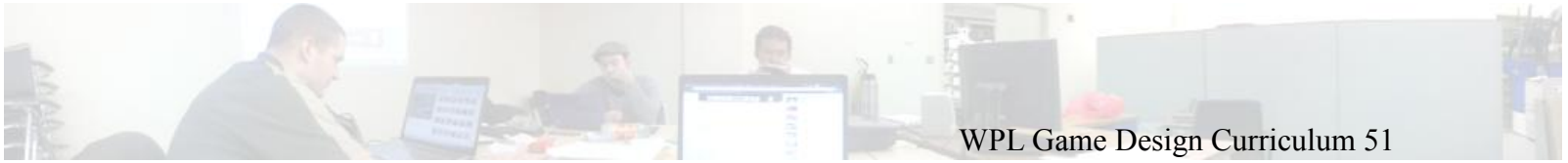


The teens and children of both pilot programs learned Scratch much faster than was seen with the staff at the library. During both pilot programs the teens had a lot of questions, most of the questions they had actually pertained to the next step in the presentation so the presenter was able to lead into the next parts of the presentation easily. One difference between the first pilot group of older teens and the second pilot group of younger teens was that the second pilot group had more angst and wanted to do their own sprites instead of the ones being used in the demonstration. Some of the times this was an easy fix and the team just let them use which ever sprite they wanted. Other times when the point of the presentation was to show how to animate the sprite, the sprite they wanted to use usually was not easily animated. The fact that teens would want to use their own sprite, more than the structured one, was kept in mind when designing future lessons.

The overall outcome received from the second and third pilot programs was that the teens would learn much quicker than the staff and be more adventurous with Scratch. The pilot programs gave the final lessons finer critiques to account for. The team thought about all these facts when designing the workshop.

IV.IV.III. Lesson 2 WPL Staff Pilot

This was the last pilot the team had time for before the final workshop had to be submitted. This pilot was also the only pilot where the team was able to test out the second lesson of the four-day workshop. The reason that this was the only time the second lesson was tested is because it was hard to have the same teens stay from the second pilot to the third pilot at the Great Brook Valley branch. Having the same staff from before made it a great opportunity to test out the second lesson. However, there was one staff member in the fourth pilot that was not in the first. The significance of this was that the team wanted to see how this person would do attending this more advanced pilot without attending the basics pilot. The team saw that this staff member did have some trouble



with the lesson but all would have been avoided if this staff member watched the video tutorial of the first lesson.

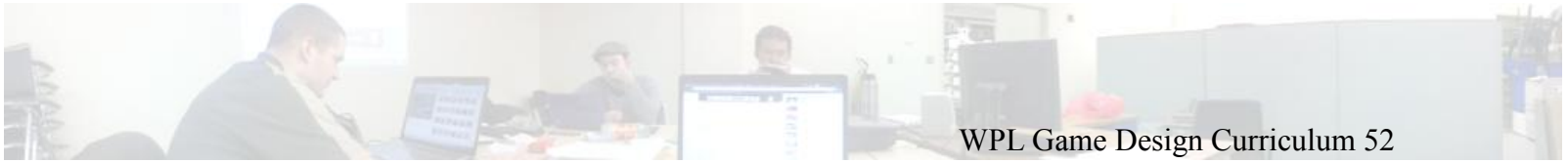
With the rest of the staff, they decided that the first part of the lesson, the pen drawing piece, was too hard of a concept. They had some trouble with the thought process behind the drawings but liked the outcome. The team decided that because of the simplicity of the drawing and the difficulty of the concepts that this part of the lesson would be reserved for the fourth day of the workshop for anyone to explore with the online resources. The staff thought the second part of the lesson was much more adequate and easier to understand for the second lesson. The second part of the lesson then ran without any other difficulties. All other concerns from this pilot were taken into account in changes to this lesson and lessons previous and after this one.

IV.V. PROGRAM MARKETING

Once the pilot was created, a date was chosen for the four-day workshop. There were 12 spots available for the teens, in our target area of 12-18 years of age, to participate in the workshops. A flyer (Appendix C) was created to advertise the workshop and to notify anyone in the library of the program. Also, the library distributed and posted the flyer at all Worcester Public School middle and senior high schools in addition to the library. This type of exposure to the teens will make the classes fill up quickly. There are only 12 computers in the computer lab of the library, where the workshop will be given, so there was an on-line registration for the teens to hold their spots. The registration can be completed through the Worcester Public Library's website, or directly at the library.

IV.VI. CURRICULUM

In curriculum design, the focus was more on recreation rather than education since the library's goal is to increase teens' interests in participating after-school program. From the survey,



the data shows that most of the program participants own game consoles and they like to play various types of game. Their favorite game types such as Shooter and RPG provide us a clue in the design of curriculum. Some of these gaming features were added into the curriculum to attract teens' attention. For example, an "event" script was added into the class demo to show them how an "event" is created in a RPG. Besides addition of features, some basic concepts of programming were added into the class because the survey shows that the participants are lacking of programming experience. The curriculum allows them to make their own games as well as to play with them. With flexible and informal class environment theses participants are not only able to understand and practice Scratch by themselves, but also enjoy their time in this after-school program. With the preliminary survey, the team was able to develop an audience-oriented curriculum for the program participants.

The successfulness of this project will, over time, be judged on its continuity. Our simplified goal in this project is to leave a curriculum with the Worcester Public Library that can continue to run once the seven weeks of this project is completed. The workshop is to be self-perpetuating, where it continues to be taught to different groups of teens at the library, whether by staff or other teens that have gone through the workshop. The curriculum needs to be simple enough so that any novice may be able to teach the lessons created with a little bit of practice. Not only is the goal to leave behind materials that Worcester teens can learn from, but also the right materials that can prepare a WPL employee or younger patron to be able to teach the lessons.

After giving our pilot programs it was decided that a four-day workshop containing three lessons is the most efficient way to present the basic information of Scratch. The four-day workshop will include a new lesson each day, with each day's topic being more advanced than the day before. There are eight different categories of blocks in Scratch each have a unique part in creating a project. The goal of the three lessons is to teach the teens the basics of all eight types of blocks. Figure 9

shows four of the types of blocks: Motion (Blue), Control (Orange), Looks (Purple), and Sensing (Light Blue).Motion blocks are used for enabling the movement of the object. With these blocks, you can program the object to move from one place to another, to change its moving direction, or to rotate. Control blocks are used for controlling the execution of the scripts. You can use them to execute scripts through conditional statements, iteration statements, and keyboard inputs. Looks blocks are often used for manipulating the appearance of the objects. You can change color, size, effects, and visibility of the objects in the program. Sensing blocks are used for detecting the interactions between objects, or between object and computer. With these blocks, you can create a communication path between objects and computer.

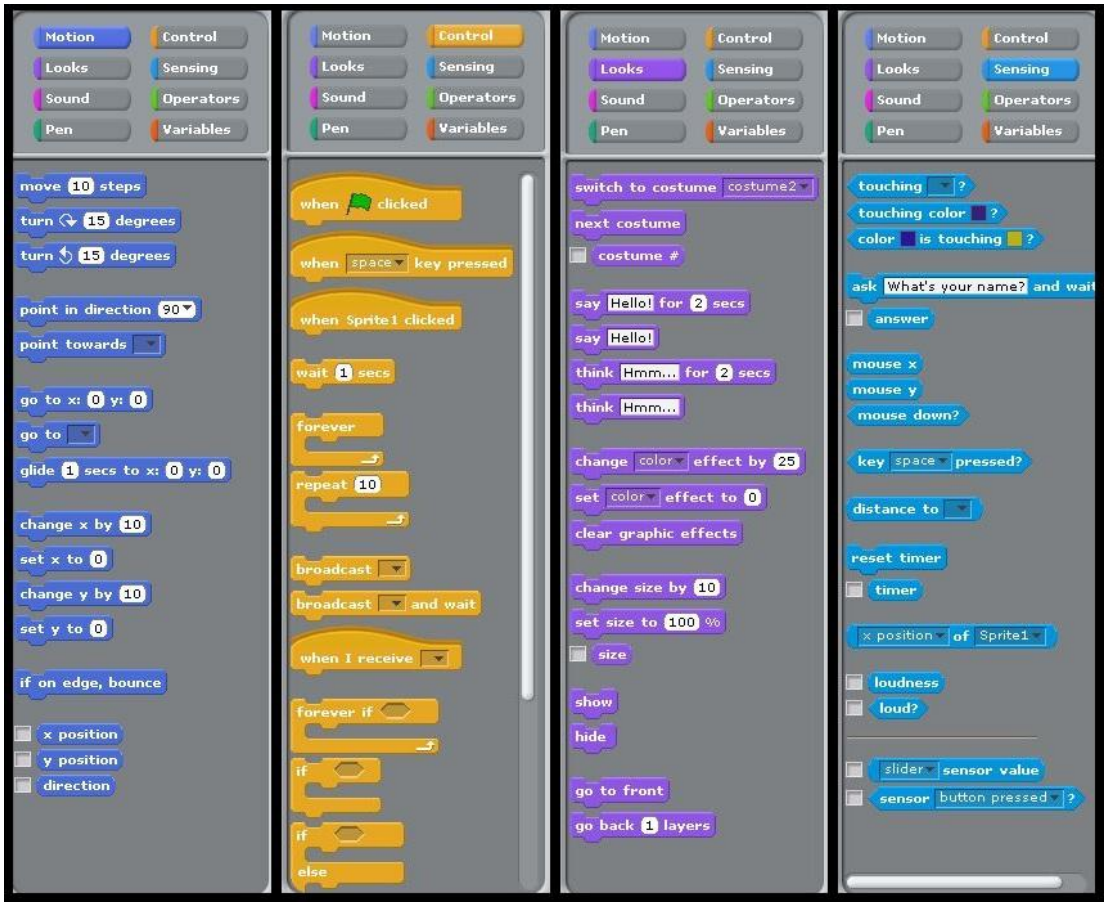


Figure 12: Scratch Blocks 1-4

Figure 10 shows the other four types of blocks: Sound (Pink), Operators (Green), Pen (Teal), and Variables (Dark Orange).Sounds blocks are used for controlling the volume and tempo, playing notes and music files. Operators blocks are used for manipulating numbers. They include basic arithmetic, logical operations and comparisons. Pen blocks are used for drawing graphics. You can change the size, color of the pen with these blocks. Variables blocks are used for storing data such as numbers, and text.

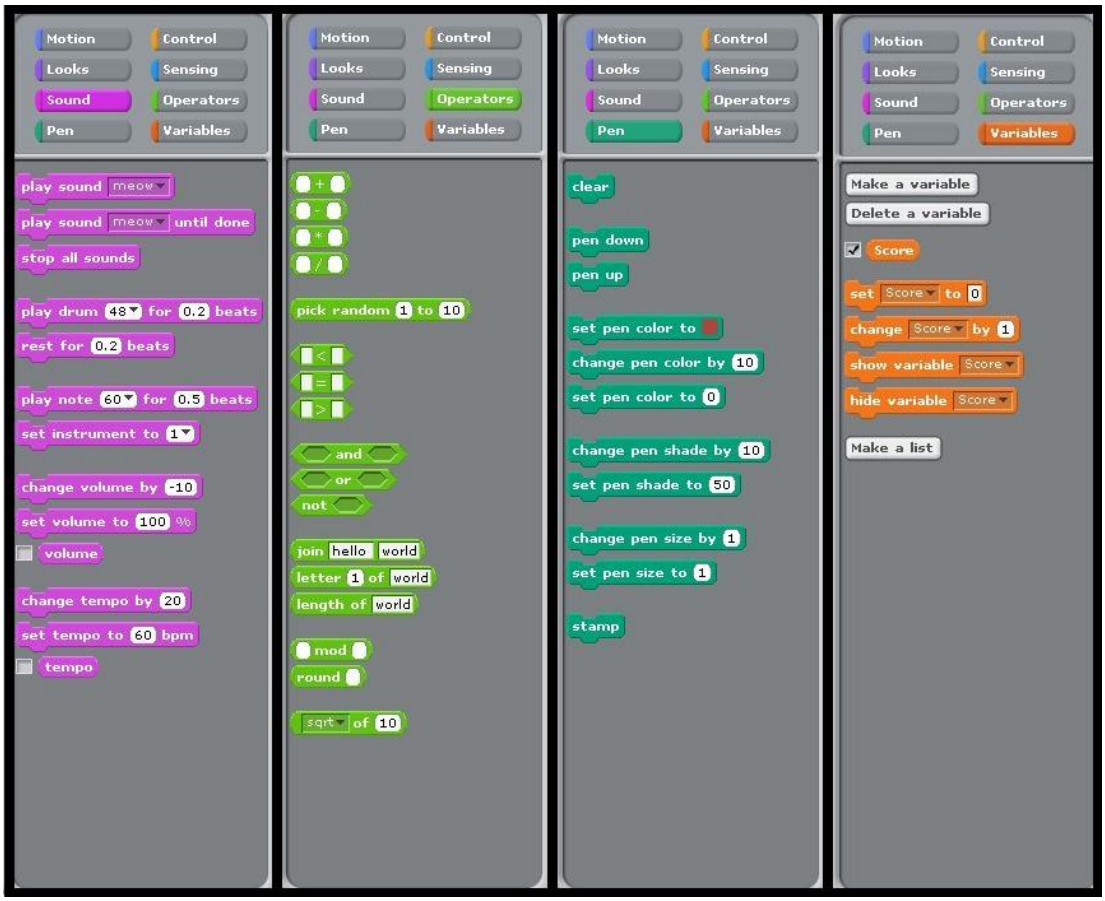
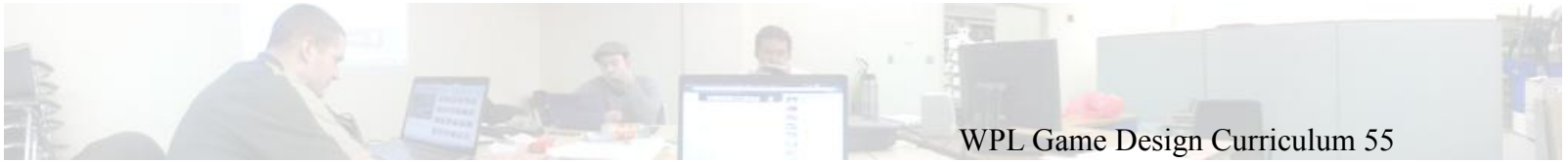


Figure 13: Scratch Blocks 5-8

The tool that will be provided after the workshop will be for any teen's use so that they will learn in the class, on their own, and in the future. It was determined from the pilot that the



presentation style will remain the same in that the lessons will be presented during the class via PowerPoint presentation, projected on a screen in front of the room. Along with the PowerPoint, a live display of Scratch will be projected on another screen to show the steps. For each lesson there will be links in the PowerPoint that will lead the teens to use and explore different online Scratch resources. There will also be links for students if they want to learn more about the programming aspect behind something that was done or if they want to find similar projects to try. Links such as the Scratch website will be good for the students to look at when they have free time during the program as well as at home. For after-class learning, it was decided by the team that each teen will be given a packet of information to take home with them. The packet of handouts will include where Scratch can be downloaded from and where our materials can be found. The handouts will include cards that are quick guides to remember how to do a basic Scratch command that was learned in the lesson. Figure 14 shows an example of the cards that will be in the handout.

Figure 14: Example of Scratch Cards

Finally the packet will include a list of links and resources to where the students can learn more about Scratch, game design, and programming on their own time. These additional Scratch resources can be found in Appendix C (Scratch, 2007), (Evans, 2010). The teens will be able to revisit any of the lessons online by going through the step-by-step PowerPoints or watching a video tutorial of each lesson. The video tutorial walks the viewer through each lesson with audio telling the user what to do as well as showing them. As seen in Figure 15 highlights and sounds were added to outline important parts of the lesson, making it easier to follow for the viewer. This is a first come first serve workshop, so once all the slots are filled no more can join. For this reason, the supplementary materials were created for teens that cannot make it to the workshop to be able to learn a little bit more about Scratch and to have fun using the program. The workshops main goal is to teach the teens about Scratch and use their creativity to create projects.

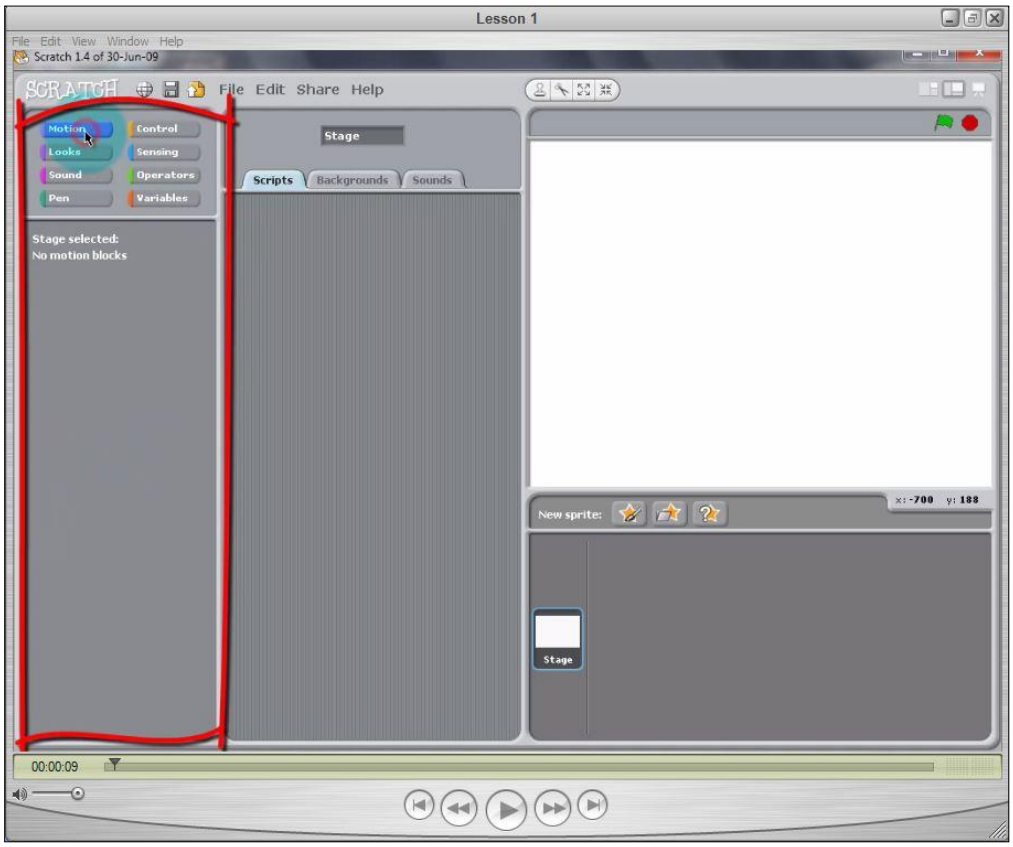
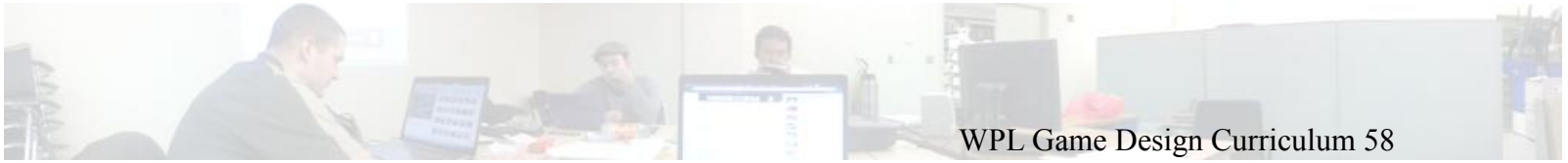


Figure 15: Video tutorial screenshot

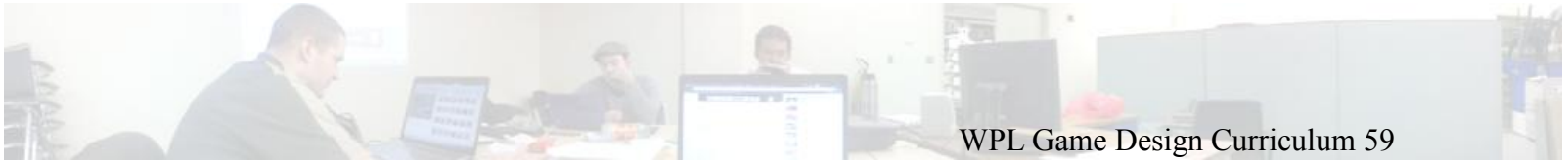
The program will include a fourth day where the students can explore Scratch and what it has to offer. There are many references online that the students can use to spark creativity within Scratch. The fourth day may be the most beneficial to the students because it takes time of testing out the program to fully learn how to use it. This time will be like a Scratch study hall where they will be able to replay any of the previous lessons or explore the online database of over 1.5 million users' uploaded Scratch projects. The Scratch projects can be viewed online in a java runtime environment where teens can test out someone's finish product. If a project interests the students they can download the Scratch file of that game from the website. The teen could then open up the project in Scratch and see how the game was made. By searching the Scratch website and its database of projects, the creativity and knowledge of the teens will undoubtedly increase. It is our



job to teach them the basics of Scratch through our four-day workshop, and provide them with the resources to continue their growth. The layout of the curriculum is shown in Table 5. The schedule allows for the students to be taught as well as teach themselves by exploring Scratch on their own. The schedule is broken up so that the basics of Scratch can be taught over three days without overwhelming the students but also keeping them intrigued with new techniques.

Table 5: Four-Day Workshop Schedule

WORKSHOP SCHEDULE				
	DAY 1	**DAY 2**	**DAY 3**	**DAY 4**
TITLES	LESSON 1 - Basics	LESSON 2 - Sensing and Events	LESSON 3 – Sensing and Broadcasting	Scratch Exploration
OBJECTIVES	Import sprites, Movement (key control), Sounds, Speech, Sprite editing	Use debug tool, Randomness, Sequence and iteration	Use variables blocks, sensing blocks, broadcasting and layers	Refine skills learned in previous lessons through editing projects already completed and creating new ones.

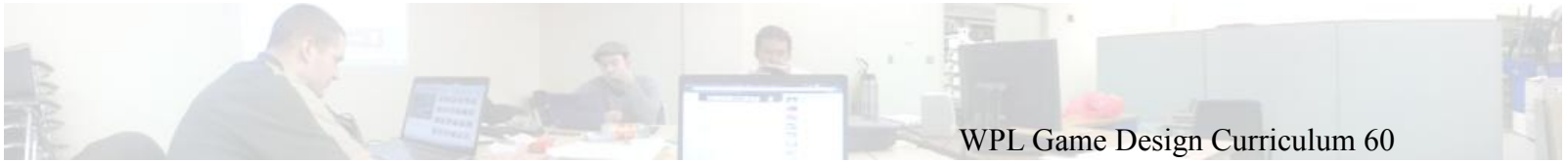


V. RECOMMENDATIONS

This chapter discusses the limitations faced and recommendations we have so this project can be advanced and further developed. Our results show that there are some limitations of our project. The first is a limitation of the amount of space the library has for the computer lab. Right now the workshop can only serve 12 people with maybe a couple more if they bring their own laptops. Without concern for the space there comes the problem of not having a specific instructor to pass the program onto. There is no one person for the team to train to become as efficient at Scratch. All of the online resources and other resources for the lessons were provided to fill some gaps in knowledge there might be. Along with not having a staff member to pass off to there just was not enough time to conduct a full workshop before passing the program off to the library. The team will conduct the first workshop but any further necessary changes to the workshop might be harder to take effect. The team would have liked to be able to critique the final workshop before fully passing it onto the library.

For the long-term, the team hopes that students will be able to use Scratch on their own. If there are students that become knowledgeable with Scratch the library could offer them the chance at teaching the workshop and hopefully create a self-perpetuating cycle of student teachers for the program. It would be good for the library to look into having a Scratch group that meets also. The team found that working together on projects helped each other learn faster. The benefits of having the workshop to teach teens and then having this Scratch group that would meet together to help each other out and share their own projects might be the next step for the library.

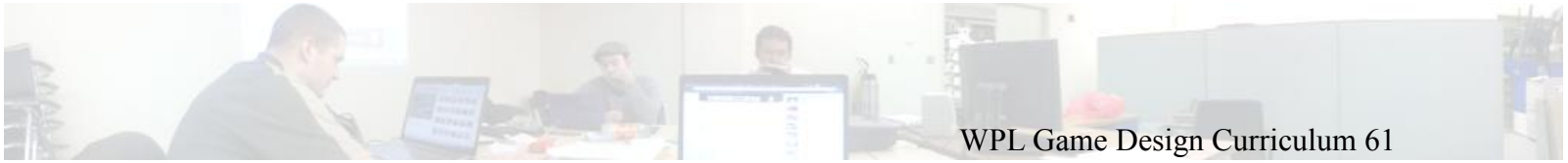
By the end of the project we will have a game design curriculum which allows the library to offer a game design class to teens. Along with the curriculum, we also provide supplementary materials such as game demos, references, and lecture notes. With the curriculum and those



supplementary materials, we can expect that the library can run a functional after-school program after this project. We hope that teens will learn basic knowledge of programming through this after-school program. By completing this project, we can see that teens will gain a unique learning experience that they wouldn't be able to receive from school and express their creativity through game design.

For our team the project is complete with the implementation of our three lesson workshop. We have some recommendations for groups to build off of our project in the future. The program that we created is made up of three lessons that teach the basics of Scratch. We recommend that in the future a group, plan, pilot, and develop some additional lessons to add onto our lessons. These lessons could make up an advanced or intermediate Scratch class that could be offered to teens after they have attended the program we created. Another recommendation for a future group is to try to implement our program into a similar setting. The WPL has two additional branches the Great Brook Valley branch and the France Perkins branch. To continue our work a group could study the feasibility of implementing our program at one of the other branches, or even a youth center or school. The target audience may be a different age group or the program may need to be altered to accommodate the type of equipment the building has.

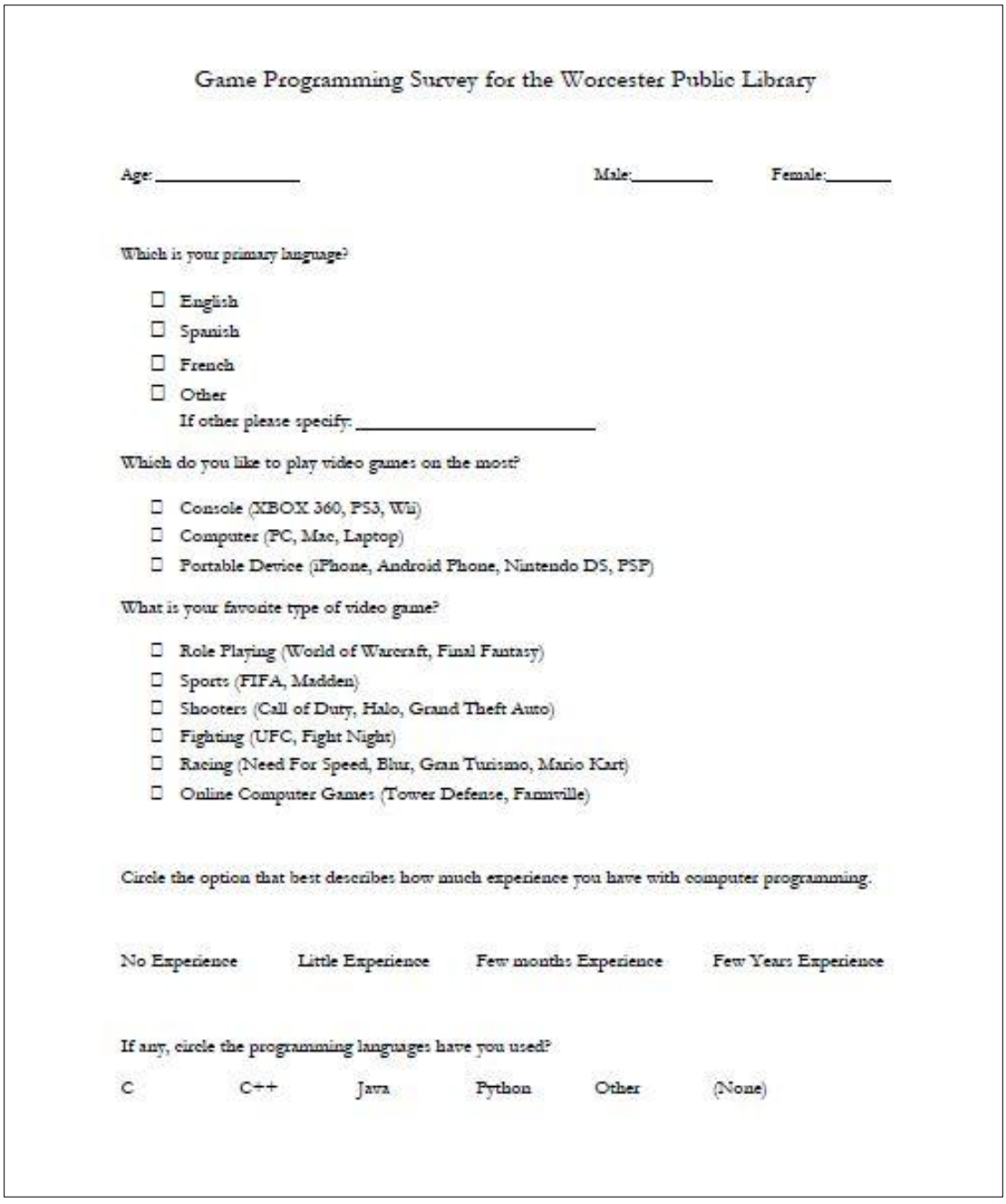
In our final presentation (Appendix D) our team made several recommendations. For future projects, we recommend that the project team should identify the target audience as soon as possible. A preliminary survey would be a good choice to get this information. The earlier you can gain information from the target audience, the sooner you can start the curriculum design, and the more time you have to study the subjects. Identifying the target audience is the first step. In order to teach and gear the curriculum towards them, the project team can conduct as many pilots as possible to adapt lessons. The more pilot programs you conduct, the more accurate understanding on the subjects, and the better your curriculum will be. Understanding the target audience will be the



next step. Beyond these two steps, understanding the needs of your sponsor is also very important. Interview would be a good choice to communicate with your sponsor. Through interviews, the project team not only gets familiar with the sponsor, but also helps the sponsor to learn more on the subject. For the success of the project, the team should try their best to find out the target audience, to understand the target audience, to communicate with the sponsor.

APPENDIX A: Survey Questions and Results

Appendix A includes a copy of the preliminary survey and the results from 31 surveys that were collected. The surveys were distributed to Worcester teens that attended any of the previously available teen programs.



Game Programming Survey for the Worcester Public Library

Age: _____ Male:_____ Female:_____

Which is your primary language?

- ☐ English
- ☐ Spanish
- ☐ French
- ☐ Other

If other please specify: _____

Which do you like to play video games on the most?

- ☐ Console (XBOX 360, PS3, Wii)
- ☐ Computer (PC, Mac, Laptop)
- ☐ Portable Device (iPhone, Android Phone, Nintendo DS, PSP)

What is your favorite type of video game?

- ☐ Role Playing (World of Warcraft, Final Fantasy)
- ☐ Sports (FIFA, Madden)
- ☐ Shooters (Call of Duty, Halo, Grand Theft Auto)
- ☐ Fighting (UFC, Fight Night)
- ☐ Racing (Need For Speed, Blur, Gran Turismo, Mario Kart)
- ☐ Online Computer Games (Tower Defense, Farmville)

Circle the option that best describes how much experience you have with computer programming.

No Experience Little Experience Few months Experience Few Years Experience

If any, circle the programming languages have you used?

C C++ Java Python Other (None)

Figure A1: Survey Questions

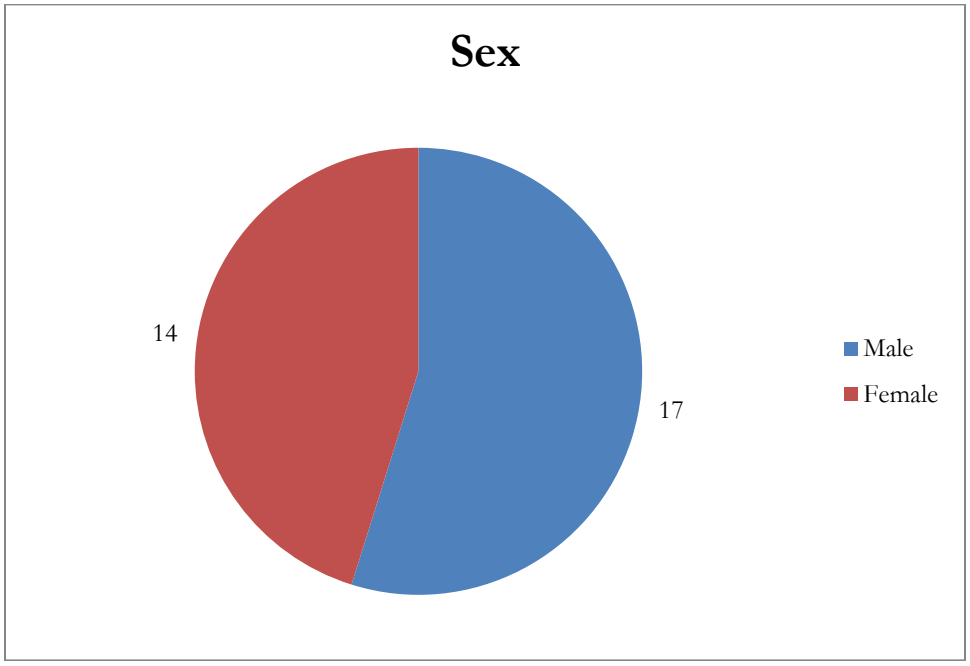


Figure A2: Sex

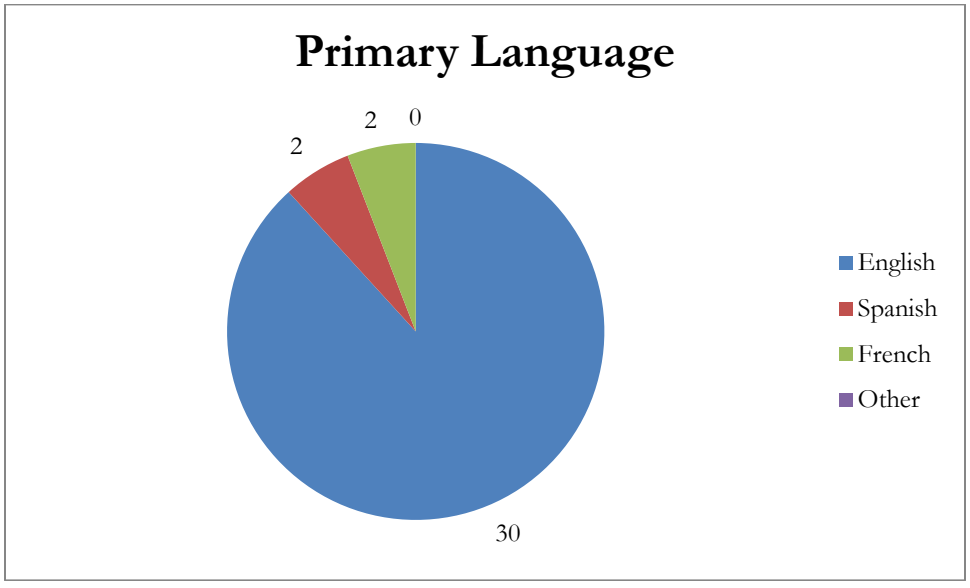


Figure A3: Primary Language

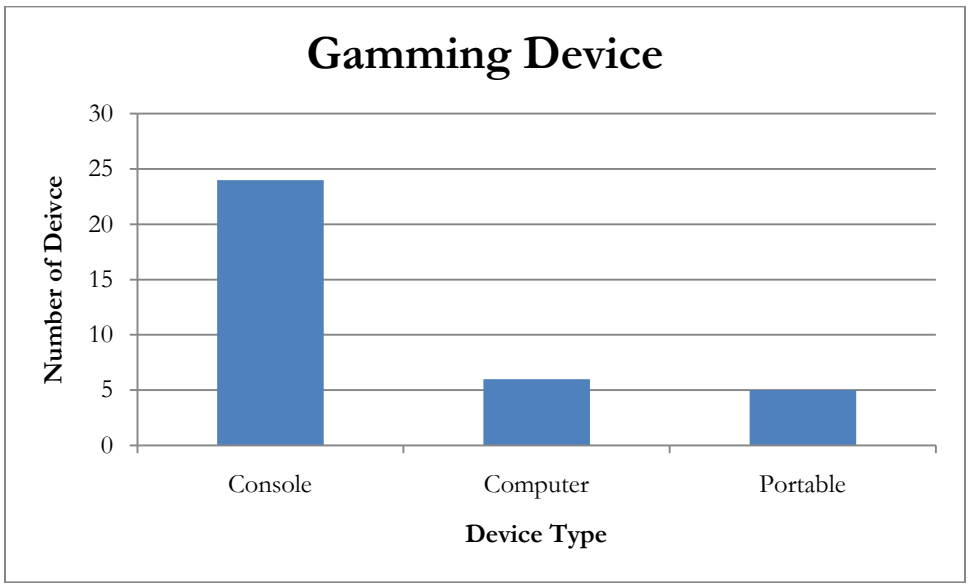


Figure A4: Gamming Device

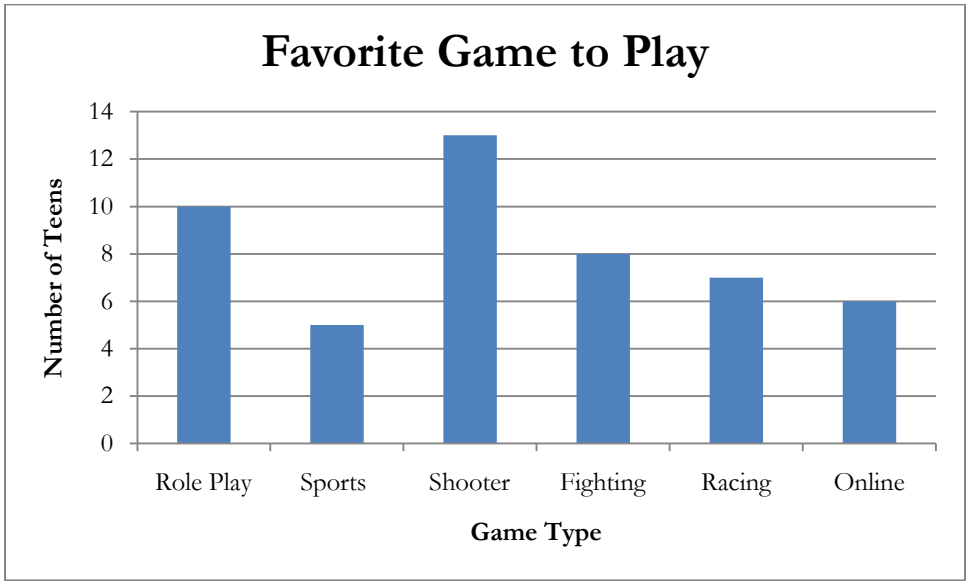


Figure A5: Favorite Game

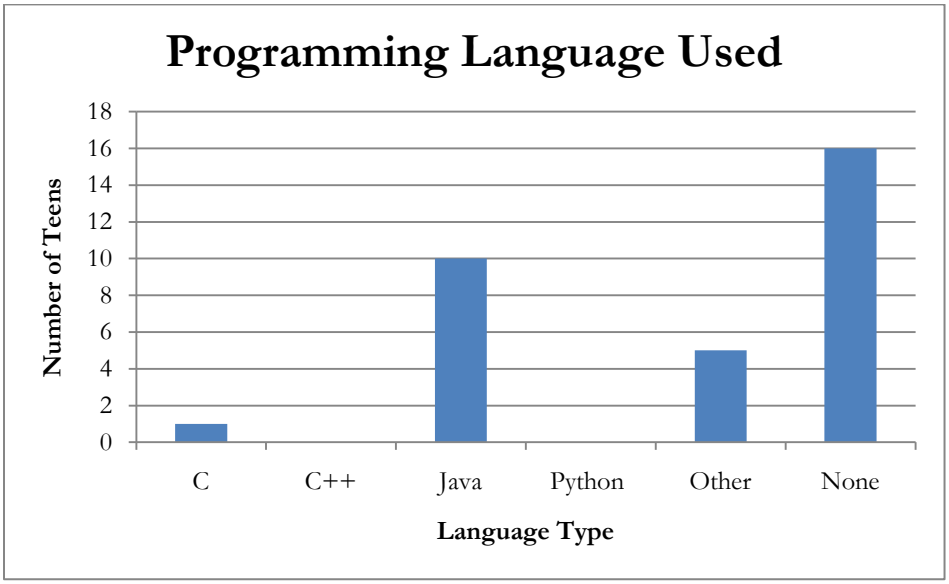


Figure A6: Programming Language

APPENDIX B: Look Ahead Schedule

Appendix B includes an example copy of a look ahead and milestones schedule that was used to plan out the project.

WPL PROGRAMMING	1/17 - 1/21					1/24 - 1/28					1-31 - 2/4					2/7 - 2/11					2/14 - 2/18					2/21 - 2/25					2/28 - 3/4				
Activity	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F	M	T	W	R	F
Meetings																																		
9 am edits @ WCPC																																		
2 pm meeting @ WPL																																		
2:15 pm small group meetings @ WCPC																																		
3 pm presentations																																		
Final presentation TBA																																		
Data Collection																																		
Collect atleast 30 surveys																																		
Contact another library with Scratch experience																																		
Conduct interviews																																		
Create flyer																																		
Develop pilot																																		
Conduct pilot and collect feedback																																		
Finish data collection																																		
Prepare eval and main topic sheets for program																																		
Progam Debut																																		
Writing																																		
Revise Milestones																																		
Chapters 1-3																																		
Draft of executive summary, Outline findings chapter																																		
Draft findings and discussion chapter																																		
Complete draft																																		
Revised complete draft																																		
Finish reports and file E-CDR forms																																		

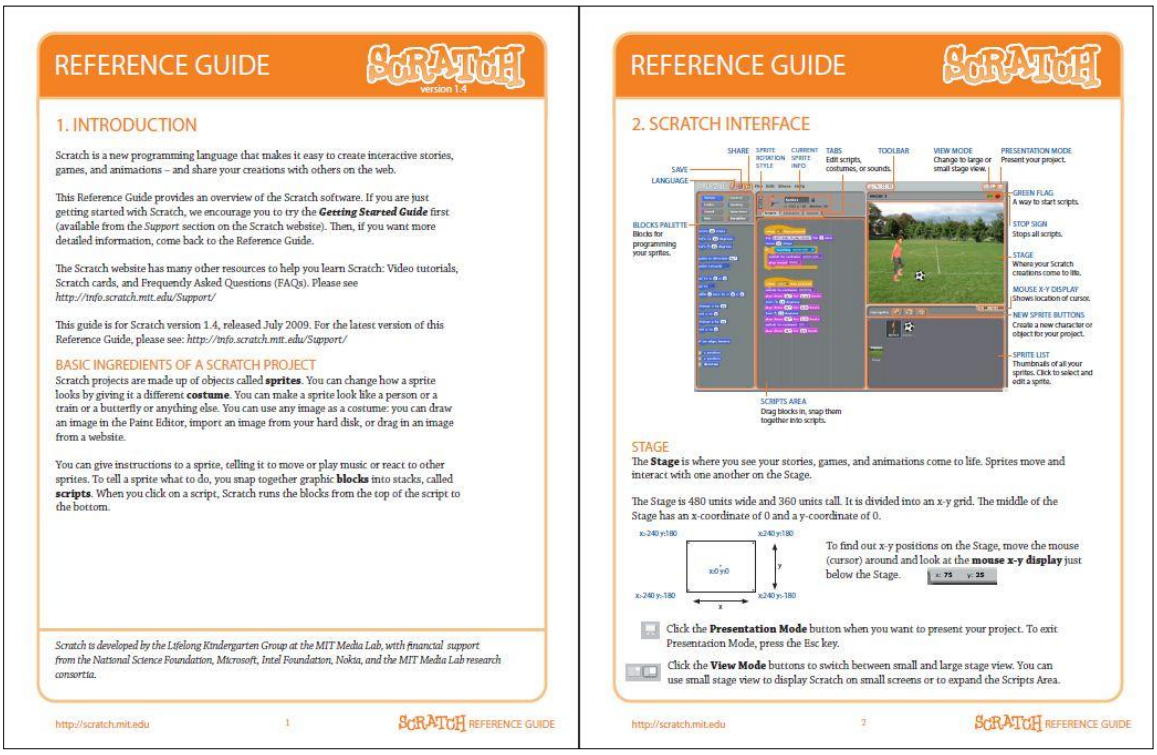
Figure B1: Look Ahead and Milestones Schedule

APPENDIX C: Lesson Materials and References

Appendix C includes materials that were created for the four-day workshop. These materials help the teens learn as well as walk the instructor through how to teach the workshop.

Figure C1: Flyer for Program

Figure C2: Sample of lesson 1 PowerPoint slides



REFERENCE GUIDE

SCRATCH version 1.4

1. INTRODUCTION

Scratch is a new programming language that makes it easy to create interactive stories, games, and animations – and share your creations with others on the web.

This Reference Guide provides an overview of the Scratch software. If you are just getting started with Scratch, we encourage you to try the ***Getting Started Guide*** first (available from the *Support* section on the Scratch website). Then, if you want more detailed information, come back to the Reference Guide.

The Scratch website has many other resources to help you learn Scratch: Video tutorials, Scratch cards, and Frequently Asked Questions (FAQs). Please see *http://info.scratch.mit.edu/Support/*

This guide is for Scratch version 1.4, released July 2009. For the latest version of this Reference Guide, please see: *http://info.scratch.mit.edu/Support/*

BASIC INGREDIENTS OF A SCRATCH PROJECT

Scratch projects are made up of objects called **sprites**. You can change how a sprite looks by giving it a different **costume**. You can make a sprite look like a person or a train or a butterfly or anything else. You can use any image as a costume: you can draw an image in the Paint Editor, import an image from your hard disk, or drag in an image from a website.

You can give instructions to a sprite, telling it to move or play music or react to other sprites. To tell a sprite what to do, you snap together graphic **blocks** into stacks, called **scripts**. When you click on a script, Scratch runs the blocks from the top of the script to the bottom.

Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab, with financial support from the National Science Foundation, Microsoft, Intel Foundation, Nokia, and the MIT Media Lab research consortia.

http://scratch.mit.edu 1 SCRATCH REFERENCE GUIDE

REFERENCE GUIDE

SCRATCH

2. SCRATCH INTERFACE

STAGE

The **Stage** is where you see your stories, games, and animations come to life. Sprites move and interact with one another on the Stage.

The Stage is 480 units wide and 360 units tall. It is divided into an x-y grid. The middle of the Stage has an x-coordinate of 0 and a y-coordinate of 0.

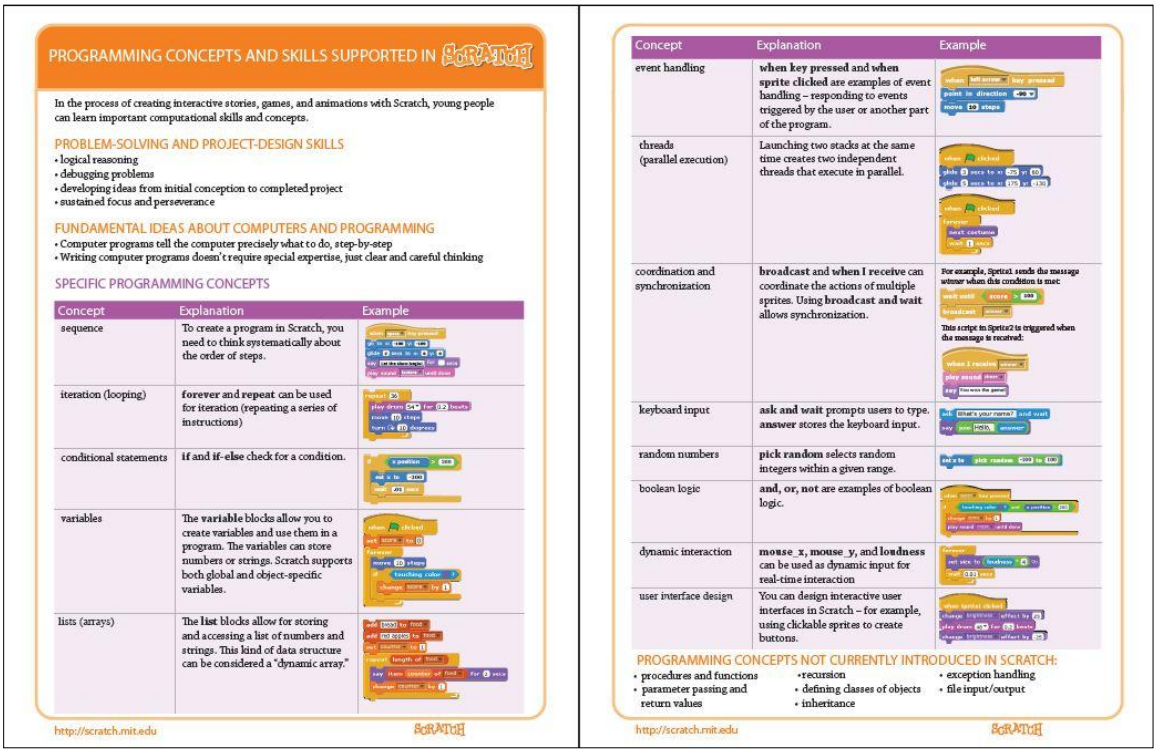
To find out x-y positions on the Stage, move the mouse (cursor) around and look at the **mouse x-y display** just below the Stage.

Click the **Presentation Mode** button when you want to present your project. To exit Presentation Mode, press the Esc key.

Click the **View Mode** buttons to switch between small and large stage view. You can use small stage view to display Scratch on small screens or to expand the Scripts Area.

http://scratch.mit.edu 2 SCRATCH REFERENCE GUIDE

Figure C3: Scratch Reference Guide



PROGRAMMING CONCEPTS AND SKILLS SUPPORTED IN SCRATCH

In the process of creating interactive stories, games, and animations with Scratch, young people can learn important computational skills and concepts.

PROBLEM-SOLVING AND PROJECT-DESIGN SKILLS

- logical reasoning
- debugging problems
- developing ideas from initial conception to completed project
- sustained focus and perseverance

FUNDAMENTAL IDEAS ABOUT COMPUTERS AND PROGRAMMING

- Computer programs tell the computer precisely what to do, step-by-step
- Writing computer programs doesn't require special expertise, just clear and careful thinking

SPECIFIC PROGRAMMING CONCEPTS

Concept	Explanation	Example
sequence	To create a program in Scratch, you need to think systematically about the order of steps.	
iteration (looping)	**forever** and **repeat** can be used for iteration (repeating a series of instructions)	
conditional statements	**if** and **if-else** check for a condition.	
variables	The **variable** blocks allow you to create variables and use them in a program. The variables can store numbers or strings. Scratch supports both global and object-specific variables.	
lists (arrays)	The **list** blocks allow for storing and accessing a list of numbers and strings. This kind of data structure can be considered a "dynamic array."	

http://scratch.mit.edu SCRATCH

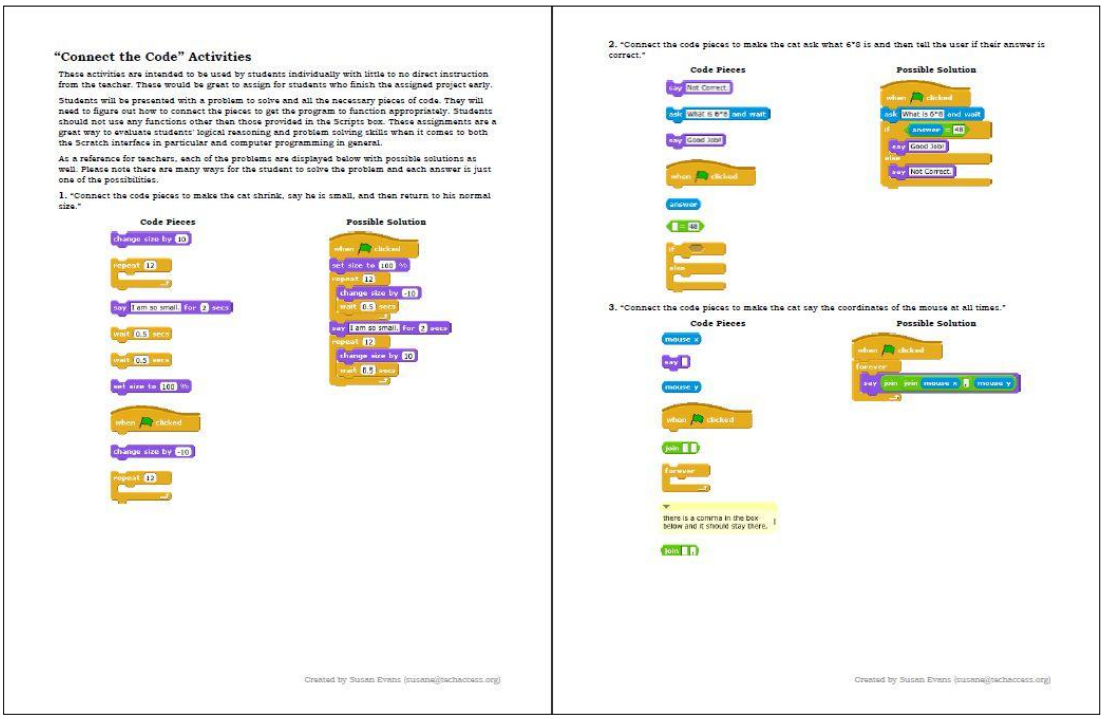
Concept	Explanation	Example
event handling	**when key pressed** and **when sprite clicked** are examples of event handling – responding to events triggered by the user or another part of the program.	
threads (parallel execution)	Launching two stacks at the same time creates two independent threads that execute in parallel.	
coordination and synchronization	**broadcast** and **when I receive** can coordinate the actions of multiple sprites. Using **broadcast and wait** allows synchronization.	For example, Sprite1 sends the message winner when this condition is met: This script in Sprite2 is triggered when the message is received:
keyboard input	**ask and wait** prompts users to type. **answer** stores the keyboard input.	
random numbers	**pick random** selects random integers within a given range.	
boolean logic	**and, or, not** are examples of boolean logic.	
dynamic interaction	**mouse_x, mouse_y,** and **loudness** can be used as dynamic input for real-time interaction	
user interface design	You can design interactive user interfaces in Scratch – for example, using clickable sprites to create buttons.	

PROGRAMMING CONCEPTS NOT CURRENTLY INTRODUCED IN SCRATCH:

- procedures and functions
- parameter passing and return values
- recursion
- defining classes of objects
- inheritance
- exception handling
- file input/output

http://scratch.mit.edu SCRATCH

Figure C4: Scratch Concepts Guide



"Connect the Code" Activities

These activities are intended to be used by students individually with little to no direct instruction from the teacher. These would be great to assign for students who finish the assigned project early.

Students will be presented with a problem to solve and all the necessary pieces of code. They will need to figure out how to connect the pieces to get the program to function appropriately. Students should not use any functions other than those provided in the Scripts box. These assignments are a great way to evaluate students' logical reasoning and problem solving skills when it comes to both the Scratch interface in particular and computer programming in general.

As a reference for teachers, each of the problems are displayed below with possible solutions as well. Please note there are many ways for the the student to solve the problem and each answer is just one of the possibilities.

1. "Connect the code pieces to make the cat shrink, say he is small, and then return to his normal size."

Code Pieces

Possible Solution

Created by Susan Evans (susana@techaccess.org)

2. "Connect the code pieces to make the cat ask what 6*8 is and then tell the user if their answer is correct."

Code Pieces

Possible Solution

3. "Connect the code pieces to make the cat say the coordinates of the mouse at all times."

Code Pieces

Possible Solution

Created by Susan Evans (susana@techaccess.org)

Figure C5: Scratch Activities sheet

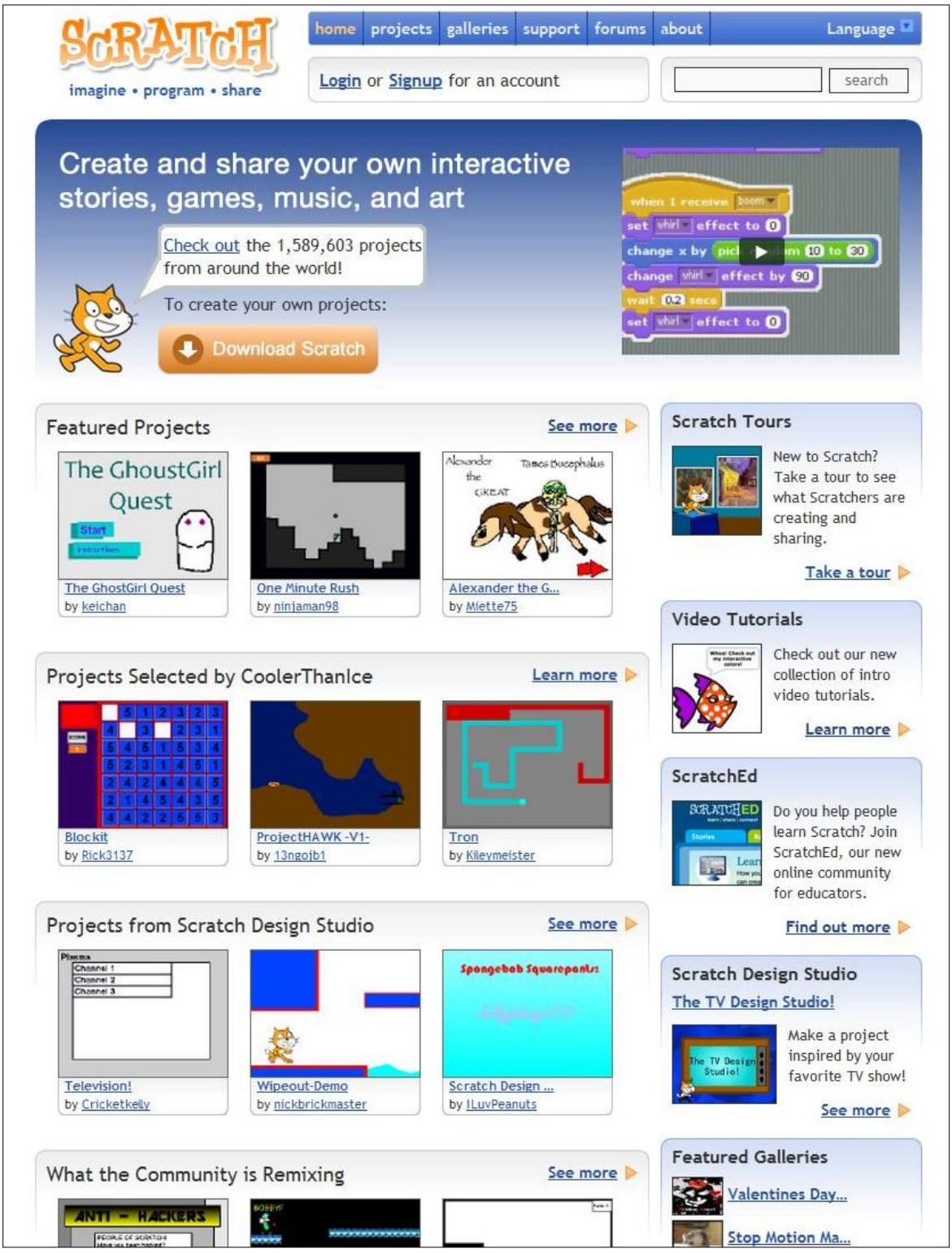


Figure C6: Scratch Website

APPENDIX D: Final Presentation

Appendix D includes the screenshots of the slides from our final presentation on February 23, 2011. The PowerPoint summarizes our project while including photos of Scratch, our pilot programs, four-day workshop, and a clip of our first video tutorial.

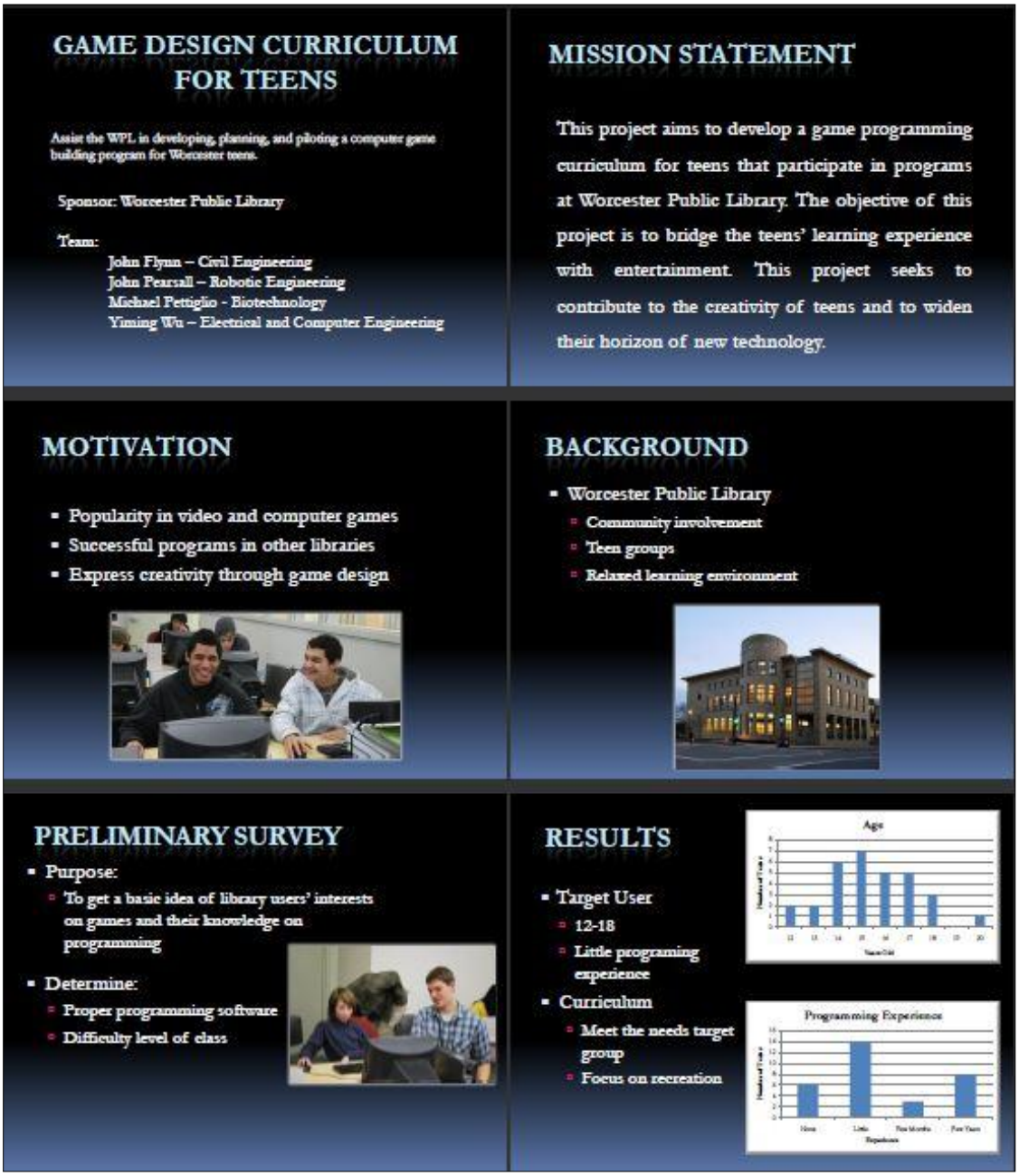
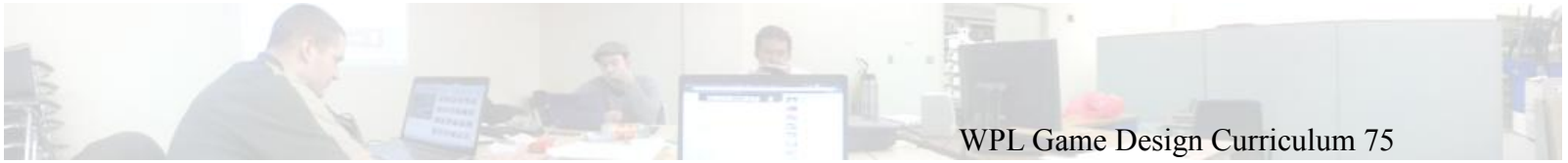


Figure D1: Final Presentation Slides 1-6

Figure D2: Final Presentation Slides 7-12

Figure D3: Final Presentation Slides 13-16



APPENDIX E: Four-Day Workshop

Appendix E talks about the set-up of our four-day workshop and the findings we determined from conducting the workshop the way we did. The four classes were conducted 2/22/11 – 2/25/11.

WORKSHOP STUDIES

After all the information was collected through the four different pilot programs, the pilot was altered to be molded into the four-day workshop. After the sign-up for the workshop was full, there was still a demand and a waiting list was created. The teens on the waiting list will then be notified when another Scratch workshop will be given at the Worcester Public Library. The workshop was given on Tuesday, February 22nd, 2011 through Friday, February 25th, 2011. Over these four days, there were three main lessons on the first three days and then the fourth day was a free class for the teens to work on any Scratch projects that they have been working on. On the fourth day the team did adapt to the needs of the participants by adding in a short lesson on the drawing tool on the program. The teens were then allowed to work on anything that they wanted.

There was a good retention rate throughout the workshop. On the first day of the workshop there were ten participants and on the final day there were a total of eight participants. It was a good to see that most of the participants stuck through the entire workshop and learn about the Scratch program. The main goal of the workshop was to teach the participants the basic skills and techniques needed to create simple projects using Scratch. Also, the team wanted to strike some interest in the teens in the computer design field and open some doors for them with a look inside of game programming on a simple level. There were a handful of teens who were asking where they would be able to download the program on their home computers to be able to continue to work on

their project at home. Many of the students would stay after the time to continue to work on their projects in the Worcester Public Library computer lab.

The classes were set up with two different computers and projectors to help guide the participants through the lessons. One projector displayed the step-by-step PowerPoint and the other displayed the Scratch interface. One showed what to do in Scratch and the other showed the technique and how to do the project. There was one presenter used during the lessons and one other team member working the Scratch display.

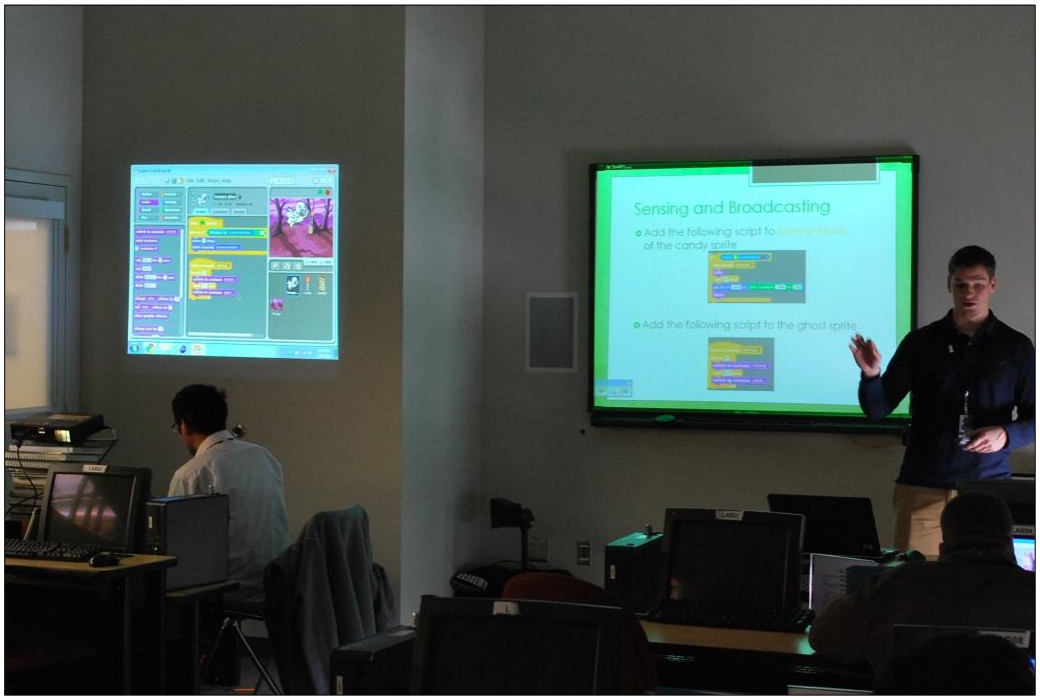


Figure E1: Class Set-Up

There was time allotted during the lecture for the teens to explore and to make sure that they were all caught up and following along with the lesson. After each lesson, there was about an hour of free time for the teens to play around with their projects by modifying the ones they just had made or by starting a new one completely. The team would walk around the classroom and help out

with any questions the students had and also show the teens some of the project that our team created over the term.

Figure E2: Helping Teens in Workshop

FINDINGS FROM WORKSHOP

While the workshop was in progress the team made notes about what was observed during the workshop. As expected from the pilot programs the teens grasped onto the concepts of the lessons quickly; the team observed attentiveness from the teens during the workshop. The teens were very focused on the projects they were working on while there. During the lessons and the free time given to the teens they were always experimenting with Scratch and testing out the many features. It almost seemed like the learning curve for the group of teens that attended the workshop was steeper than anticipated.

The teens, on the first day, were asking questions that would be covered in the lessons to come later in the week. One of the teens went right from the first lesson and created a game that

used concepts from the third lesson, concepts that were not taught yet. Another teen questioned the use of blocks that were not touched upon and was curious how to use them.

Figure E3: Teens Laughing in Workshop

All of the teens seemed to adapt Scratch to their own interests. A few of the teens that attended were great at drawing and used Scratch to draw their own sprites and animate them. By the end of the workshop, one teen had drawn his own action hero and was making a fighting game where his hero had super powers and abilities. Another teen took what he learned and made a complicated maze game that used almost all of the eight different types of category blocks, including the pen category. From seeing how focused the teens were and how absorbed they were into their work the team feels the workshop was a success. Since the workshop worked well the teaching style was good. Another IQP group could try to change the style to see which way works the best. Our team did not have the time to really test out different styles of teaching the lessons. Along with the different teaching style, other teams could make more advanced lessons for new workshops.

APPENDIX F: Online Pages

Appendix F includes screenshots of where our team's materials will be available. These web pages were created after the completion of the workshop. All the materials will be available via the main WPL website which may refer the viewer to a YouTube page created for the video tutorials, or the Scratch page where the projects are located.

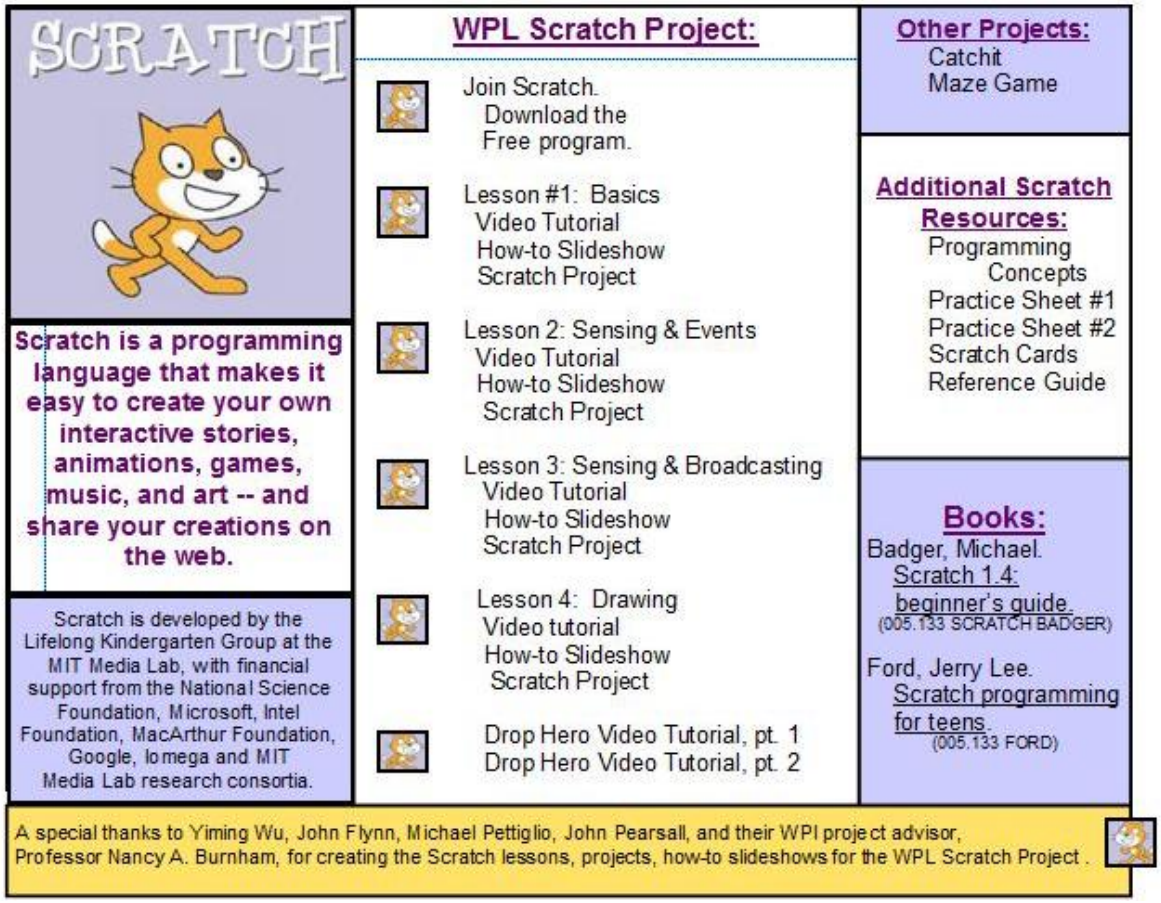


Figure F1: Layout of WPL Scratch page

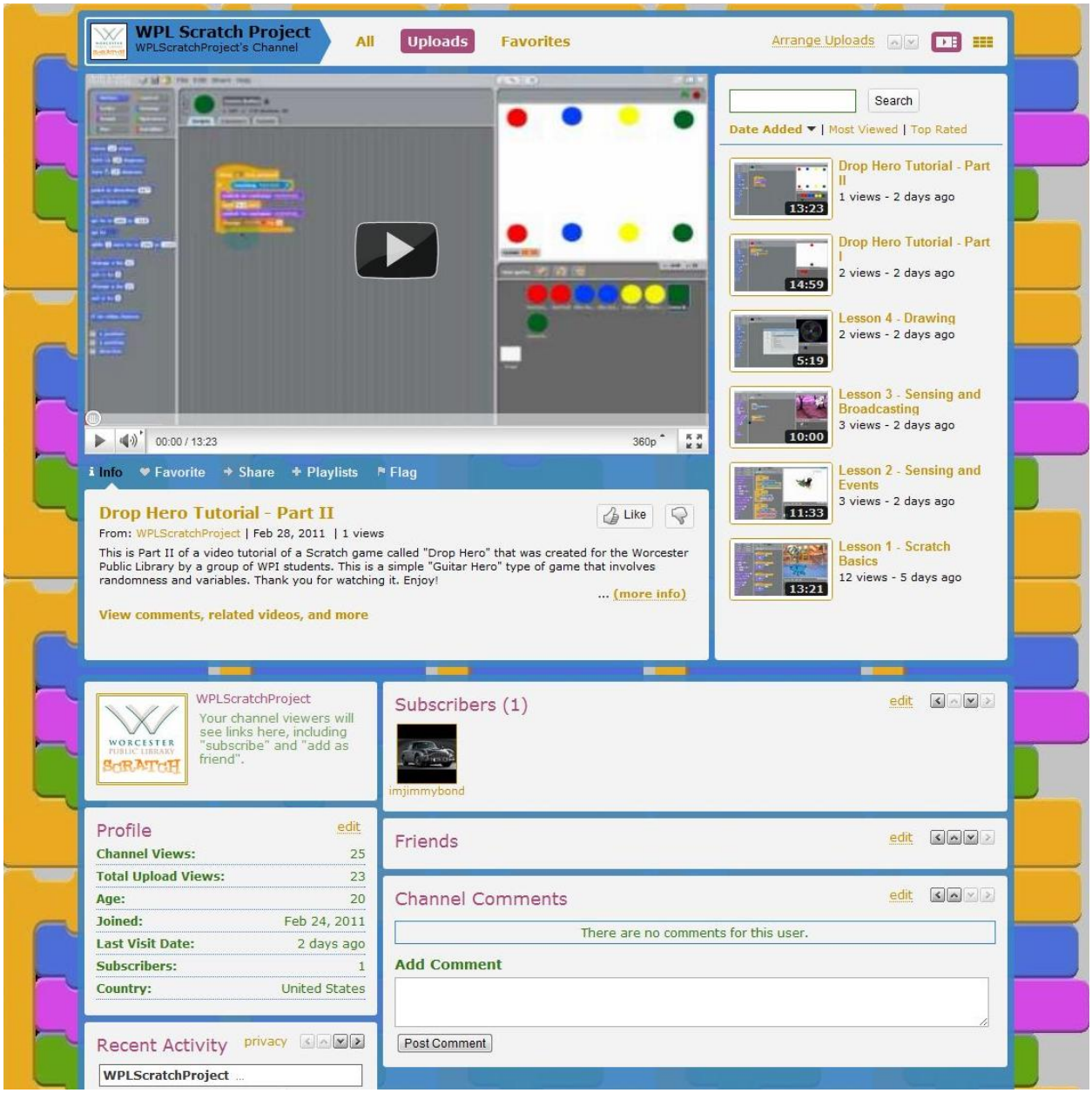


Figure F2: WPL Scratch YouTube page

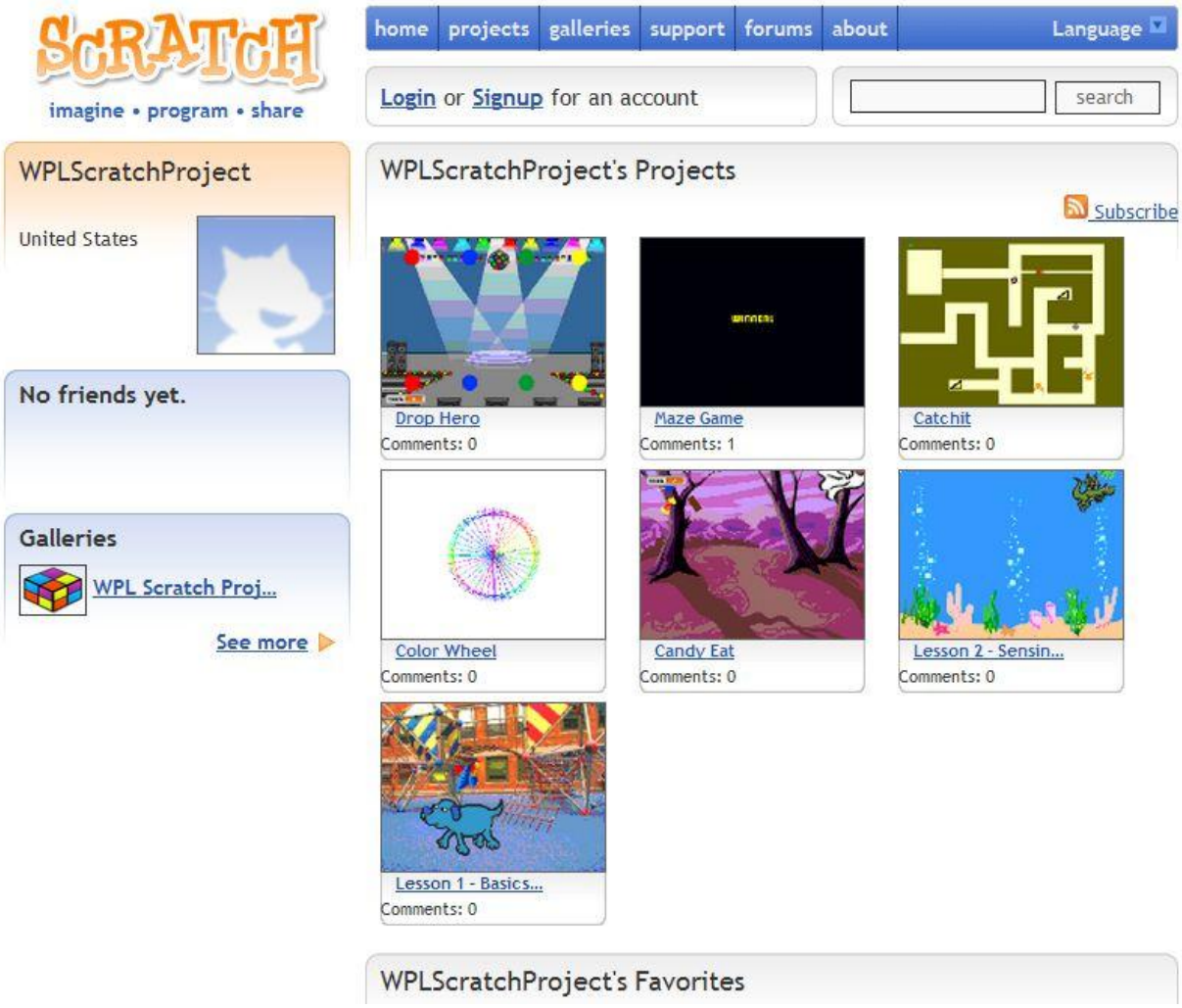
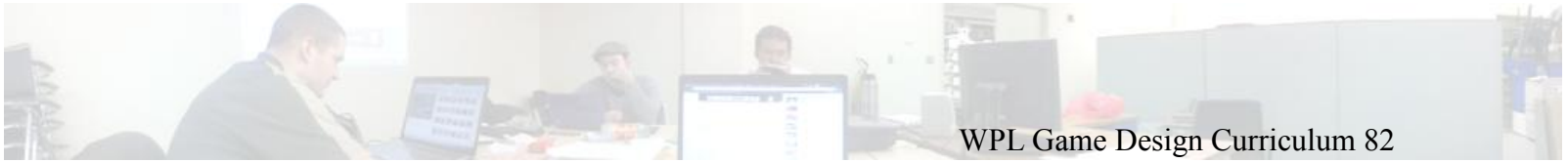


Figure F3: WPL projects on Scratch website



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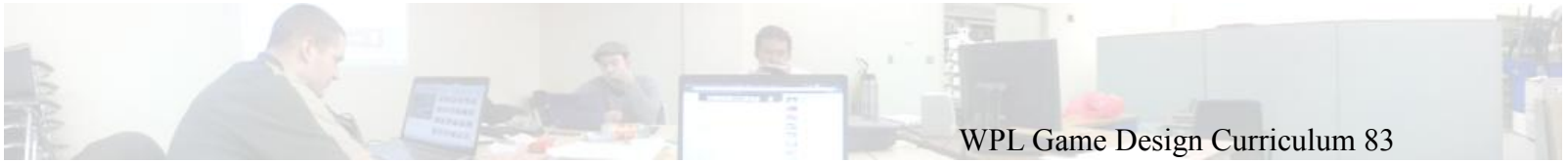

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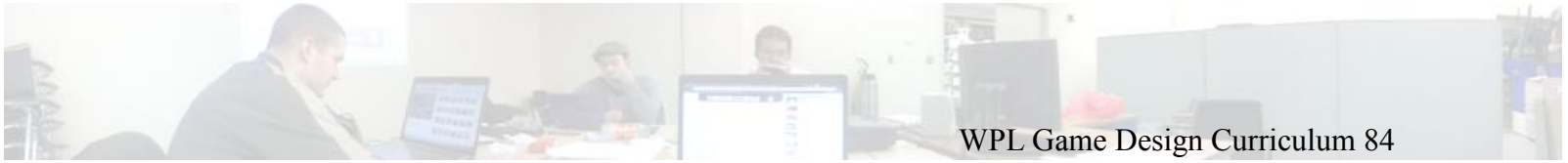

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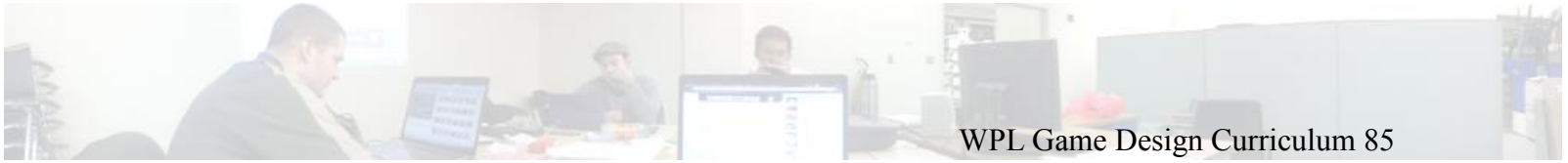

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