Action Research in Initial Teacher Education:

DigiPen Project-Based Learning

Edward R. Howe, Thompson Rivers University

Andres Ruberg, Kamloops School District 73
Abstract

This research investigates DigiPen, an innovative locally developed secondary school course. In DigiPen, students are actively engaged in project-based learning while studying how to work effectively in teams focused on digital game design. Students learn how to apply art, math, physics, and computer science knowledge to curriculum that is relevant, interesting, and fun. Also, students learn important life skills such as computer coding, critical digital literacy, managing complex tasks, and working together to develop original projects.

Moreover, DigiPen exemplifies the new British Columbia curriculum with cross-curricular integrated approaches to learning. The results of this mixed-methods study identified major themes: career, life skills, leadership, teamwork, and inclusion. Students indicated DigiPen played a significant role in their higher education choices and career paths. Thus, project-based learning shows great promise for providing meaningful learning experiences to build on. It is hoped this research will lead to further projects offering students additional learning opportunities.

**Keywords:** Project-based learning, DigiPen, digital game design, secondary school, cross-curricular pedagogy
Introduction

The theory/practice divide still pervades much curriculum, teaching, and learning at all grade levels. While much research supports innovative pedagogies including inquiry and project-based learning (Blumenfeld et al., 1991; Holm, 2011), what goes on in K-12 classrooms often doesn’t reflect these practices, as teachers tend to teach the way they were taught to and resort to traditional teaching strategies (Britzman, 2003; Korthagen, Loughran, & Russell, 2006). What can be done to bridge the gap between research and teaching? One solution is to provide action research opportunities during initial teacher education, so that teacher educators, teachers, and teacher candidates can effectively build bridges between theory and practice; universities and schools; scholars and practitioners. Thus, in the spirit of building bridges and breaking down educational silos, the Thompson Rivers University / Kamloops School District 73 K-16 Innovation Network was formed in 2016 and has since spawned a number of exciting research projects, involving teams of university faculty,
DIGIPEN PROJECT-BASED LEARNING

teacher candidates, and school teachers. These partnerships embrace project-based learning and are cross-curricular, reflecting the new British Columbia curriculum core competencies: communication; creative thinking; critical thinking; positive personal and cultural identity; personal awareness and responsibility; and social responsibility. This paper focuses on one such research project — DigiPen.

This research highlights collaboration between a secondary Bachelor of Education STEM (Science, Technology, Engineering and Math) program and a unique, locally developed high school course, based on the DigiPen Institute of Technology (DigiPen, 2016; Kushner, 2002). Over the past two decades, DigiPen programs have spread to high schools across North America and around the world. DigiPen is a significant part of the innovative Singapore education hub, Global Schoolhouse (Knight & Morshidi, 2011). In DigiPen, students are actively engaged in project-based learning while studying how to work effectively in teams focused on digital game design. Students learn how to apply their math, physics, and computer science knowledge to curriculum that is relevant, interesting, and fun. In addition, students learn a variety of important life skills such as how to manage complex tasks and work together in small groups over a semester to produce innovative games.

DigiPen provides a niche for exceptional students who might not always find school the most appealing learning environment. Moreover, DigiPen exemplifies the new British Columbia (BC) curriculum with cross-curricular and integrated approaches to learning (British Columbia Ministry of Education, 2016). Recently, the BC Ministry of Education announced that all students from K-12 must learn how to program a computer. This is an admirable goal. However, it is unclear how this can be achieved and teachers are at a loss as to how to modify or revise existing courses in order to effectively deliver this to students (CBC News, 2016). DigiPen is one possible solution, as it represents an effective way to integrate computer programming and animation into a course that connects STEAM subjects (Science,
DIGIPEN PROJECT-BASED LEARNING

Technology, Arts and Math) to actively engage students in meaningful ways. Research supports gaming and game design as a viable method of learning (Gee, 2005; Shute & Kim, 2011). In the area of game design, Gee’s (2010) working example as a new mode of inquiry shows great promise in providing a context to scaffold peer discussion with the ultimate goal of sharing curriculum, teaching and learning. However, strategies for integrating game design in traditional classrooms are few and far between. Indeed, examples of effective integration of game design in school are rare (Gee, 2013). Nevertheless, a noteworthy exception and working example of game design within a classroom setting has recently been piloted (Herro, 2015). DigiPen is another exceptional example. Thus, with respect to the foregoing, the purpose of this research is to investigate Digital Game Design (DigiPen) project-based learning to see how this unique program affects students’ learning, education, and career path. The structure of this paper is as follows: firstly, we outline our conceptual framework and the methodology used. Then, the DigiPen curriculum is described in detail. Finally, the results of this study are reported, and the implications are discussed.

Conceptual Framework

This research stems from shared interests in science and constructivist educational philosophies between a researcher and a teacher. We believe that effective teaching and scholarly research are essential elements of teaching and learning across the K-16 curriculum. So, we are both scholar practitioners — teachers and researchers; and as such, our shared conceptual framework reflects the tenets of action research, project-based and inquiry learning. Thus, DigiPen exemplifies project-based approaches to curriculum, teaching and learning and is well described by the following definition:

Project-based learning can be described as student-centered instruction that occurs over an extended time period, during which students select, plan, investigate and produce a product, presentation or performance that answers a real-world question or responds to
DIGIPEN PROJECT-BASED LEARNING

an authentic challenge. Teachers generally serve as facilitators, providing scaffolding, guidance and strategic instruction as the process unfolds. (Holm, 2011, p. 1)

Project-based learning has its roots in real world experience and Dewey’s (1938) constructivist philosophy — education is meaningful reflection on experience. It also draws from a growing body of literature on situated learning (Hung, 2002; Lave & Wenger, 1991; Vincini, 2003). In addition, developments in cognitive psychology and learning theory have extended our knowledge of metacognitive processes and educational psychology (Brown, Collins, & Duguid, 1989; Cole, 1996). Indeed, there is much research to support the premise that we learn through active participation and experience. Clearly, there is consensus among educators that knowledge, thinking, and doing are inextricably linked. We know that learning builds on prior experiences. Moreover, learning is a co-construction of knowledge amongst learners and teachers. Project-based learning embodies all the aforementioned and is a significant untapped resource in our design of K-16 curriculum, teaching, and learning.

Initial Teacher Education and Action Research

The complex and contested area of teacher education is filled with dilemmas (Falkenberg, 2015; Loughran, Hamilton, LaBoskey, & Russell, 2004; Martin & Russell, 2009). How can teacher educators effectively bridge gaps between theory and practice; universities and schools; scholars and practitioners? As this research stems from a joint initiative between our university and the local school district, with the goal of improving learning for students at both levels, it is a form of action research (Tomal, 2010). Thus, research questions were generated collaboratively between the principal researcher and the DigiPen teacher. Furthermore, this action research project arose from key stakeholders within our community who expressed a strong desire to find out how this popular program was affecting the career paths of students. This greatly influenced the original design of the study, the survey and interview questions asked, and the overall conceptual framework of this
DIGIPEN PROJECT-BASED LEARNING

project. Thus, survey research combined with reflexive ethnography (Fetterman, 1989; Hammersley & Atkinson, 1983/1989; Wolcott, 1999) were employed (cf. Adler, 2011; Kearns, 2012).

Methodology

This study incorporated mixed methods. Existing and former DigiPen students were contacted via email and invited to participate in an online survey (see Appendix A). Some participants were also interviewed and interpretive data was collected from the classroom setting. Thus, data sources included surveys of former graduates and ethnographic data from the DigiPen classroom. In addition, current DigiPen students provided formative feedback to their teacher on a weekly basis, online. Also, a teacher candidate made weekly observations and journal reflections of the DigiPen classroom, collecting documents, videos, photographs, and observations over the course of the semester. With the help of the two DigiPen teachers, an online survey was given to all DigiPen graduates from 5 cohorts (fall 2012- fall 2017). Of the 99 students contacted, 32 responded and completed the survey. The surveys included demographics and 5-point Likert-scale questions as well as open-ended questions pertaining to how DigiPen affected students’ program of study and career paths. Reflections from two teacher candidates and qualitative interview data were added to provide rich descriptive narratives. Vignettes from some of these narratives are included in the results section following a description of the DigiPen curriculum.

Curriculum Design and Implementation

Here, we describe the DigiPen course in detail. Firstly, the contents are highlighted and then the pedagogy and rationale are summarized. In DigiPen, students learn computer programming, digital art, game design, math, physics and other cross-curricular skills. DigiPen is an intense course that runs all day, every day, with one teacher, for an entire
semester (450 hours), in a close cohort. Students earn 16 credits towards high school graduation while also receiving advance credits towards up to two university courses.

DigiPen Curriculum Areas

DigiPen, while focusing on digital game design, is cross-disciplinary integrating a number of subjects, including computer science, art, math and physics. In addition, students are introduced to relevant and highly sought-after job skills such as working in teams and problem solving through project-based learning. The DigiPen curriculum areas are summarized here:

Computer Programming

- General concepts in Computer Science in the context of Java programming language
- Use Java-based game engine code library to create more complex programs
- Learn Javascript-like scripting language within the context of a game engine

Digital Art

- Learn fundamental art and animation theory
- Create 2-dimensional digital art projects, both static and animated
- Learn how to create and animate in 3D

Game Design

- Learn game design fundamentals through board games
- Explore game design processes by which complete and logically consistent games are created
- Students analyze games from a design perspective and present their findings in a presentation format

Math & Physics

- Linear algebra as it applies to vector manipulation
- Coordinate-based algebra and trigonometry
DIGIPEN PROJECT-BASED LEARNING

- Vector-based kinematics and dynamics

Team Management

- Build capacity to work as a team through small group projects with randomly assigned groups
- Equip students with team management resources and conflict resolution skills

DigiPen Pedagogy

A wide variety of evidence points to the value of engaging students with content through the use of examples and projects that they find personally relevant and interesting. The model used in the DigiPen classroom has a high school student cohort simultaneously studying four courses within the context of a theme in which they have expressed a personal interest. These students work with the same peers all day every day for one semester learning material in a context that they find personally meaningful. Adopting this model, paired with passionate instruction seems to increase student engagement, resilience and willingness to take risks, all of which contribute to deeper and more significant levels of understanding.

Interdisciplinary Theme-inspired Project-based Curriculum

We have found that generally students learn best when they are solving problems and working on projects that they believe have relevance to their interests and potential futures. The challenge with traditional classrooms is that each student has different interests and ideas of what their future holds. This means that classroom teachers can try to make projects that appeal to individual student interests, but it is difficult, and is rarely achieved on a regular basis. By creating a cohort of students, who have been grouped because of their common interest in a theme or topic, the challenge in making projects relevant disappears. The opportunities for relevance expand even further when one considers that these students are being taught four courses simultaneously within the context of their chosen
theme. This means that projects can seamlessly include material from a wide variety of subjects and has the added benefit of having projects that meet curricular goals for several courses simultaneously. Based on our experience, students who believe that what they are doing matters can achieve incredible results, far beyond what they could generate with a generic assignment in a traditional classroom.

**Growth Mindset**

There is a large volume of research and anecdotal evidence pointing out the advantages associated with developing a growth mindset in students. Students should regularly have discussions with their teacher to ensure that they are moving towards a belief that their strengths and abilities are not fixed. The concept of developing a “growth mindset” in students has existed for decades, and recent neurological research has confirmed that having a growth mindset may be the largest predictor of student success during their secondary education and beyond (Dweck, 2006). This philosophy, more than any other perhaps will result in capable and successful project-based learning.

**Community Building**

Almost every day, for up to half the class time, students work in randomized groups, and share their findings with peers. To see one of the largest benefits of working with the same 28 people every day requires students develop a strong sense of community and remain open to collaboration. Regularly working with different students in the class and then sharing findings as a group has numerous benefits. This teaching strategy encourages building relationships with everyone in the class, not just those an individual may relate best with or with those whom generally agree. Randomized groups allow students to develop new perspectives and approaches to problems in addition to building their capacity to share ideas and express opinions. Ultimately, this structure builds a classroom in which ideas flow naturally from one student to the next, resulting in a shared knowledge to which the entire
class has access. This is the goal of many organizations and reflects a society in which every individual has value. Moreover, this classroom structure mirrors that of most workplaces.

Beyond the building of community, students grow immensely in confidence and presentation ability. This occurs because in addition to presenting and defending ideas within their small groups, student groups share their results with the class on a regular basis. To summarize, the small group work encourages students to work with a variety of individuals, promoting the building of an interdependent community of learners and building student confidence to share their understanding with others.

Assessment Elements

Skills-based assessment. Students are assessed on skills only in the DigiPen classroom. There is no traditional “mark” as such and thereby no homework component, test component, or other traditional components associated with traditional grading schemes. Students do have occasional assignments, tests, and other traditional activities interspersed between instruction and projects, but these serve only as opportunities to build and display specific skills. When a student completes this academy they have a list of skills developed over the course of the semester, with a proficiency level highlighted for each skill and a description of what specific tasks they should be able to complete based on that proficiency level. These skills are developed over the course of the entire semester and as a result a student’s level of ability is constantly changing and the current skill assessment reflects their current level of understanding (not an average).

Project-Based Learning. The majority of the work that students do in this setting is projects that are either designed to help students develop specific skills or open-ended in the sense that students can choose which skills they plan to develop and display within the project deliverables. Although there is some traditional delivery before major project work can begin, the vast majority of student learning occurs during the project itself. The lessons
taught prior to starting a project are more a means of showing what is possible and how to
find and use resources. Students generally push themselves far beyond what is “taught” and
have created projects that challenge or extend the built-in limitations of the software they are
using. During project work time, the teacher is available for assistance, but rarely “solves” a
student’s problem. Most of the time students are directed to a resource (the material covered,
past projects or most often another student who has solved a similar problem). When the
teacher does assist a student directly it is understood that they are now the “expert” on that
problem and that other students encountering similar challenges will be sent to them.

Student self- and Peer-assessment. At the end of a project students are given a self-
assessment sheet, where they describe what they accomplished, challenges they overcame
and what level they believe themselves to be at with the specific skills they were trying to
display with that project. For each self-assessed skill students are required to give a specific
piece of evidence that speaks to the tasks that they should be able to perform at the indicated
level of proficiency. Additionally, most major projects also involve some form of peer-
assessment whereby 2-3 other students will look at the project. In this confidential peer
assessment students give each other feedback as to what they were impressed with, what they
would improve and at what level they would currently assign you in the specific skills on
display. The DigiPen teacher collates the self-assessment, peer-assessment and teacher-
assessment in order to provide a holistic final report enabling the student to reflect on in a
post-production process following each major project.

With our conceptual framework, the DigiPen curriculum and educational philosophy
explained, we now turn our attention to the results of the study.

Results

What follows is a summary of the surveys, ethnographic field data and follow-up
interviews collected from September 2016 through January 2018. The survey responses
DIGIPEN PROJECT-BASED LEARNING

helped to frame interview questions and subsequent conversations in order to probe deeper into students’ experiences. In particular, the focus was on how DigiPen affected higher education and career choices. Five significant themes emerged: Career, Skills, Leadership, Teamwork, and Inclusion as shown in Table 1.

[Insert Table 1 here]

Career

There is a strong connection between the DigiPen program of instruction in digital game design and the decision of many students to pursue higher education in various related fields such as software design and animation. While career opportunities utilizing computer programming and software engineering abound, very few courses are available to high school students, making DigiPen unique in this regard. Interest in DigiPen continues to grow as more students in our region discover this program. There were 38 applicants for only 28 seats in the fall 2017 DigiPen class. Students have a keen interest in this field of study. Many of them chose to travel a great distance in order take this course. In fact, some students had to transfer out of their high schools while some had to even arrange for homestays for the semester in order to attend DigiPen. A majority of graduates indicated that DigiPen positively affected their career path (50% Strongly Agree; 30% Agree; 20% Undecided) as shown in Figure 1 and in the following responses to the open-ended questions:

   It opened my eyes to computer sciences and game design… pushed me to further explore jobs in computer science and confirmed that I wanted to work in computer sciences. (SS3)

   Before DigiPen I had no idea what I wanted to do for a career. But now that I’ve had a taste, I know the video game industry would be a career I would be happy in. (VS1)

   DigiPen was what led me into the Digital media industry and helped me understand myself. (SS4)
DIGIPEN PROJECT-BASED LEARNING

It made the idea of being an artist in this line of work more achievable. (SK2)

It changed my future dream of being a Mechanical Engineer to a Software Engineer. (SS9)

[Insert Figure 1 here]

Clearly there is strong correlation between DigiPen project-based learning and students’ higher education and career paths. This is further illustrated in Figure 2 and the survey responses.

[Insert Figure 2 here]

Skills: I have the skills necessary to enter my field of work…

Many students attested to the unique skills they acquired during the DigiPen course. The following quotes describe specific skills such as computer programming, physics and math and how these skills were effectively integrated throughout the semester.

I had past experiences with Digital art, Game design, and 3D modeling. DigiPen [taught] me to fundamentally use all of these skills together. (SS4)

It gave me an abundance of skills and outlooks, as well as developing my […] thinking in a new way. (SS1)

It helped my skills in game design to blossom. (NS4)

DigiPen, unlike any other class in secondary school, places the students with little controlled work and […] taught us to be involved in our own goals and projects.” (SS4)

DigiPen not only gave me the skills I needed to enter into this industry, but showed me how the companies (such as we visited) need to work in a team-based environment. (VS1)

Leadership

Another theme strongly endorsed by most students surveyed was leadership. As shown in Figure 3, DigiPen provided leadership skills (44% Strongly Agree; 48% Agree; 8%
DIGIPEN PROJECT-BASED LEARNING

undecided) to students who otherwise might not have opportunities in other classes to act as leaders. This is further supported by participants’ responses to the open-ended survey questions like “How did DigiPen affect your learning?” and “Do you have anything else to share?”

It helped me learn to be a true leader in a team setting and how to work in a team without going off on my own. (NS4)

It showed me to look at the whole picture. (LL1)

DigiPen treated us like adults, and we had to act [like ones]. With schools being such a controlling environment, DigiPen gave us the responsibility. (SS4)

[Insert Figure 3 here]

**Teamwork: DigiPen helped me learn how to work in a team…**

Perhaps one of the most striking and noteworthy features of DigiPen is that many students acknowledged that they are introverted, yet this classroom environment encouraged them to develop social skills, to improve their communication with others and to work collaboratively on projects. A majority of participants mentioned the value of learning how to effectively work together as a team to achieve common goals. More than 80% of participants agreed that DigiPen helped them to learn how to work in a team (58% Strongly Agree; 31% Agree; 11% Undecided) as shown in Figure 4. Responses to open-ended survey questions further support this finding:

It helped me [learn to] work as a team and enjoy learning. (SS1)

It was a class full of people who wanted to be there and shared similar interests. (NS2)

Before DigiPen I had troubles fitting in… Our class became a close group of friends and a team. We still help each other out if we’re doing individual projects to do with coding or video games. (VS1)

[Insert Figure 4 here]
Inclusion and Accomplishment

In DigiPen, students spend an entire semester together in a cohort. There is a very close bond that forms between them. This was evident through weekly visits to the DigiPen classroom. Observations made by teacher candidates of the classroom environment included a high level of student engagement, pride, and dedication. Students spent the entire day working on their DigiPen projects and often were there late after class as well.

- Students were focused, motivated and involved in their project because it was something they were interested in and passionate about.
- Students demonstrated curiosity, cooperation and collaboration.
- Students shared a sense of pride and accomplishment. (Sarah, TC observations)

The DigiPen classroom gave students a safe place to hang out and provided a niche for them. DigiPen was a place where they felt part of a group. It provided students with a sense of self-worth and belonging—something that had been missing from their previous schooling. “I felt like I actually belonged there when normally I felt like an outcast.” (VS1)

Sara’s Narrative Inquiry

My name is Sara Spada and I am a Bachelor of Education student from Thompson Rivers University, in Kamloops, BC. I have been part of the DigiPen research project since December 2016. Since then, I have made weekly observations at Sahali Secondary School’s DigiPen classroom. I observed students work both independently and in groups of three. In this time, I have learned and witnessed how interactive and purposeful this program is to students.

In being a teacher candidate, we are taught about how important it is to have your students engaged in the materials and lessons in your classroom. We are also taught about how important it is to have the opportunity for inquiry in your lessons and how
important it is for students to have ownership in their learning. This is exactly what I observed in the DigiPen classroom. Students were focused, motivated and involved in their project because it was something they were interested in and passionate about. Students were also given the freedom of choice regarding the content they created. The level of creativity that these students presented was astounding; from character development, story plot, to illustrations.

In observing the DigiPen classroom, I saw students generate a lot of curiosity towards their projects. I often heard students discuss among each other “I wonder what would happen if I did this?” or “I wonder if I changed this if it would make my graphics more effective?” This also leads into the concept of cooperation and collaboration. Even though students were presenting their final group projects to be judged by a panel, I never saw students get competitive between groups. Often, students from different groups would work together if someone had a question or problem. I often saw students ask each other for help and gladly work together to solve the problem. From this, I can honestly say that the DigiPen classroom was very much a community for these students. When working in groups of three, students were not allowed to take ideas from their own individual projects and incorporate them into the team game. This way, there had to be a discussion formed among the team members regarding what direction they wanted to take their game in. This very much led students to practice their communication skills, as they had to voice their opinion to their team mates and provide a rationale as to why they thought this idea would serve best.

Students shared a sense of pride and accomplishment when I asked them questions regarding the premise of their game and what role each of them had in their team. When asking students about their journey in the DigiPen program, students often shared how they overcame a concept they initially struggled with, for example with
coding and graphics. This very much shows the attribute of self-discovery; students were challenged with something and overcame this obstacle.

From my observations, the DigiPen program is very much a gateway for students to pursue further education in digital animation and interactive games. DigiPen is a hands-on and minds-on program. Students are both engaged and challenged throughout the course of this program. The projects throughout this program incorporate not only the core competencies of the BC education plan, but also supports students learning in a way that is both authentic and empowering.

Michelle’s Narrative Inquiry

My name is Michelle Tondevold and I am a teacher candidate in the Bachelor of Education program at Thompson Rivers University in Kamloops BC. I have been part of the DigiPen research project from September 2017 until April 2018. In this time, I have made weekly observations in the DigiPen classroom at Sahali Secondary School. I observed students working independently, in groups from 2 to 5 as well as had several opportunities to observe the groups as they showed me their works in progress, allowed me to try and test their games and asked me for feedback.

Looking at the class of 28 as a future teacher, I understand how important it is for the students to engage in their work, be self-motivated and proud of the material they produce. The students of the DigiPen program were always very enthusiastic about sharing their projects with me, and often encouraged me to try what they had created. This tells me that the program was working, these students were learning a valuable skill and each week I could see a positive trend in their talents and abilities. I enjoyed walking around the class and observing the students as they helped each other with issues within the game development. There were classroom “experts” as well, several
students were very proficient programmers, or inventive and creative game designers and others were excellent team leaders. Watching these students develop more difficult games was very exciting, and as I got to know them a little more each week I also was able to ask what they were planning for the future. I heard some fabulous future job plans such as working for the military on a flight deck, an animator for Disney and one student had aspiration of being a mechanical engineer to build roller coasters.

In November 2017 the students opened their classroom up for other students from another class to come in and demo their games. The students of the visiting class all tried each of the video games, they then each voted on their top 3 game choices. Once the votes were tallied each game got at least one vote, which implies that every game found a niche — An impressive task considering they were only 2 months into their DigiPen semester.

Watching the final projects unfold was interesting as I witnessed teams have to pull together to complete a large project that was to be presented to the public. This added a whole new dynamic as they could not present a project that had issues, was not finished or that was missing pieces. Only one team of the seven was not working well together, and this can happen as not all personalities mesh. Other teams found they fed off each other’s nervous energy, while a few teams used the pressure to buckle down and produce. The end results where amazing despite the pressure and stress! Each group produced a short game that was well developed, included some form of instructional pregame to aid players, and each team was responsible for a presentation about the game. Each team had 3-4 computers on display with their games ready to be tried by the public. It was a grand success and an epic finale to another great DigiPen semester.
Conclusion

This research investigated the DigiPen program in order to answer questions such as: How did DigiPen affect students’ career paths? Also, during this process, a teacher candidate gained valuable experience as a research assistant. It is expected this research will help inform future action research and project-based learning involving teacher educators, teachers and teacher candidates. Thus, this research benefits teacher candidates, our program, and the school district. Results show that the teacher candidates made a strong connection between teaching and research. Furthermore, DigiPen graduates indicated that project-based learning played a significant role in their experience and education.

Knowledge is a narrative construct, which references the totality of a person’s personal practical knowledge gained from formal and informal educational experience (Xu & Connelly, 2009). Naturally, teachers have a great deal of experience to draw upon. Much of this is tacit knowledge that often goes unreported but it is an integral part of a teacher’s curriculum, teaching and learning. Thus, the educational significance of this study includes the DigiPen program of instruction in addition to a unique collaborative research methodology. This research is different from many other studies as it employs a teacher candidate undergraduate research assistant. Finally, this research project facilitated knowledge mobilization through the growth and development of the principal investigator, teacher candidates, and secondary teacher to help bridge the gaps between theory and practice; universities and schools; scholars and practitioners. Perhaps most importantly, this research also helps break down the traditional silos of various disciplines to show teacher educators what is possible when we work in collaboration with other key stakeholders in education.
References


Appendix A Survey Questions DigiPen Project-Based Learning

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Undecided</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I had the mathematics skills to complete my program.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I had the computer science skills to complete my program.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I had the physics skills to complete my program.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I have the skills necessary to enter my field of work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. DigiPen helped me learn how to program a computer.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. DigiPen helped me learn how to work in a team.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. DigiPen gave me greater confidence in my ability to acquire new skills.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. DigiPen provided me with leadership skills.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. DigiPen helped me develop problem solving skills.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. DigiPen helped facilitate my creative thinking.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. DigiPen positively affected my post-secondary education.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. DigiPen positively affected my career path.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Open-Ended Questions
1. Why did you decide to enrol in DigiPen?
2. How did DigiPen affect your learning?
3. How did DigiPen impact your career path?
4. Do you have any other things you’d like to share?
Appendix B DigiPen Pictures (There are 10 other pictures to be included, space permitting)
### Table 1  
*Summary of DigiPen Student Survey Open-Ended Questions*

| Theme     | Tally | Representative Student Responses                                                                                                                                                                                                                                                                                                                                                           |
|-----------|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
| Skills    | 46    | I had past experiences with Digital art, Game design, and 3D modeling. DigiPen [taught] me to fundamentally use all of these skills together. (SS4)  
It gave me an abundance of skills and outlooks, as well as developing my […] thinking in a new way. (SS1)  
It helped my skills in game design to blossom. (NS4)  
DigiPen, unlike any other class in secondary school, places the students with little controlled work and […] taught us to be involved in our own goals and projects.” (SS4)  
DigiPen not only gave me the skills I needed to enter into this industry, but showed me how the companies (such as we visited) need to work in a team-based environment. (VS1) |
| Career    | 27    | It opened my eyes to computer sciences and game design… pushed me to further explore jobs in computer science and confirmed that I wanted to work in computer sciences. (SS3)  
Before DigiPen I had no idea what I wanted to do for a career. But now that I’ve had a taste, I know the video game industry would be a career I would be happy in. (VS1)  
DigiPen was what led me into the Digital media industry and helped me understand myself. (SS4)  
It made the idea of being an artist in this line of work more achievable. (SK2)  
It changed my future dream of being a Mechanical Engineer to a Software Engineer. (SS9) |
| Inclusion | 9     | I felt like I actually belonged there when normally I felt like an outcast. (VS1)                                                                                                                                                                                                                                                                                                                   |
| Teamwork  | 5     | It helped me [learn to] work as a team and enjoy learning. (SS1)  
It was a class full of people who wanted to be there and shared similar interests. (NS2)  
Before DigiPen I had troubles fitting in… Our class became a close group of friends and a team. We still help each other out if we’re doing individual projects to do with coding or video games. (VS1) |
| Leadership| 3     | It helped me learn to be a true leader in a team setting and how to work in a team without going off on my own. (NS4)  
It showed me to look at the whole picture. (LL1)  
DigiPen treated us like adults, and we had to act [like ones]. With schools being such a controlling environment, DigiPen gave us the responsibility. (SS4) |
Figure 1: DigiPen and Career Path
Figure 2: DigiPen and Career Skills
Figure 3: DigiPen and Leadership Skills

- **Strongly Agree**: 44%
- **Agree**: 48%
- **Undecided**: 8%
Figure 4: DigiPen and Teamwork