

Project-Based Learning in IT Skill Development

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My research question is “With IT Skill Development being important to the visual aesthetics of web design, should IT Skill Development become a Project-based learning environment in higher education?” Project-Based Learning (PBL) is an innovative, systematic teaching method that promotes student engagement through deep investigations of complex questions. This means that students learn by doing. For example, IT 106: Introduction to IT Problem Solving Using Computer Programming introduce students to problem-solving with a procedural approach using a high-level programming language as a tool. Students are required to create algorithms for solving simple problems and use a programming language to implement, test, and debug algorithms for solving problems. The problem with IT 106 is that students are learning from the books instead of working in teams and researching codes that help students build applications into computers. According to John R. Mergendoller (2013) on bie.org he stated that “Projects have to be planned around topics that lend themselves to thoughtful consideration, and students have to be provided with the tasks, supports and scaffolds needed to develop critical thinking tools and strategies. Projects that develop critical thinking competencies are designed around cognitive tasks that require deliberative thought – making judgments between alternatives, figuring out the best way to create something, weighing evidence, reconsidering initial ideas, creating a plan for solving a problem, summarizing an argument’s key points.” These are the following instructional methods of Project-Based Learning:

- Requires collaboration and teacher guidance
- About the process
- Student-directed
- Students make choices that determine the outcome

- Products are presented to an authentic audience
- Based on real-world experiences or problems
- Real learning occurs through the project

Interdisciplinary Rationale

My two disciplines are Information Technology and Art & Visual Technology (See Appendix A to view the diagram). With Information Technology there are functionality, developer, compatibility, and backend/database system engineering. Web Developers need Web Designers to understand how to sell their product by understanding the brand of the website and the aesthetics (look and feel) of the website. Web designers have to understand design principles & theories, user experience design, aesthetics, and usability in order to design the frontend of a website. It's important for designers to convey their audience with great visuals that consist of unity, white space, hierarchy, balance, and alignment. They need developers to code the backend of a website to make the website function and be compatible with users. With the two disciplines combined together create the learning challenges in IT skill development.

Literature Review

Preparing Students for A Project-Based World. In Lathram et al. (2016) summary talks about work through challenges with Project-Based Learning and how to collaborate with others. Learning how to utilize their own interests and passions to grow their skills? Mastering core academic content that is relevant to the problems and challenges of their futures, and relevant to their own future careers? Collaborating with others, learning complex skills and behaviors needed to successfully complete projects that one will likely encounter in college and especially career? Fostering academic mindsets, cultivating executive functioning and social and

emotional skills needed to be flexible, maintain and upgrade their skills in a rapidly changing economy?

Development and evaluation of a web map mind tool environment with the theory of spatial thinking and project-based learning strategy: Web map mind tool environment. In (Hou et al., (2016) talks about the five principles of how teachers should use an incremental project design for java. From there, it talks of how teachers should start with the basic lessons of java before getting to the complex ones.

Using project-based learning to teach object oriented application development. Project-based learning is a student-centered approach to instruction in which students work in teams to complete an open-ended project. It is ideally suited to the teaching of analysis, design and implementation, especially when using object-oriented analysis and design methods. This paper describes the use of project-based learning in a two course sequence on systems analysis, design and implementation and discusses the lessons learned from our experiences teaching these courses over the past five years (Fernandez & Williamson, 2003).

The impact of prior experience in an information technology programming course sequence. Like most computing departments, the IT Department of GCCIS at RIT offers an introductory programming sequence as part of the core requirements for a BS in IT. Students typically spend their first three quarters completing the sequence that uses Java as a programming language and progresses from basic programming constructs to object-oriented design and implementation (Holden & Weeden, 2003).

The Incremental Teaching Project Design for Project-Based Learning and Its Application in Java Programming Course. Project-Based Learning (PBL) is a widely adopted pedagogy that ignites students' interest of a subject through the investigation of an authentic

problem and cultivates their abilities of innovation and self-learning. Traditional PBL often involves a project of complexity and significant scale, which, under the time constraint of a course, is often difficult for students to handle and risks insufficient comprehension of the knowledge and negative impact on learning confidence. This paper proposes an incremental teaching project concept and its design strategy on top of the traditional project-based learning. An incremental teaching project is carefully designed for a Java Programming curriculum, based on which we discuss the dos and don'ts of applying incremental PBL to teaching (Huang, 2016).

Student-Centered Learning Environments in Higher Education Classrooms: In Hoidn (2017) summary he talks the benefits of Student-Centered Learning and higher education and how it maintains the knowledge they gain from classroom setting. "The overall objective of such learning environments is to develop students' deep conceptual understandings and self-regulation as contributions to their developing strong identities as learners and as increasingly effective participants in the meaningful social practices of their learning communities in higher education and elsewhere in their lives (e.g., Greeno, 1998 , 2011)."

Brainstorming as a Way to Approach Student-centered Learning in the ESL Classroom: Story-telling provides the opportunity for students to use their own ideas and bring their own experiences to the conversation. Given that much of the learning is related to their daily experiences (Unin, 2014), story-telling can be used as a brainstorming strategy to address students' reluctance to speak English more voluntarily. It was observed that story-telling, as a brainstorming strategy, can be used as a way to approach SCL that reflects active involvement and participation (Brandes & Ginnis, 1986). The findings on story-telling support the existing literature by Slavin (1995), as well as, Hamzah and Lu (2010), who found that students are more

confident and motivated to express their ideas when brainstorming in small groups (Unin & Bearing, 2016).

Student-centered Education and Constructivism: Challenges, Concerns, and Clarity for Teachers: Today, educators are in a quandary. The educational culture increasingly compels educators to utilize methods of constructivism without considering the problems that constructivist learning theory poses to its pedagogical offshoot. These problems may best be underscored by philosopher Roger Scruton (as quoted in Glenn 2013) who wrote of Rousseau's Emile on which much constructivism is based: "even if it were possible to educate children in this way, one thing is certain: that each generation would know less than the one before." Teachers should reflect on how they can reconsider the use of constructivist pedagogy in their own classroom, how they can work to reframe the discourse in this increasingly "student-centered" educational environment, and not promote nor permit the caricature of alternatives to constructivism in their buildings, districts, and states (Hoidn, 2017).

Pedagogies for Student-Centered Learning: Online and On-Ground: There are a great many more methods associated with learning and linked to various pedagogies, some of which we will discuss further in chapter 2. But the initial question in designing a learning environment is, What learning theories and methods help inform and connect the appropriate curricular approach to the specific learner population and need? Identification of the appropriate theory, methods, and practices surrounding teaching and learning are what provide the foundation for building curriculum, learner and academic support systems, and professional development. These theories and methods are what drive the development of the learning-

assessment strategies and are key to building the curriculum most appropriate for the learner population and learner objectives needs (Crumly, Dietz, & d'Angelo, 2014).

Interactive student-centered learning: a cooperative approach to learning:

Conversely, a student-centered philosophy establishes that the teacher must assume the responsibility as facilitator of student learning. This process requires the teacher to be a motivating force in student learning, participation, thinking critically, problem solving, and performing successfully in evaluations and assessments. This procedure shifts the responsibility for learning to the student (Spooner, 2015).

Using game theory and Competition-based Learning to stimulate student motivation and performance. This paper introduces a framework for using Game Theory tournaments as a base to implement Competition-based Learning (CnBL), together with other classical learning techniques, to motivate the students and increase their learning performance. The paper also presents a description of the learning activities performed along the past ten years of a course where, in five of them, Competition-based Learning has been used. Finally, the experience gained is described together with an analysis of the feedback obtained from the students' surveys. The good survey results, and their similarity along the years, suggest that the combination of game theory with the use of friendly competitions provides a strong motivation for students; helping to increase their performance (Burguillo, 2010).

Gamification for Teaching Java. The term 'gamification' refers to the use of game elements in non-game environments like education, business, sales and marketing. The method of 'gamifying' has been applied in many different contexts and for many different reasons; for

instance, in order to improve productivity, to increase sales, to motivate employees and customers, et al. (Çubukçu et al., 2017) .

Gamification for Assessment of Object Oriented Programming. For university education, especially for teaching a computer science course, engagement seems to be of high importance, and gamification is likely to be a way to deal with this issue (Wood & Reiners, 2012). Gamification could let the system be “more fun and engaging” (Zichermann, 2011). Shahdatunnaim, Noorminshah, and Norasnita (2015) did a literature review on gamification in online collaborative learning for programming courses, where they analysed the challenges for programming students, discussed the elements for students’ participation in the OLC (Online Collaborative Learning) environment and game elements for facilitating it, and then presented the methods on gamification in OLC (Çubukçu et al., 2017).

Learning Programming through Games and Contests: Overview, Characterisation and Discussion. Learning of programming and, more generally, of computer science concepts is now reaching the public at large. It is not only reserved for people who studied informatics (computer science) or programming anymore. Teaching programming to school children presents many challenges: the big diversity in ability and aptitude levels; the big amount of different tools; the time-consuming nature of programming; and of course the difficulty to motivate schoolchildren to keep them busy with hard work. There are various platforms that offer to learn coding and programming, in particular game-based platforms, which are more and more popular. These latter exploits of the gamification process focused on increase in motivation and engagement of the learners. This paper reviews the main kinds of online platforms to learn programming and more general computer science concepts, and illustrates the review with concrete platforms examples (Combéfis, 2016).

The Study of Gamification Application Architecture For Programming Language Course. Students sometimes find it hard to learn new programming languages. They often confront unfamiliar programming terms and are required to visualize the processes that happen in the computer memory. Weak students find this a burden and end up memorizing the processes without understanding them and their working. This situation invariably leads students to get low grades in their programming subjects. Some researchers suggested that an enjoyable approach must be adopted in learning difficult subjects. Studies have shown that applying gamification elements in websites engages users. “Gamification” refers to the use of game elements in a non-game context to increase engagement between humans and computers. This research try to solve the problem by apply gamification elements in programming language course as a new architecture of Gamification application to increase the effectiveness of learning and enhance the understanding of students' (Khaleel et al., 2015).

Gamification-based learning framework for a programming course. Students occasionally find it difficult to learn new programming languages. Previous work showed that students have experienced ineffective learning, lack of interest towards this course and lack of motivation. The rationale for this is that in previous studies, some researchers have mentioned the use of game elements but none have mentioned a gamification framework that integrates the requirements for learning programming language subjects. Therefore, this study proposed gamification framework that consists of game elements and programming learning requirements. This framework is verified by lecturers and students. The findings shown, the mean score of each combination of programming learning requirements and game elements is more than 4.00 (Khaleel et al., 2017).

Website design: viewing the web as a cognitive landscape. “Website design presents a new challenge for marketers conversant in print media. Unfortunately, many companies have taken what they developed for other media (magazine advertisements, catalogues, etc.) and applied it directly to their website (e.g., www.pathfinder.com)” (Rosen & Purinton, 2004). It's important to have a website for clients with navigation where any client can navigate through different web pages. Clients like to see great content and visual elements, so it is easy on the eyes. It's important to not have a clutter page.

Colour appeal in website design within and across cultures: A multi-method evaluation. Colour has the potential to elicit emotions or behaviors, yet there is little research in which colour treatments in website design are systematically tested. Little is known about how colour affects trust or satisfaction on the part of the viewer. According to (Cyr, Head, & Larios, 2010) “When using saturation, you can take two colors and place them together. If having one color smaller than the other for example yellow and placing it with black. The black would be more intense than the yellow because of the size”.

Website design quality and usage behavior: Unified Theory of Acceptance and Use of Technology. ““Owing to data protection restrictions, contacting users through banks was not an option. However, because most people are users of banking services, convenience mall intercept sampling served to draw a broad cross-section of consumers. Three city centers accounting for differing lifestyles were targeted (Al-Qeisi, Dennis, Alamanos, & Jayawardhena, 2014).” One of the important things when working with clients is to research and sketch based on their needs on how they want their website built. It's all about designing a website for their target audience. When incorporating colors for website, you want to see what type of company it

is. For example, a financial firm or a consulting firm. Choose colors that are more serious and business oriented.

Creative Interpretation in Web Design Experience. “Two visual stimuli were provided through which participants communicate their experiences: thought bubbles and speech bubbles. The bubbles are interpreted in a way that the thought bubble is used to depict inner thoughts and the square-like bubble is for oral expression (Tähti and Niemelä 2006). The purpose of the model is to enable the participant to express all experiences, including negative ones, more freely than for example in interviews, to collect all dimensions and qualities of visual web experience (Silvennoinen, Rousi, & Mononen, 2017)”. In a visual design perspective, designers need to have guidance by making sure that the website is structured and not overbearing. It is also important for the website to communicate to the audience in order for the website to have a clean but simple message. Working with clients to make sure that the website is witty or fun or have some kind of emotional impact.

Development And Evaluation Of A Web-Based Fun Reading English Resource For Primary Learners- An Executive Report. Web-based applications are important because it aids with students learning and reading comprehension skills. With Web-based applications, students performance in schools will increase. “This study adapts the ADDIE model that takes into account the generic stages (Sumarni, 2009), which are: (i) Need Analysis; (ii) Design; (iii) Development; (iv) Implementation; and (v) Summative Evaluation of the EPFun resource. Figure 1 shows the framework of research methodology (Aziz, 2016)”.

Evaluating Responsive Web Design's Impact on Blind Users. “Websites complying with accessibility guidelines can be ineffective, inefficient, and unpleasant for blind users. Although the responsive-design websites investigated had acceptable levels of accessibility, they

posed numerous usability barriers and triggered intense, negative user emotions. We performed an empirical study of RWD and NWD to evaluate the subjective attributes of blind users' experience. We adopted an exploratory approach using qualitative and quantitative indicators to understand the pragmatic phenomena of UX (Nogueira et al., 2017)". People who have disabilities, it's important to have accessibility for them to read thoroughly on computer screens. There are many open-source websites that provides screen readers for free. Those sources available are JAWS and NVDA for Microsoft. There are Voice Overs within the Apple computers and iOS devices and more.

The Importance of Process-Oriented Accessibility Guidelines for Web Developers.

Having accessibility for a website is very important as it would allow individuals with disabilities easier use of a website. Web Content Accessibility Guidelines (WCAG) 2.0 gives tools to aid developers in making a more accessible website. "The guidelines were developed through a systematic review of current research followed by an evaluation with web developers with varying degrees of accessibility experience (Linn & Siri, 2016)".

Improving web accessibility: a study of webmaster perceptions. If a website is accessible it's easier for people with disabilities to use it. An accessible website allows users to navigate a website without that much problems. "A survey was developed, with questions asking webmasters about their knowledge of web accessibility and their perceptions of when and why web sites should or should not be accessible. The goal of this survey was to be exploratory in nature (Lazar et al., 2004) ”.

Research-derived web design guidelines for older people. The Web Design Guidelines were created to give web developers a list of how to make website accessibility and usability easier for older users. "Gathering various published studies that proposed Web design guidelines

for older people (both industrial and academic papers) to remove the overlaps, to categorize them in a meaningful way (using the established clustering methods of card sorting and affinity diagram), and to verify the usefulness of those guidelines with the target user group addressed by the guidelines: older Web users (Kurniawan & Zaphiris, 2005)".

Web Site Usability, Design, and Performance Metrics. When determining the usability of a website a developer must test their website and see if fits the usability standards. The developer must have users to test their website and make sure that it has some form of validity, this is the only way to make sure a website is good to go. "To collect usability and design data and examine no mological validity through testing the theoretical relationships, we analyzed actual Web sites of large, publicly held firms (Palmer, 2002)".

The Elements of User Experience, Second Edition: User-Centered Design for the Web and Beyond. User experience is important to web design and development to get user input on how the website looks and to see if a website is too complicated to navigate through. Many sites neglect user experience which leads to users having trouble navigating through their websites. (Garrett, 2010) explained: "If your site consists mainly of what Web pros call content—that is, information—then one of the main goals of your site is to communicate that information as effectively as possible. It's not enough just to put it out there. It has to be presented in a way that helps people absorb it and understand it. Otherwise, the user might not ever find out that you offer the service or product they're looking for. And even if they do manage to find that information, they're likely to draw the conclusion that if your site is difficult to work with, your company probably is as well".

Teaching Java with the BlueJ Environment: BlueJ is a visual programming environment designed to teach object oriented programming, using Java as the implementation

language. BlueJ allows students to concentrate on solving programming problems without becoming distracted by the mechanics of compiling and executing Java programs. This paper reports on the first use of BlueJ to teach Java to an introductory programming class, in a computing degree in 1999. Several mechanisms were put in place to help students with any problems they encountered. Surveys and interviews were used to collect data on student backgrounds, perceptions and attitudes towards BlueJ. In spite of some problems encountered with installing and running the software, students who participated in the study generally found that BlueJ was helpful in learning Java (Hagan & Markham, 2001).

Guidelines for Teaching Object Orientation with Java: How to best teach object orientation to first year students is currently a topic of much debate. One of the tools suggested to aid in this task is BlueJ, an integrated development environment specifically designed for teaching. BlueJ supports a unique style of introduction of OO concepts. In this paper we discuss a set of problems with OO teaching, present some guidelines for better course design and show how BlueJ can be used to make significant improvements to introductory OO courses. We end by presenting a description of a possible project sequence using this teaching approach (Kölling & Rosenberg, 2001).

Using software testing to move students from trial-and-error to reflection-in-action: Introductory computer science students rely on a trial and error approach to fixing errors and debugging for too long. Moving to a reflection in action strategy can help students become more successful. Traditional programming assignments are usually assessed in a way that ignores the skills needed for reflection in action, but software testing promotes the hypothesis-forming and experimental validation that are central to this mode of learning. By changing the way assignments are assessed—where students are responsible for demonstrating correctness through

testing, and then assessed on how well they achieve this goal—it is possible to reinforce desired skills (Edwards, 2004).

Research Methods

Survey

I have interviewed a professor discussing IT 106 and asked what is the issue with IT 106 course? He stated that: “IT 106 is taught in one-size fits all environment and that students have a hard time focusing on how to implement the codes to work. There are so many students who are stressed and are failing due to an honor code violation.” I decided to do a survey on surveymonkey.com and I had surveyed 92 students and the questions were as followed: What is your age range? What is your gender? What is your race? Should IT 106 (Introduction to IT Problem Solving Using Computer Programming - Java Version) be an experimental learning course? Do you think you would gain more from an experimental learning or traditional course in IT 106? If so, state your reason. After doing this survey, I realize that the IT department at the Volgenau School of Engineering is lacking with their course IT 106 because it’s still a class that is Teacher-Based Learning instead of Project-Based Learning (See Appendix B to view the diagrams).

Infographic. I created an infographic on Project-Based Learning that has the following four components that are associated with PBL and they are 21st Century Skills, Student-Centered Learning, Inquiry-Based Learning, and Gamification (See Appendix C to view the diagrams) Based on the website www.aeseducation.com it discusses about 21st Century Skills which consist of the four C’s, the acronym FLIPS, and Literacy Skills (IMT)

- **Critical thinking:** Finding solutions to problems

- **Creativity:** Thinking outside the box. This skill empowers students to see concepts in a different light, which leads to innovation.
- **Collaboration:** Working with others
- **Communication:** Talking to others and is the glue that brings all of these educational qualities together.
- **Information literacy:** Understanding facts, figures, statistics, and data
- **Media literacy:** Understanding the methods and outlets in which information is published
- **Technology literacy:** Understanding the machines that make the Information Age possible
- **Flexibility:** Deviating from plans as needed
- **Leadership:** Motivating a team to accomplish a goal
- **Initiative:** Starting projects, strategies, and plans on one's own
- **Productivity:** Maintaining efficiency in an age of distractions
- **Social skills:** Meeting and networking with others for mutual benefit

With Student-Centered learning, there are the Four Key Principles and Learning Styles

- **Learning Is Personalized:** Teachers know students and have strong relationships with them
- **Learning Is Competency-Based:** Students move at their own pace in every subject
- **Learning Happens Anytime, Anywhere:** Student makes discoveries around them
- **Student Takes Ownership:** Students play direct roles in their own success

- **Visual (spatial):** You prefer using pictures, images, and spatial understanding.
- **Aural (auditory-musical):** You prefer using sound and music.
- **Verbal (linguistic):** You prefer using words, both in speech and writing.
- **Physical (kinesthetic):** You prefer using your body, hands and sense of touch.
- **Logical (mathematical):** You prefer using logic, reasoning and systems.
- **Social (interpersonal):** You prefer to learn in groups or with other people.
- **Solitary (intrapersonal):** You prefer to work alone and use self-study.

Based on the YouTube video of What is Inquiry-Based learning, the video talks about the two components of Inquired-Based Learning which are the Four Phases of Inquiry and the Four Levels of Inquiry:

Four Phases of Inquiry

- **Orientation:** Form of discussion
- **Conceptualization:** Generate questions and define a hypothesis
- **Investigation:** Explore, experiment, and interpret data
- **Conclusion:** Conclude the project

Four Levels of Inquiry

- **Confirmation Inquiry:** Teachers teaches the concept, creates the questions and models the process
- **Structured Inquiry:** Teachers create the initial sets of questions and students collect the data
- **Guided Inquiry:** Teachers provide the research and students own the research process

- **Open/True Inquiry:** Students formulate their questions and design their own experiments

Gamification also uses examples of the four C's (Critical Thinking, Communication, Collaboration, and Creativity). Games can get students excited by ideas and teaches them the fundamental concepts while teachers make the knowledge more meaningful with the games by giving students real-world experience to build off those concepts. According to thinkspace.csu.edu.au, it discusses the seven elements of digital literacies within gamification:

Seven Elements of Digital Literacies

- **Media Literacy:** Critically read and creatively produce academic and professional communications in a range of media
- **Information Literacy:** Find, interpret, evaluate, manage and share information
- **Digital Scholarship:** Participate in emerging academic, professional and research practices that depend on digital systems
- **Learning Skills:** Study and learn effectively in technology-rich environments, formal and informal
- **ICT Literacy:** Adopt, adapt and use digital devices, applications and services
- **Career & Identity Management:** Manage digital reputation and online identity
- **Communications and Collaboration:** Participate in digital networks for learning and research

Bruner's Discovery Learning Theory from www.edudemic.com is also associated with Gamification which are:

- increased motivation
- buoyed creativity
- enhanced problem-solving skills
- a greater sense of personal responsibility
- the joy of autonomy and independence

Analysis

I created a chart to compare and contrast with George Mason University IT 106: Introduction to IT Problem Solving Using Computer Programming (See Appendix D to view the chart). I researched the following universities: Rochester Institute of Technology (RIT), Massachusetts Institute of Technology (MIT), California Institute of Technology (Caltech), Radford University and Liberty University. RIT Java course is structured with two hours of lecture, two hours of lab, and one hour of recitation. The professor is the one who grades exams and homework, unlike George Mason University Java course. The Teaching Assistant (TA) is the one who grades all homework at GMU. During lectures at RIT, students work as teams where they design how they would build their codes during the first part of the lab. During the second part of the lab, students work individually of what they design together in the computer lab. In recitation, students have the opportunity to ask the TA any questions that are related to previous homework assignment this last for one hour. At MIT, students don't work in teams however there are many available books and resources students can take the time to view. Caltech was very difficult to find information on their syllabus but it appears that there are no groups working together on assigned assignments. Radford University Java course has many books and resources as well as videos to understand the material. The problem is that there are quizzes every week. Finally, Liberty University has books and study guide to help students with

the materials and there is a discussion board where students have to respond to at two other classmates. There are some codes listed in the textbook and some from the instructor. Quizzes and exams are open-book.

Conclusion and Reflection

Project-Based Learning is beneficial for IT students because they gain critical thinking, collaboration, communication, and creativity skills. Students would also gain from leadership and social skills within Project-Based Learning. It's more of a real-world experience and students can use Project-Based Learning skills in their career and that schools are moving towards Project-Based Learning. Developers really need to work in teams to learn how to use each other skills to create a project. If the IT department at the Volgenau School of Engineering can take time to develop Project-Based Learning course for students, students would be more successful in passing their classes as well as using leadership, collaboration, and creativity throughout their college career and job career.

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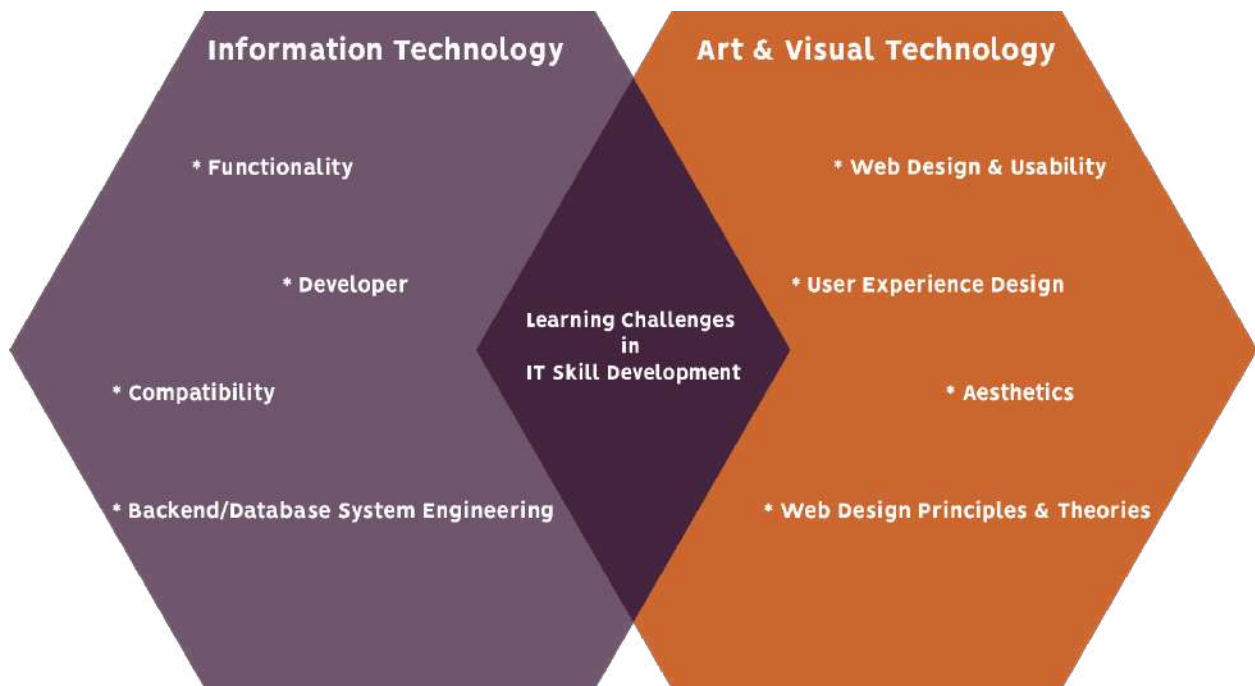
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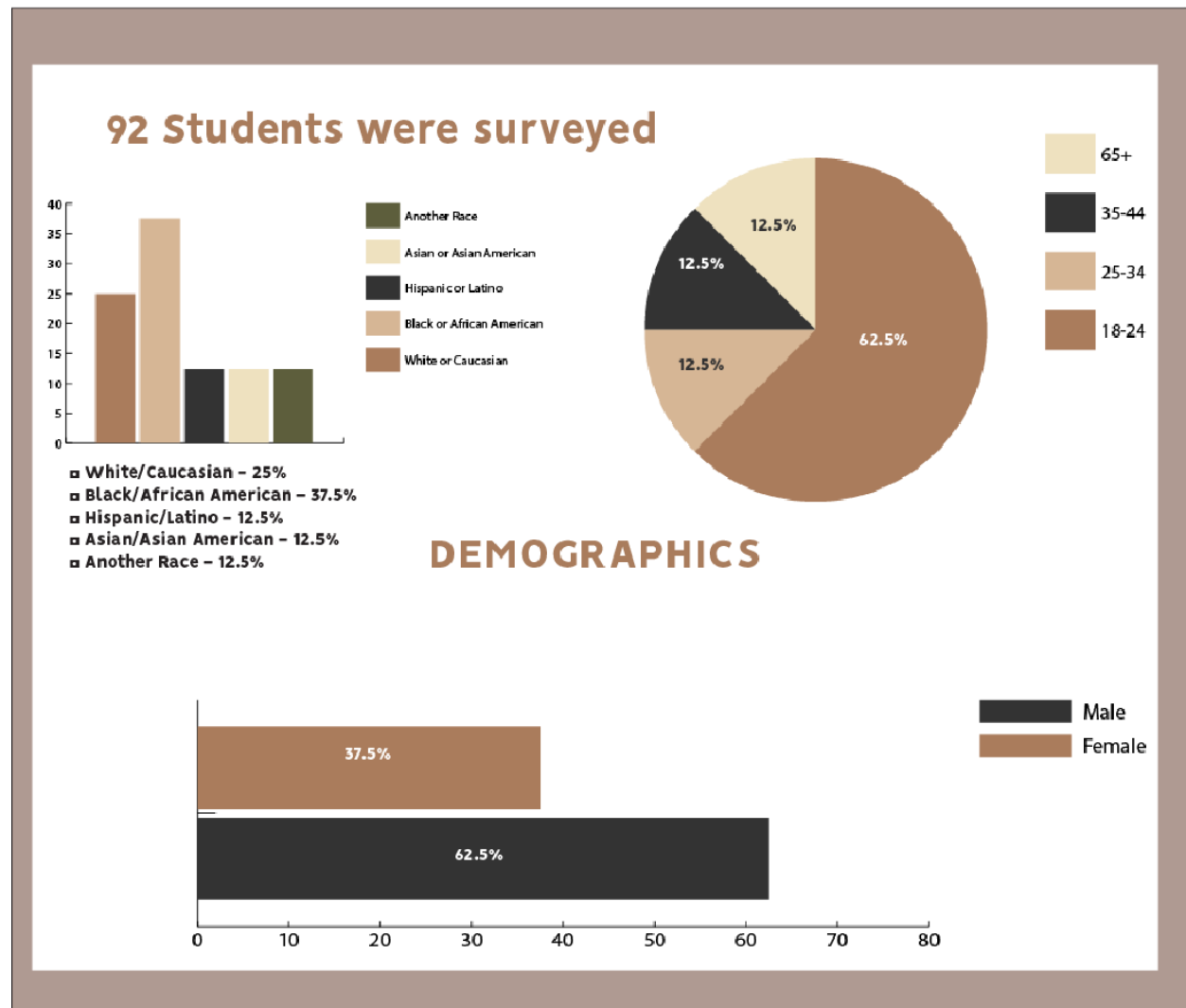
Appendix A

Interdisciplinary Rationale: Venn Diagram was created on Adobe Illustrator

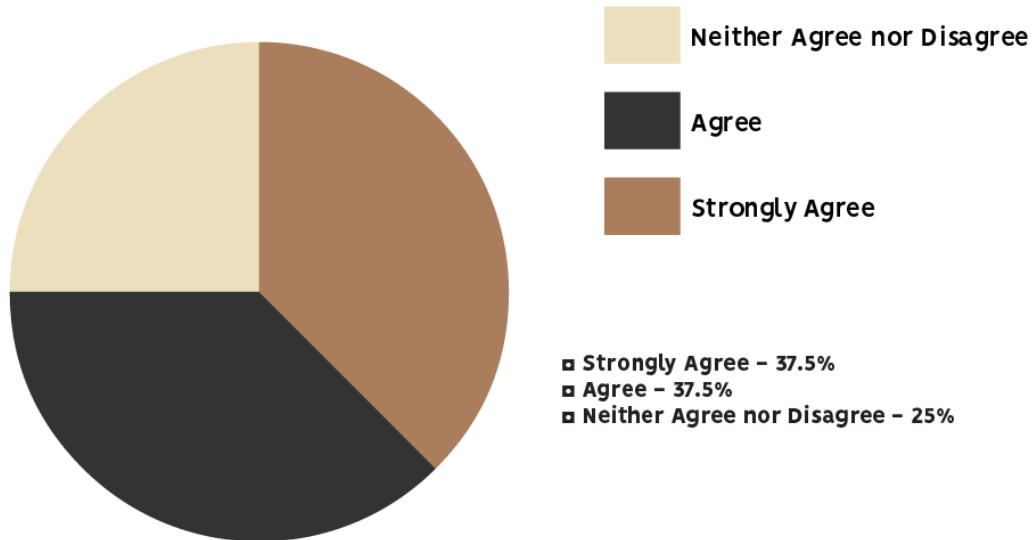


Appendix B

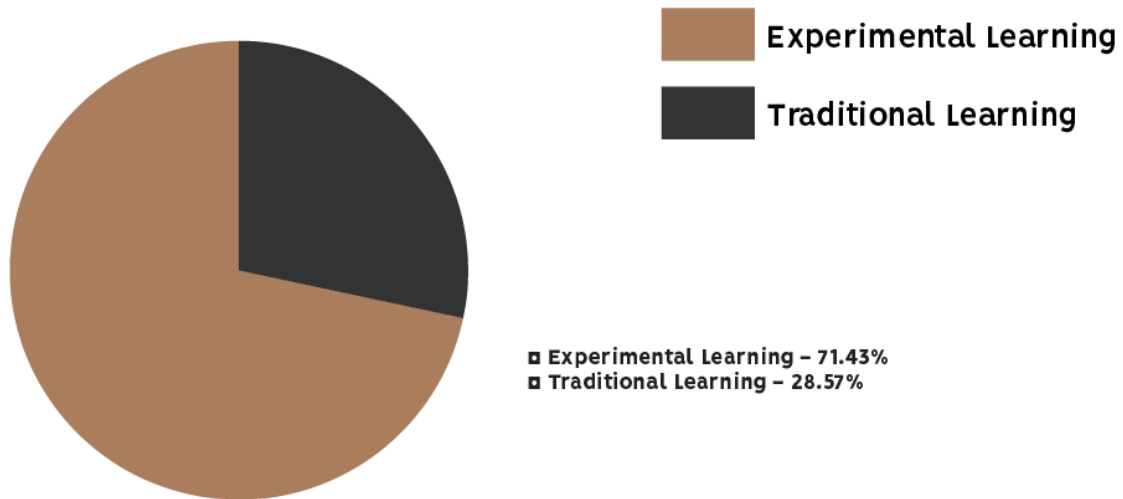
Research Methods: Demographics chart I created on Adobe Illustrator based on
surveymonkey.com



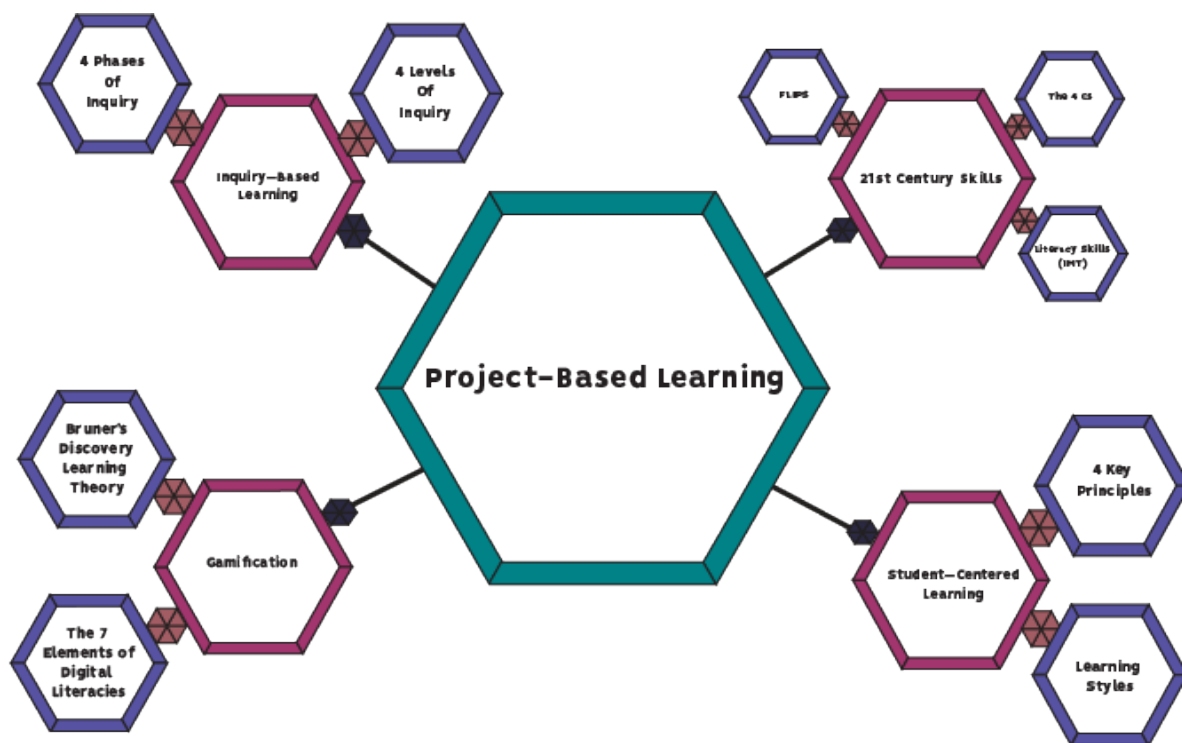
Should IT 106 (Introduction to IT Problem Solving Using Computer Programming – Java Version) be an experimental learning course?

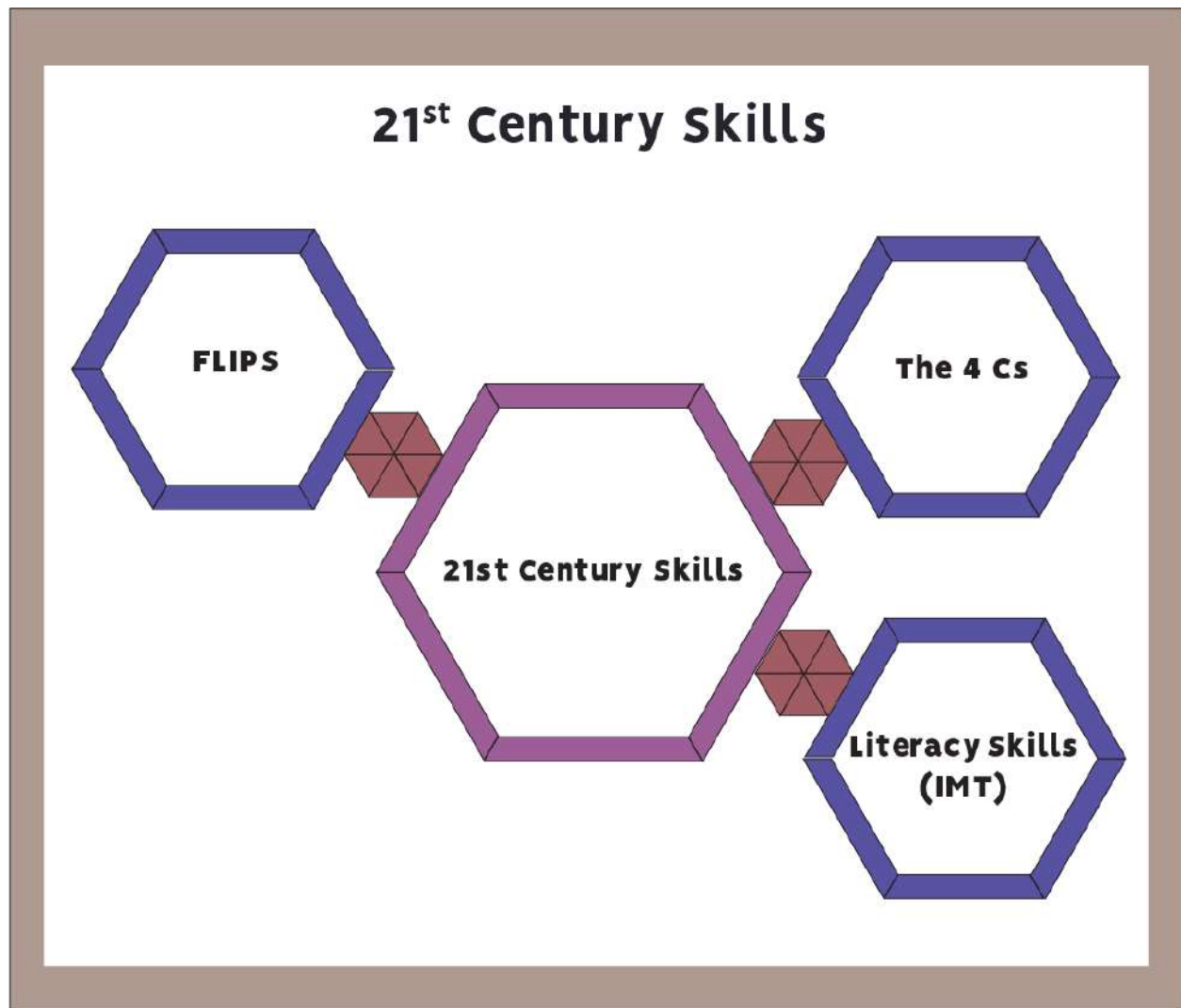


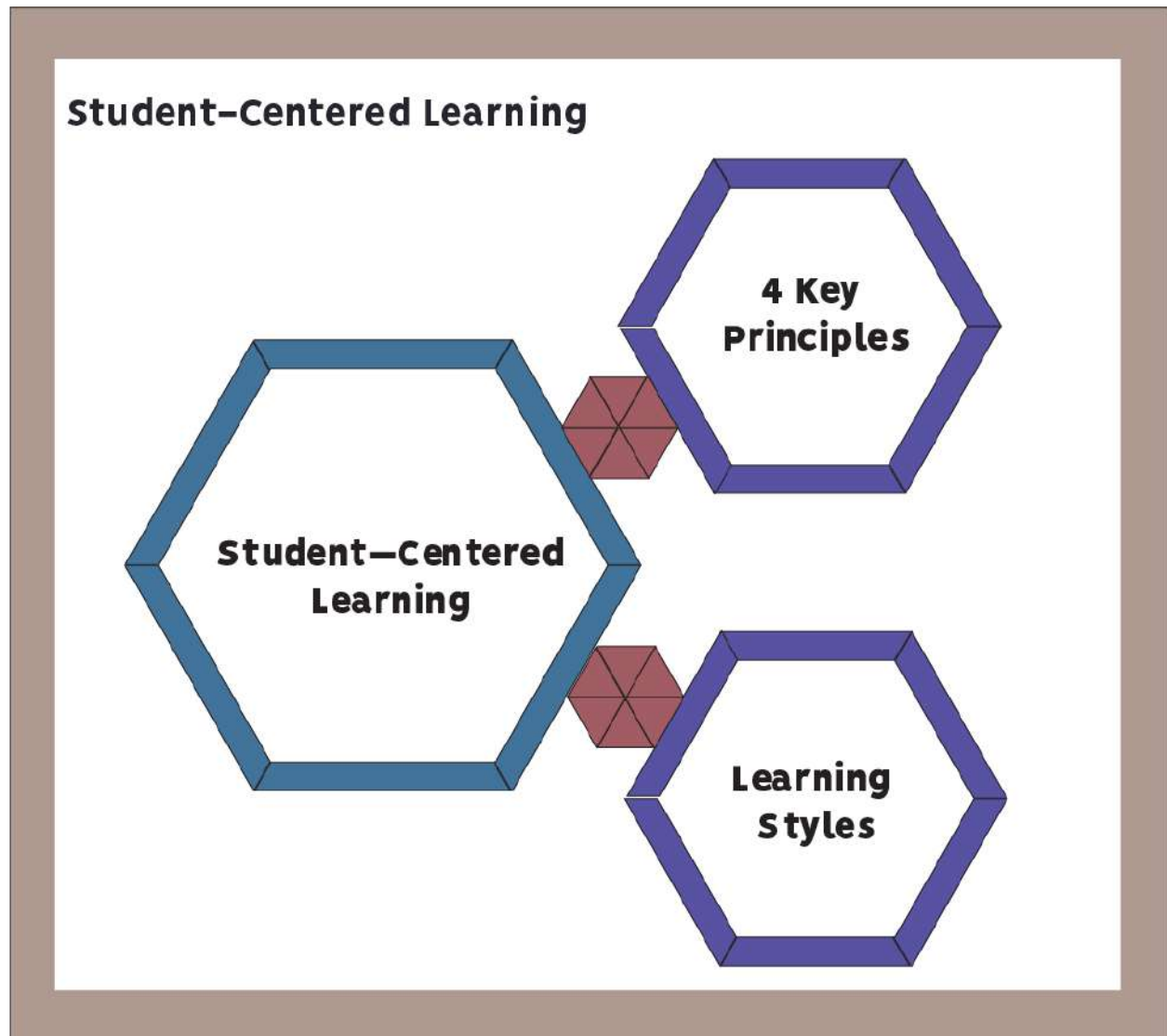
Do you think you would gain more from an experimental learning or traditional course in IT 106? If so, state your reason.

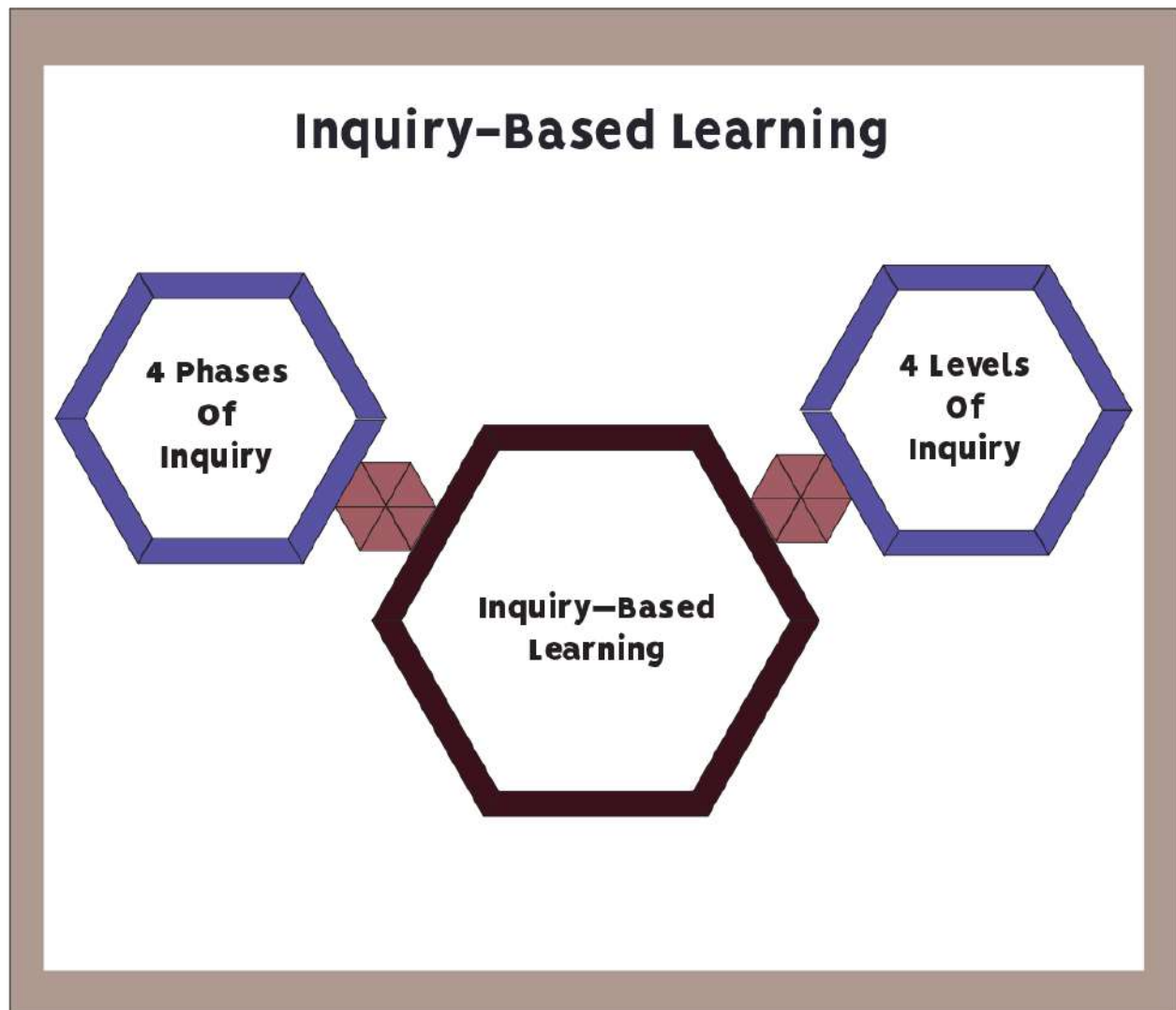


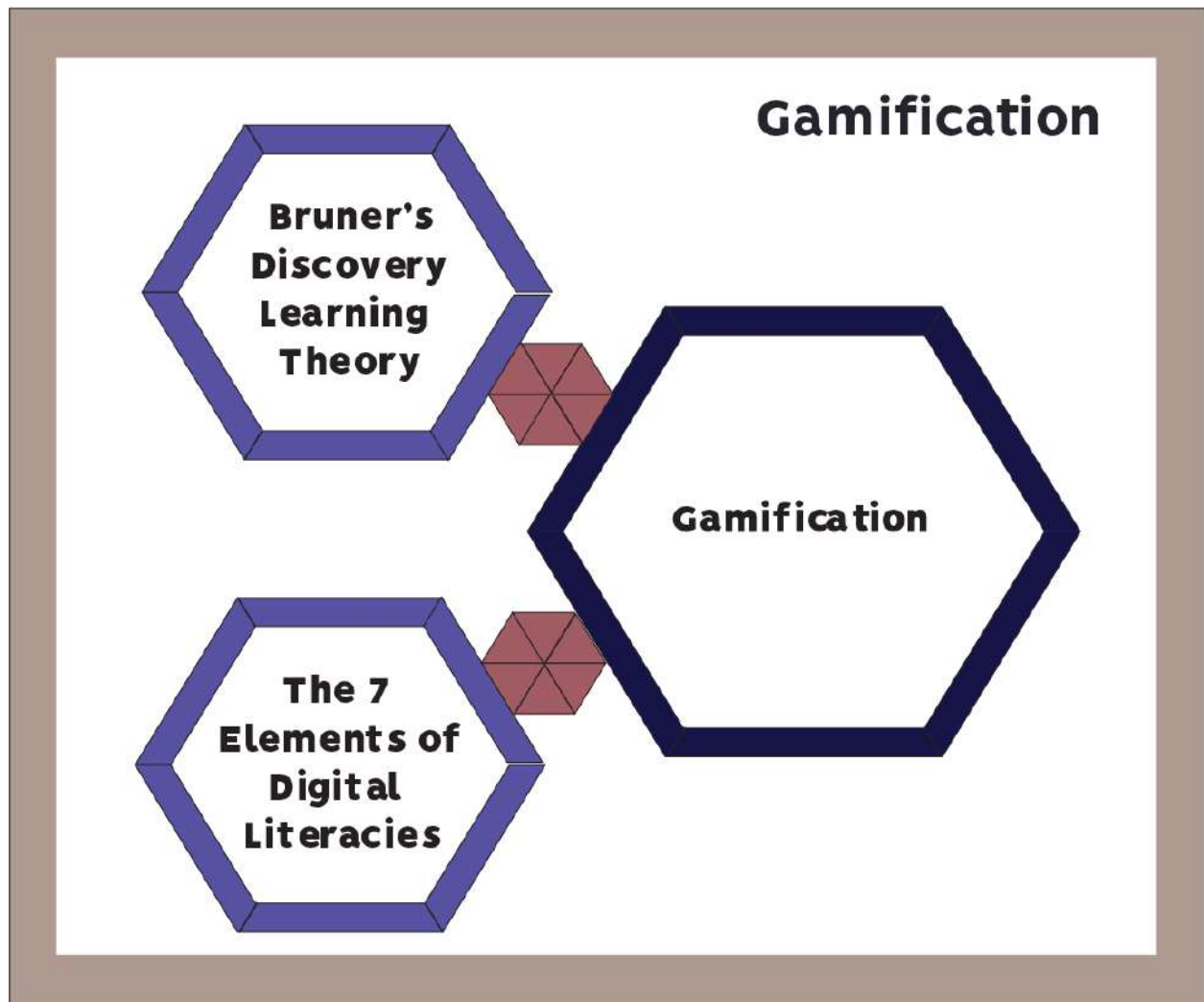
Infographic based on Project-Based Learning was designed on Adobe Illustrator

[illegible]














Appendix D

Analysis chart based on the comparison/contrast of George Mason University Java Course: Chart
was created in Adobe Illustrator

Universities	Teams	Labs	Goals
	Yes	Yes	To introduce students to Engineering Problem solving (EPS)
	No	Yes	To teach students the basics of Java Programming
	No	Yes	To show the fundamentals of Java Programming
	No	Yes	This course prepares students to program stand-alone applications
	No	No	Introduces students to software testing