

**Business Proposal**  
**of**  
**Game Development Certification Program and Talent Platform**

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# Table of Contents

<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
DESCRIPTION OF THE BUSINESS CONCEPT .....	3
NEED ANALYSIS AND BUSINESS OPPORTUNITIES.....	3
PRODUCTS AND TARGET MARKET .....	3
MARKET GROWTH STRATEGY .....	4
FINANCIAL FORECAST .....	4
<b>BUSINESS OF GAME EDUCATION.....</b>	<b>5</b>
DESCRIPTION OF THE BUSINESS CONCEPT .....	5
NEED ANALYSIS AND BUSINESS OPPORTUNITIES .....	5
NEW GAME EDUCATION CONCEPT .....	6
CERTIFICATION PROGRAM AND TALENT PLATFORM .....	6
INTERNATIONAL ORIENTATION .....	8
<b>MARKET RESEARCH .....</b>	<b>8</b>
POTENTIAL TARGET MARKET .....	8
INITIAL TARGET MARKET .....	9
LONG-TERM OPPORTUNITIES.....	9
CHINA AND JAMAICA MARKETS.....	9
COMPETITIVE ANALYSIS .....	10
<b>BUSINESS STRATEGY .....</b>	<b>10</b>
BUSINESS MODEL .....	10
MARKETING AND PROMOTIONS .....	11
EDUCATOR INCENTIVES.....	11
<b>OPERATIONS.....</b>	<b>12</b>
PRODUCTION COST .....	12
OPERATION COST .....	12
PROFIT POTENTIAL .....	12
FUNDING REQUIREMENTS.....	12
<b>OVERALL SCHEDULE.....</b>	<b>13</b>
PHASE I: THE CONSTRUCTION OF 4 TO 6 CERTIFICATE TESTS AND ONLINE COURSES .....	13
PHASE II: THE CONSTRUCTION OF TALENT DATABASE AND LEVEL 2 CERTIFICATES.....	13
PHASE III: ADVANCED COURSES AND MANAGEMENT COURSES TOWARD PROFESSIONAL LEVEL .....	13
<b>APPENDIX A: SAMPLE GAME PROGRAMMING COURSE.....</b>	<b>14</b>

# **EXECUTIVE SUMMARY**

## **DESCRIPTION OF THE BUSINESS CONCEPT**

Considering the scenario that dozens of students in each high school or college of the United States take *Game Development Certification Exam* annually, the company that manages such an exam would be undoubtedly successful and productive. Given the popularity of game development among young people, game education demonstrates great revenue potential for education providers as one of the fastest growing business. Game education refers to training courses and related assessments targeted on (1) K-12 students who take game development courses as a supplemental curriculum of STEM or CTE objectives, (2) college level students who take courses as professional opportunity or personal interests, and (3) adult learners who plan to advance profession or seek new career opportunities.

We operate game education as an integrated platform, instead of training courses or learning materials, to meet the needs of potential learners. First, our program is structured based on industry-recognized skills that cover all fields of game development with a collaborative effort of industry leaders, professionals, researchers, and educators. Second, the program provides a wide range of courses that follow industry-recognized skills and research-based instructional guideline. Third, course completers are evaluated based on industry-recognized skills and acknowledged by the gaming industry with certification. Finally, completers' skills are demonstrated on the talent database, and learners are provided with the employment opportunities and professional guidance through the platform. All levels of learners can take advantage of the program to meet their academic and professional needs.

## **NEED ANALYSIS AND BUSINESS OPPORTUNITIES**

Gaming industry experienced fast business growth in the past few years, leading to higher demand of qualified workforce. Industry leaders, government agencies, and educational system have recognized the needs of game education: industry leaders need adequate and talented workforce, career agencies need to sponsor employment opportunities in the fast-growing profession, and educational systems need to adopt proper curriculum and training programs. The key stakeholders of game education include developer associations, related government agencies, and educators who demand for effective and structured programs at all educational levels.

Two major educational providers of game education, career development agencies and K-16 educational system, show urgent needs of standardized and structured game development curriculum. While training programs of specific game engine may lead to skills of Indie game production, professional development agencies need structured game development curriculum to prepare learners to become qualified professionals of all levels, from Indie game developer to AAA game projects member, through a series of courses from foundation to advanced skills. K-16 educational system has strong needs for structured game education for two reasons: career development at college level and STEM and CTE orientation at K-12 level.

With the continuous growth of gaming industry, related training programs to cultivate game developers from beginning to advanced professionals becomes important to the industry, employment agencies, and educational system. Structured game education creates great business opportunity for education providers to meet the needs of this huge market. A platform to connect the needs of gaming

industry, employment agencies, educational system, and potential game developers will dominate the game education market and bring in great revenue.

## **PRODUCTS AND TARGET MARKET**

The *Game Development Certification Program and Talent Platform* is an integrated environment to achieve primary goals of game education: producing qualified game developers to meet industry and career needs. The platform includes three major functions: certification program based on industry-recognized standards, learning center of online courses of game development skills, and talent database. The certification program covers 3 levels of certification exams, constructed upon industry-recognized skills in all fields of game development. The learning center includes all online courses related to each certification exam, guided by research-based instructional design. The talent database is a network that learners' skills can be demonstrated and searched for employment opportunities and direct financial income. The platform provides potential game developers the venue to learn skills, demonstrate talents, be recognized by the industry, and find immediate employment.

The platform targets on three potential groups of people, K-12 students, college students, and adults. The primary markets are K-12 educational systems, college level training programs, and career development agencies. The international market includes two primary partnerships with China and Jamaica. At the initial stage of the product development, the market effort will focus on American K-16 system and Jamaican career development agency.

## **MARKET GROWTH STRATEGY**

Our marketing strategy emphasizes on the partnership with educational system and gaming industry. We build a network with the industry, educational system, and individual learners to collaboratively cultivate potential game developers to pursue a highly rewarded career pathway. Our promotion strategy varies based on the products. The certificate program will be demonstrated and promoted in educational conferences, gaming industry networks, and direct advocates to educational systems. The online course will be promoted in formats of free workshops and training programs. We will partner with school systems, department of education, department of labor, and college systems to provide free workshops to educators and career development professionals. The talent database will be introduced to employers and industry leaders through professional organization network such as IGDA websites and conferences. We will provide incentives to educators that every educator using our product will become our potential sales force.

## **FINANCIAL FORECAST**

We expect that the platform will be adopted by thousands of American high schools, colleges, and career development agencies. Given the market potential, we project that the online courses will bring in roughly \$50,000 from school site licenses (50 schools and \$1,000 per school) in the first year of operation and grow to \$1,000,000 (1,000 schools) annually within 5 years. The certification program is expected to bring in \$4000 (100 students and \$40 per student) in the first year, but grow to \$200,000 annually (5000 students) within 5 years. The number of test-takers and learners will grow when more courses and certificates are created on our platform. Revenue potential is unlimited considering the growing demand in game education.

## **BUSINESS OF GAME EDUCATION**

### **NEEDS OF INDUSTRY-RECOGNIZED GAME EDUCATION PROGRAMS**

Gaming industry is growing dramatically in the past few years, leading to higher earnings and increasing demand for qualified game developers. However, game production companies face potential challenge to recruit qualified and diversified workforce to meet business needs. The inadequate workforce in game development hinders the competitiveness of American gaming industry in global market. Game engines and software companies need to introduce their products to potential game developers who learn the application of the software and apply their skills for employment opportunities and financial income. However, potential game developers are disadvantaged on access to effective game education due to little understanding of the game development professional pathway. Industry leaders, government agencies, and educational system have recognized the needs of game education: industry leaders need adequate and talented workforce, career agencies need to sponsor employment opportunities in the fast-growing profession, and educational systems need to adopt proper curriculum and training programs. The key stakeholders to sponsor game education include developer associations, related government agencies, and educators who demand for effective and structured programs at all educational levels.

Two major educational providers of game development, career development agencies and K-16 educational system, show urgent needs of standardized and structured game development curriculum. Professional development agencies normally partner with gaming software companies to teach game development courses or workshops. However, these training programs are limited to the applications of specific software instead of structurally cultivating game development workforce. Program completers are not recognized for their professional skills by employers due to the limited skills and the lack of systematic training of the game development pathway. Game development covers a broad range of fields including game design, script writing, game programming, animation, music/sound production, graphic design, and related skills. Game developers may be categorized into various job titles based on responsibilities and skills. While training programs of specific game engine may lead to skills of Indie game production, professional development agencies need structured game development curriculum to prepare learners to become qualified professionals of all levels, from Indie game developer to AAA game projects member, through a series of courses from foundation to advanced skills.

K-16 educational system has strong needs for structured game education for two reasons: career development at college level, and STEM and CTE orientation at K-12 level. Although many colleges offer game development courses as supplemental subjects of computer science and programming, the results of those courses have the same weaknesses of professional development programs: the lack of systematic skills as a professional. Therefore, colleges need structured game education curriculum to teach game development subjects as employability skills. Meanwhile, K-12 education is eagerly looking for game development curriculum to meet its STEM and CTE goals. First, game development covers a broad range of skills that are related to K-12 Science, Technology, Engineering, and Math (STEM) objectives. From instructional perspective, students are motivated to learn STEM-subjects such as math, science, and computer science in game programming, animation, or graphic design projects. Educational system could recruit more students to the STEM fields in a motivational and entertaining manner at the

early stage of K-12 education. Second, K-12 career-and-technical education (CTE) has annual budget for developing students' career skills to meet industry needs, and game development is one of the fastest growing profession. K-12 CTE programs could increase students' professional and employability skills in game development curriculum. Therefore, two major funding sources of K-12 educational system, STEM and CTE, demonstrate strong political and academic needs of industry-recognized game education in K-12 curriculum.

### **NEW GAME EDUCATION CONCEPT**

An effective game education is supposed to meet the needs of all stakeholders: gaming industry, employment agency, educational institutions, and individual career development. Therefore, well-designed game education program must possess the following functionalities:

1. Game education program must be structured systematically based on industry-recognized skills. Since game development include a broad range of fields and related skills, it is necessary to identify different level of skills based on job responsibilities and professional needs. The skills should be structured from platforms-and-software independent game development foundation to advanced knowledge of specific environment.
2. Game education program must provide a wide range of courses based on general industry-recognized skills and employability skills. Beginning courses may introduce the broad concept and skills of game development as a career pathway. Intermediate level courses may introduce specific software for Indie game development. Advanced courses may lead to specific software environment for AAA game development and project management. Learners can choose a series of courses based on personal interests or professional needs.
3. Game education program must be able to evaluate the learning result based on industry-recognized skills. Learners' professional skills should be recognized after completing a course, and the talents should be acknowledged by the industry.
4. The talent of completer can be searched by and demonstrated to the industry leaders and employers for immediate employment opportunities, potential skill searching and job offering, freelancing opportunity, or partnership.

### **CERTIFICATION PROGRAM AND TALENT PLATFORM**

The *Game Development Certification Program and Talent Platform* is designed to achieve primary goals of game education: producing qualified game developers to meet industry and career needs. The platform includes three major functions: certification exams based on industry-recognized standards, learning center of online courses of game development skills, and talent database.

**Certification Exams.** International Game Developer Association (IGDA) Diversity Committee launched the game education initiatives to promote game education at K-16 level. The committee identified professional standards as a guideline to cultivate potential game developers to learn the basics of game development and advance to game development professionals. In a collaborative effort with Entertainment Arts Research Inc. (EARI), the standards are categorized into different levels and subjects, and the related skills can be tested via the online testing system. Test-takers with a passing score will

receive an industry-recognized certificate, demonstrating that the person meets the industry standards and masters the required skills. The following table demonstrates the three levels of certification tests.

Certification Tests Description		
Levels	Description	Certificate
1	The preliminary test of game development as a career pathway. All fundamentals of game development concepts will be examined in this test.	Test-takers with a passing score receive a Game Development Level 1 certificate as a ticket to take Level 2 tests
2	Level 2 tests are built upon different software environments to create Indie or mobile games. Test-takers will have an option to take one or multiple level 2 tests.	Test-takers with a passing score receive an Associate Game Developer certificate as a ticket to take Level 3 tests
3	Level 3 tests are built upon different 3D game engines, 3D modeling software, professional music/sound effects production, programming, animation, and other advanced skills in specific field of game development.	Test-takers with a passing score receive a Game Developer in (specific field) certificate.

**Online Learning Center.** The platform provides a wide range of courses to meet learners' professional needs. In contrary to traditional tutorials or online lessons, the courses on the platform demonstrate unique design: industry-recognized skills as the guideline, project-based learning application, authentic learning library, and just-in-time instruction. The courses match the skills in certificate tests so that learners are prepared to master industry-recognized skills and earn the certificate.

**Talent Database.** Completers of the certificate tests will receive three major benefits: (1) be recognized as Associate Game Developers or Game Developer in specific subject membership, sponsored by IGDA Diversity Committee, (2) publish the best works on the talent database which industry leaders and potential employers search and identify employment and outsource opportunities, and (3) receive professional guidance from IGDA members through the professional forums to advance to game development professionals. The platform is a marketplace to show members' talent, communicate for professional guidance and networking, search for employment opportunity, and seek for financial income.

## **INTERNATIONAL ORIENTATION**

The certificate and talent platform is internationally oriented for both English and non-English speakers. The tests are open to all level of learners in the world, and the skills are standardized based on industry-recognized skills. For example, the skills of test-takers in Asia can be recognized by American employers based on testing results. Although the original courses are English versions, the courses can be re-designed in other languages, such as Chinese, to meet the needs of learners in foreign countries. The talent platform will organize and unite potential game developers in different countries to demonstrate and share talents, compete for employment opportunities, and strive for the growth of gaming industry.

## **MARKET RESEARCH**

### **POTENTIAL TARGET MARKET**

The potential learners of game development include three major groups: adults for career advancement, college students for professional development, and K-12 students for academic or career interests. Therefore, the certificate program and talent platform may operate different functionality for learners' professional needs.

The first group is K-12 students who take game development courses and tests as supplemental curriculum for K-12 STEM subjects or career-and-technical education (CTE). The primary learners are high school students who take either computer science or related CTE classes. The courses and tests cover multiple game development subjects including game programming, graphic design, animation design, and music production, which can be integrated with existing computer science or related CTE curriculum to learn game development skills, career-related skills, or problem-solving skills. The certificate program and learning center are web-based, and the product can be applied in school environments or afterschool programs with computers and the Internet access. An industry-recognized certificate is part of K-12 CTE objectives, which have sufficient funding and can be demonstrated to school systems and policy makers. Therefore, K-12 CTE will be a critical user of our level 1 and 2 tests and related courses.

The second group is college students who take game development as a professional development opportunity or personal interests. College students have the capability to take online courses at their spare time for employment opportunities or immediate income from mobile market. Further, the level 2 and 3 courses and tests can be integrated with college level curriculum and used by faculties as instructional supplement. College faculties and students may utilize the platform for employment explorations.

The third group is adults who either want to advance to higher level of game development profession or seek game development as a new career. Adults may take training programs on level 2 or 3 courses and use the certificate and talent platform for employment opportunities. Training agencies and professional development institutions will likely utilize the platform to strengthen their professional development capabilities.

## **INITIAL TARGET MARKET**

The certificate program and talent platform cover a wide range of courses and related tests targeted for different level of learners. However, the initial market of the platform would focus on two groups of learners with immediate needs: K-12 programming and CTE students and K-16 learners of mobile game development. The two groups of learners share common characteristics in that they have little background on game development but show great interests in implementing Indie games on computer or mobile devices during their academic pursuit. Further, the funding to support these groups are available from department of education and department of labor, leading to quick return of the investment. A few courses and tests for these groups may effectively promote the brand of the platform to K-16 educational systems and get recognized by decision-makers of education.

## **LONG-TERM OPPORTUNITIES**

The certificate program and talent platform can be developed to become a central hub of game education, which will benefit all stakeholders of gaming industry. (1) When gaming software companies attempt to reach more users, they can develop their courses under the certificate guideline and publish the online courses on the platform. (2) Game developer associations cultivate potential game developers at the early stage of professional development through proper guideline and networking on the platform. (3) Government agencies sponsor employability skills in game development and create immediate employment opportunities. (4) Educational systems achieve CTE and STEM objectives and motivate students toward professional development and academic achievement. (5) Learners and educators utilize effective learning materials to develop industry-recognized skills and seek employment opportunities and financial income. Game developer associations, gaming software companies, government agencies, educational system, and professional development agencies are likely to partner with the platform and take advantage of the platform to expand influences and profits.

## **CHINA AND JAMAICA MARKETS**

The certificate program and talent platform has strong interests in international market. The operation focuses on two initial international markets: China and Jamaica. Collaborating with Chinese and Jamaican partners, EARI proposes to build specific structures on the platform to meet the needs of Chinese and Jamaican markets.

Our Chinese partners, including educational institutions and software development companies, plan to invest in the Chinese version of online courses to meet the requirements of certificate tests. Our partners will host training programs and facilitate certificate tests in China. Further, EARI will open a specific forum on the talent platform to connect gaming software companies with Chinese users and help these companies expand services and products in China market. Last, our partners will manage Chinese members on their talents and specialties, and sponsor members to communicate with potential employers in US. Our talent platform will connect the communities of two countries and build an effective channel to integrate talents of two markets.

Our Jamaican initiative focuses on immediate employment opportunities and quick financial returns. Taking advantage of little language and cultural barrier between US and Jamaica, EARI proposes to utilize our level 2 courses and certificate program to quickly train young adult from beginner to middle level of game developers. We will prioritize our courses on three fields: mobile game development, animation development, and graphic design. After completing the courses and passing the tests, learners

will be able to immediately demonstrate their talents on our platform for employment opportunities, create simple graphics, animations, and game mechanics as entry-level game developers, and/or publish Indie games for Android and Apple mobile platforms. In short, our Jamaica initiative targets on immediate employment and visible income.

### **COMPETITIVE ANALYSIS**

Non-profit institutions have created great software environments under the sponsorship of federal government and non-profit foundations, e.g., Alice by Carnegie Mellon, Scratch and App Inventor by MIT, and Greenfoot. These educational tools come with various curriculum and instructional materials, aiming at STEM-related subjects from elementary to secondary education. These free software environments have been promoted by educational institutions nationwide and adopted by educators at workshops and conferences funded by federal grants. However, these software environments are rather educational tools for computer science and math subjects than game design. Therefore, these educational institutions are not competitors in game design curriculum market.

Commercial companies have attempted to offer game design curriculum to secondary schools, e.g., Stemfuse created a series of curriculum for game design and GameSalad offered instructional materials for teachers. Free software such as GameMaker, GameSalad, and Unity has been introduced to educators in various educational and commercial events, and teaching materials have been distributed for free trial. However, the attempts have not triggered massive adoption of their game design curriculum by school systems, demonstrating that approaching to educators and students is not the right strategy to promote game design. Business model of providing curriculum and teaching materials to educators and students does not meet the needs of educational systems.

Microsoft Academy utilized its power to partner with department of education in various states. The academy offers dozens of online courses including game design, and a completer receives a certification from Microsoft. This strategy demonstrates great success because department of education pushes the online academy to local school systems and promotes the courses in mandated professional development events. However, the Microsoft Xna curriculum does not stand out from dozens of technology courses or provide updated technology on game design. Thus, Microsoft Academy's game design curriculum has the advantage of the overall platform, but the technology does not represent the reality of game design industry. Our certificate program integrates career development components, educational components, and employment opportunities that meet the needs of all learners. Unlike Microsoft Office certificate or Adobe certificate, our platform will partner with gaming companies and host certificates of all fields of game development at different levels and become the central hub of game education.

## **BUSINESS STRATEGY**

### **BUSINESS MODEL**

EARI's certificate program and talent platform is built upon core strength of the business: (1) industry-recognized skills developed with a collaboration of industry leaders, educators, and researchers, (2) researched-based instructional design as a guideline for online courses, (3) effective network of game industry, government agency and educational systems, and (4) international orientation and collaboration.

One major characteristics of the platform is collaboration and partnership. While EARI builds the fundamental structure of the platform and guideline of tests and courses, we collaboratively create testing content and online lessons with gaming software companies. Our international partners will build their versions of online courses by following our guideline. The platform will become a collaborative hub to host all game development courses, under EARI's supervision and guideline. Therefore, the testing and courses can be infinitely developed based on industry and educational needs.

Our revenue model is flexible with our partners. We provide certificate tests to individuals or educational institutions at a fixed cost to sponsor the major operations of certificate program, membership, and marketing expenses. Training courses will be paid by users at a negotiated price (individual or site), and the revenue will be shared by EARI and partners based on the investment of the course. The talent platform will be free to individual members, and will be open to industry at a reasonable fee to cover the cost of operations.

## **MARKETING AND PROMOTIONS**

Our marketing strategy emphasizes on the partnership with educational system and gaming industry. We build a network with the industry, educational system, and individual learners to collaboratively cultivate potential game developers to pursue a highly rewarded career pathway. (1) The major market of the certificate program focuses on K-16 educational system to meet their CTE and employability needs. Therefore, our marketing approach will target on policy makers and administrators to demonstrate measurable and visible outcome of game education via the certificate program. (2) The online courses target on educators and professional development faculties to provide best instructional design and technology for easy access and structured course management. One of the advantages of our instructional design is the just-in-time instructions and worked-example approach that learners master the learning process with great flexibility. (3) The talent platform connects employers and learners for employment opportunities and direct income. The marketing effort of the platform focuses on building long-term relationship and sponsorship through membership, forum and small interests group, and career guidance.

Our promotion strategy varies based on the products. The certificate program will be demonstrated and promoted in educational conferences, gaming industry networks, and direct advocates to educational systems. The online courses will be promoted in formats of free workshops and training programs. We will partner with school systems, department of education, department of labor, and college systems to provide free workshops to educators and career development professionals. The talent database will be introduced to employers and industry leaders through professional organization network such as IGDA websites and conferences. We will demonstrate of the advantages of talent database to industry leaders that potential employees and freelancers can be identified at minimum costs to the industry.

## **EDUCATOR INCENTIVES**

At the beginning phase of the certificate program, we will give incentives to educators who can bring our platform to their school systems. We will reward educators that adopt our platform and utilize the platform in classrooms with gift cards. If an educator can refer us to other schools or school systems, we will reward the educator with a reference gift card. We consider all educators that use our platform potential sales force of our products.

## **OPERATIONS**

### **PRODUCTION COST**

The cost to construct the entire platform will depend on the scale of the project. We project that the initial certificate program of 4 to 6 tests will meet the immediate needs of the K-12 market and professional needs of American and Jamaican markets. The creation and construction of these online tests will cost \$100,000 and the production of related courses will cost \$600,000. However, the potential partners will compete for the opportunities and contribute at least half of the costs to promote their software environment on our platform. The construction of talent database will cost \$100,000 at the initial stage. We will search sponsorship from game developer associations and partnership with gaming companies to build the infrastructure of the platform. The expansion plan of the talent database will be determined based on the size of membership and industry needs.

### **OPERATION COST**

We project that the operation of the platform will cost \$500,000 for the first year, and the operation cost will grow with the increases of our services in testing, online courses, and capacity of the talent database. Major operation costs include the maintenances of computer server/network, test bank, website, sales and marketing employees, and administrative staff. After the first year of operation, the revenue of the platform will cover the costs and begin to make net profit.

### **PROFIT POTENTIAL**

We expect that the platform will be adopted by thousands of American high schools, colleges, and career development agencies. Given the market potential, we project that the online courses will bring in roughly \$50,000 from school site licenses (50 schools and \$1,000 per school) in the first year of operation and grow to \$1,000,000 (1,000 schools) annually within 5 years. The certification program is expected to bring in \$4000 (100 students and \$40 per student) in the first year, but grow to \$200,000 annually (5000 students) within 5 years. Our licenses to career centers and community outreach programs are expected to generate \$100,000 annually. The number of test-takers and learners will grow when more courses and certificates are created on our platform.

### **FUNDING REQUIREMENTS**

Our initial funding to build the certificate program, online courses, and talent database will come from government agencies, private investors, potential partners, and EARI's funding. The platform will see a financial return after the first year of operation. Thus, the company will make net income after we officially launch the program for the first year. We will expand the certificate program and online courses with our partners who intend to invest in our company and launch their courses on our platform.

## **OVERALL SCHEDULE**

### **PHASE I: THE CONSTRUCTION OF 4 TO 6 CERTIFICATE PROGRAM AND ONLINE COURSES**

The phase I of the platform will target on two immediate needs: K-12 game programming and K-12 mobile game development. The certificate program will include level 1 certificate of (1) game development, level 2 certificates of Associate Game Developer in (2) mobile game development, (3) graphic design, (4) animation design, (5) game programming, and (6) 3D modeling. The primary goal of Phase I certificate program is entry level employment opportunities and direct income from mobile markets. The projected implementation period of Phase I is 12 month. The primary markets will cover American K-12 system, K-16 professional development, and Jamaica.

### **PHASE II: THE CONSTRUCTION OF TALENT DATABASE AND LEVEL 2 CERTIFICATES**

After the implementation of Phase I, we will start to construct the talent database that learners load their completed works to demonstrate. Meanwhile, we will partner with gaming software companies to create beginning level courses on specific software environment. We will provide general guideline to course production and collaboratively create Level 2 certificate tests based on industry-recognized standards. The goal of Phase II certificate program is entry level employment opportunities with different focuses. The course works will include all fields of game development with specific software environment. The Associate Game Developer membership will be launched with the talent database and professional forums. The projected implementation period of Phase II is 24 month, but the continuous expansion of Level 2 courses and tests are ongoing. The primary markets will cover American K-16 system and Chinese and Jamaican markets.

### **PHASE III: ADVANCED COURSES AND MANAGEMENT COURSES TOWARD PROFESSIONAL LEVEL**

The implementation of Phase III courses and tests depends on the implementation of level 2 courses and industry needs. Courses will focus on high level of knowledge and skills on specific software environment as well as management skills. Completers of the level 3 courses and tests will demonstrate professional skills of project management of AAA games as mid-level leaders/managers. Therefore, the implementation of Phase III certificates will need partnership with gaming companies and industry leaders. The talent database will be expanded to meet the needs of employers and the advanced professionals as a platform to recruit project managers and lead developers.

## APPENDIX A: SAMPLE GAME PROGRAMMING COURSE

**The first component** of the learning system includes the design of 18 projects in 6 sequential units, and each unit will cover a set of K-12 game programming skills aligned with Computer Science Teacher Association (CSTA)'s computer science standards, Career, Technical, and Agricultural Education (CTAE)'s career skills, or Common Core math standards. A group of researchers and educators from IGDA and CSTA will collaboratively identify the skills and design a sequence of projects to cover all standards. In each unit, three projects will be developed to cover each of the three game programming languages, including Stencyl for visual scripting, JavaScript in Unity, and C# in Unity. Students will be able to explore the same programming skills in different game engines so that computer science and programming skills can be transformed to different programming environments. The educational design team chooses Stencyl and Unity as the supporting game engines because of their real-world applications and authentic multi-platform publishing potentials.

**The second component** includes instructional materials, just-in-time video lectures, graphic library, and sample works for each project. Teachers may utilize the sample work to introduce the game mechanics, the game development document template to facilitate creative design, and the project milestones to manage the implementation process of individualized game projects. Based on the software environment, video lectures are categorized into just-in-time primary modules to build the game mechanics and optional modules to enhance game effects. The modularized approach is grounded on Repenning's (2012) research on project-first just-in-time principle of game programming that students learn and use specific programming procedures based on design needs. The graphic library provides students resources to design and develop individualized game themes and aesthetics.

**The third component** includes evaluation tools to assess each project. When students complete a project, they must take an online multiple-choice assessment before uploading the completed game to the system. The multiple choice assessment will evaluate students' understanding of the learning objectives in the unit, and the result will be sent to the teachers' account. The completed game will be uploaded to the teachers' account, and teachers may grade the game based on provided rubric. If a student finishes all 18 projects with passing grades, teachers may assign the student to take the final online assessment. Students who pass the final assessment will receive an Associate Game Programmer certificate from EARI. The certificate is industry-recognized and endorsed by IDGA Diversity Committee and Educational Research Team.

***Major functions from teachers' view.*** After a teacher creates a class in the online learning and evaluation system, a classroom management page will be displayed. The classroom management page includes a unique identification name of the class, a project information page, and a student management page. Teachers can provide the unique class name to students for class registration. The project information page includes 6 units of 18 projects in a 3 by 6 table. If a project is clicked, users will be directed to the individual project page, which includes related standards, game development document template, recommended major milestones of the project, video lecture of primary and optional modules, graphic library, the multiple-choice assessment and answer keys, and the project evaluation rubric. Teachers may utilize the instructional

materials to introduce the project, guide individualized design, and facilitate project implementation. The student management page lists all registered students of the class. When a student name is clicked, the student name and the assessment information of each project will be loaded onto the page. Teacher may check the scores of multiple-choice test, grade the uploaded game based on provided rubric, and mark the student for project completion. If a student passes all 18 projects, the teacher may register the student to take the final online exam for certification.

***Major functions from students' view.*** Students register to a class by filling out the provided class name and student information. After logging in, students will enter the project page, showing all 6 units of 18 projects in a 3 by 6 table. If a project is clicked, users will be directed to the individual project page, which includes related standards, game development document template, recommended major milestones of the project, video lecture of primary and optional modules, graphic library, the multiple-choice assessments, and the project evaluation rubric. Students may utilize instructional materials to understand the project requirements and design individual games. Students may use the just-in-time video lectures and graphic library to build the game mechanics and create aesthetic effects as needed. After completing the project, students take the multiple-choice assessment, attached the completed game, and submit the assessment and game to the teacher. After the teacher marks the student for project completion, the student can see the two grades of the project.

***Learning Outcome.*** Students are expected to learn game programming skills and improve related academic and professional skills after using this online learning and evaluation system. From authentic and project-based learning approach, students are motivated to learn game programming, computer science, math, or professional skills in one game project. Students' academic performances will be evaluated in multiple-choice format and performance-based assessment. Finally, students who pass the final exam will receive an industry-recognized Associate Game Programmer certificate.