Contents

Science, Technology, Engineering, and Mathematics Distance Learning Course for High School Students

Executive Summary

Organizational needs

The Trident College Upward Bound Math and Science Center (UBMSC) is a federally funded program dedicated to improving college access and completion rates for low-income, potential first-generation college students. It falls under the TRIO umbrella of programs primarily established at higher education institutions to serve underrepresented students from middle school through graduate school. UBMSC is a comprehensive experience for high school students interested in and showing proficiency in science, technology, and mathematics (STEM) careers. Students must be a potential first-generation college student (neither parent has a baccalaureate degree) and/or meet federal income guidelines, attend one of three target schools, and be enrolled in a college prep curriculum with the intention of obtaining a math or science degree.

UBMSC consists of an academic program in which students attend Discovery Saturdays with workshops and enrichment activities that help students plan for college and career, six-week Discover Summer Component in which students receive instruction in math, science, English, foreign language, and electives, and a BRIDGE component in which recent high school graduates attend to receive college credit that can be transferred to other institutions.

The organization offers instruction during the summer and would like to offer a digital literacy course that can be offered to students remotely. This experience will prepare students for distance education, online collaboration, improving study skills, completing technology projects, and success in math and science high school and college courses.

Problem to be solved

Students entering college are often not prepared for the challenges of distance education because they have not been exposed to them, have not been successful completing them, or are not prepared for the rigor of a college level distance learning course. Additionally, the UBMSC does not have an instructor who teaches technology applications such as web design, graphic design, or programing apps. The math and students have interest in such projects and also can benefit from them in college and career preparation and building confidence for future challenges in math and science courses.

The director would like to offer a course that teaches students technology skills as well as prepare them for college level classes. The students are rising juniors and seniors in Charleston, South Carolina. The emphasis of the course is how to prepare students for distance education, collaboration, programming and design, and be encouraging and fun to keep students motivated and interested in completing difficult courses.

Rationale for a Distance Education approach.

One of the goals of this course is to acclimatize students to distance learning at the college level and to have students communicate to people it other parts of the world to learn about collaboration that is done virtually. A distance education approach is needed for students to gain the experience of an actual online college course and also improve computer literacy to complete academic and professional tasks while still in high school.

Primary learning objectives for the course or lesson(s)

After the implementation of this distance education course, the students will successfully be able to:

- Use a college learning management system in order to take an actual course through distance education.

- Complete an individual and collaborative technology project that has practical applications for the user and that will prepare students for future math and science courses.

- Develop the necessary study, communication, technical, and academic skills to successfully complete distance learning courses.

- Gain exposure to design, programming, and other computer applications.

- Learn about different careers in technology, math, and science and the necessary education and other requirements they will need to fulfill in order to follow their chosen career path.

Audience description, their needs, Distance Education Impacts

The audience is composed of 15-20 rising eleventh and twelfth graders who are low-income or potential first-generation college students who are interested in STEM careers and are taking the steps to pursue STEM majors in college. The students live in Charleston, South Carolina and are part of the Trident College Upward Bound Math and Science Center. Students attend urban schools in South Carolina.

They will have access to the computer lab and will take the course for 60 minutes Monday through Thursday for six weeks, for a total of 24 hours of in class time and possibly some out of class time with mobile devices or computers at home. There will be synchronous discussions and communications as well as asynchronous components where the students will follow modules to complete class requirements.

Most of the students who participate in UBMSC qualify for free or reduced lunch, which is often used as a qualifier for living in a household of low socio-economic status (SES).   Most recently, because of federal policies and funding as well as lower technology costs, high speed

internet has become available at most schools nationwide and there are higher computer to

student ratios than ever before for all economic groups (National Center for Education Statistics,

2014). However, although the technical infrastructure for schools with a high population of low

SES students has been gaining on schools with large numbers of high SES students, teacher

technology training and utilization as well as the types of software and the related assignments

are often quite different among SES groups (Hohlfeld, Ritzhaupt, Barron, & Kemker, 2008).

Although low-income students might have numerous opportunities at school to use

computers, they do not always have that luxury at home and their parents are unlikely to offer

the same expertise at navigating the Internet that other parents of high SES are able to offer. As

can be expected, there is a differential in computer literacy among SES groups (Rizhaupt, Liu,

Dawson, & Barron, 2013). Many high school students must take online (virtual) classes as a

requirement to graduate. However, the rates of enrollment and completion in distance education

vary by gender, race, and SES, favoring white, high SES, females (National Center for

Education Statistics, 2014).

A distance learning course will not only prepare students for a college environment, it

will also instill confidence, motivation, and expertise in completing computer projects of all

types now and throughout life. This course will go beyond just teaching digital literacy; it will

permit career exploration and experimentation so that students further their interest in STEM

professions.

Positive impacts

Students should gain access to technology, complete individual and group projects and be

prepared to successfully complete online courses, particularly in math and science. Students

should learn more about majoring in math and science and how to succeed in courses.

Negative impacts

Students may have trouble with technology infrastructure. Students may have difficulty with course rigor and programming requirements. There may be technical difficulties which will slow dissemination of information and communication. The structure of the course may be too loose. Students may lose interest in computer courses and math and science.

How would it be implemented?

Students will use the Canvas learning management system to complete the course. They will have individual logins and will have access to the library resources. They will be together in a lab where they can collaborate but will also be learning from an instructor in Tampa, FL and communicating with Tampa students in the USF Upward Bound Program.

What would it cost?

The cost will be the labor of the instructor and technology equipment that is not already present in the computer lab. The instructor and facilitator will be compensated. The USF Canvas Learning Management System and other campus provided software and tools will be used for instruction and course delivery without additional costs. Students will also be able to access the application gateway to complete aspects of their project that require commercially available software. The costs would be the headsets with microphone ($15 x 15), web cameras ($30 x 8), instructor labor ($450), and facilitator labor (likely already covered by grant because they are UBMSC staff) for a total of about $1000 to be absorbed by the UBMSC program.

How would it be supported (and by who)?

The instructor will hold office hours or hold sessions via Study Buddy (a free live collaboration online service), other, online collaboration services or Blackboard Collaborate during the hour long course to be available for support and instruction.

What types of media would it use and why?

Audio, video, screencasting, text, presentation software, graphics, wikis, interactivity software and other media will be used to offer students a college like course and to help students complete a technology project such as an app, a website, and audio cast, Flash video, or other projects that will help develop STEM proficiency. The students can use the USF application Gateway to use much of the software or will use freely available coding tools or open source software.

What instructional strategies would it use and why?

Teaching Strategies:

- Media Presentation, such as video, audio, and PowerPoint presentations synchronous and asynchronous developed by other online and by instructor
- Surveys
- Conferencing
- Detailed instructions to follow to complete specific procedures
- Written objectives/follow-up review

Learning strategies:

- Written assignments
- Reflective Journal
- Technology application assignments using software
- Peer Review

How would you measure your success?

Objective	Outcome
Complete pre/post-test and weekly quizzes	Students will be versed in terminology/concepts
Gain survey knowledge of technology types	Complete application of each technology
Complete individual application project	Students will gain confidence and expertise
Collaborate/coordinate for group track project	Gain communication and cooperation skills
Present group project/complete peer review	Develop confidence, critical thinking, and plan
Gain knowledge and expectations for STEM	STEM awareness, motivation, and commitment
Reflect on experience and career possibilities	Apply self-analysis and coping skills

How problems will be overcome

The project will be implemented next year, so the specifics of the program can be adjusted later and do not necessarily need to be completely in line with all the desires of the director but just be sufficient to offer a comprehensive course description and design that will satisfy the class requirements. We will talk to the director if there is a conflict or question. The project will begin on a small scale, and expand over time. We will make sure that everyone has a specific role to play to move the project along, and we will have timelines and benchmarks along the way.

Problems students face will be overcome by offering a 2-week, midterm and semester survey to get their feedback and make adjustments. During the course, there will be regular and reliable technical support from the instructor, facilitator, and USF Information Technology Department. Concerns will be addressed within 24 hours and will be followed up on until resolved.

Content Outline

Weekly Timeline

Week One: Introduce Distance Education, learning/study/college survival skills

Weeks Two and Three: Introduce Applications: Web Design (Weebly), Apps (App Builder other drag and drop interface), Interactivity (Hot Potatoes or other interactive game builders), Podcasting/Audio and Video editing (Audacity, Moviemaker). The introduction has to be brief but also offer a real world examples students can complete quickly and easily.

Week Four: Introduce career track and survey, group by track, assign roles, students decide format for presenting material (delivery method)

Week Five: Individual projects completed by viewing instructor-led material or internet

resources

Week Six: Finish individual and incorporate it into cohesive whole and present.

Canvas, Distance Learning Content

- What is Canvas/Learning Management System?
- Netid Activation and Login to Canvas
- Canvas Navigation
- Canvas Assignments, Discussions, Quizzes, Grades
- Distance Learning Overview, Types, Tips, Warnings

College Survival STEM Prep

- High school versus college
- Active versus passive learning
- Time management
- Rigor of STEM Courses
- Prerequisites

Web Design

- Website components
- Website Structure (CSS)
- Website Graphics
- Weebly – interface
- Weebly – Create, Edit Pages
- Weebly - selecting, changing themes
- Weebly – Editing headers and footers, choosing layouts for each page
- Weebly – Adding content
- Weebly – Settings, Analytics
- Example Site Building

App Building

- Definition
- Types

- Operating systems

- Intro to programming

- App Builder – Interface

- App Builder – Components, Adding

- App Builder – Editing components

- App Builder Example

- Further Exploration

Interactivity

- Google Forms

- Games such as hotpotatoes.com

- Interactions and simulations types and examples

- Narration, avatars - Voki

- Planning (storyboarding, etc., Implementation, Revision

- Example

- Further Exploration

Audio/Video Editing

- Terminology

- Freeware software options

- Audacity interface

- Audacity projects Wee

- Video editing freeware interface

- Video editing process

- Example

- Further exploration

Career Track

- Core Track Description: Materials Engineering, Computer/Electrical Engineering, Medicine, Math and Sciences, Vocational/Occupational Technology

- Subtracks (occupations)

- Inventory (survey)

- Presentations include

- Job responsibilities

- Academic prerequisites

- Major requirements

- Interview or Day in the Life

- Job Outlook

- Estimated cost of degree

- Self-prediction after ten years

Delivery Media, Methods, and Rationale

Throughout the course, numerous delivery media will be used and adapted based on the content or task involved. Each week will have an introduction/instructions page, an independent content learning assignment (such as viewing a tutorial), a discussion assignment, a reflection assignment, a synchronous information or collaboration session, and a technology application assignment based on the content from the learning assignment.

Media	Method	Rationale
Text/Print (online)- cheat sheet format	Asynchronous – Can print and search	Consistent style sheet, refer to at any time, brief
Screencast	Asynchronous video, instructor-led but also blended	Refer to at any time do along with screencast
Demonstration	Synchronous – Presented live by instructor and facilitator (studybuddy.com)	Can answer questions via chat, audio, or video, complete action at same time as instructor
Tutorial	Asynchronous – Students complete and answer questions as part of weekly quiz	Engaging, checks for comprehension, assesses progress
Video and audio supplements	Asynchronous or Synchronous – may be from external source	Students may need additional guidance, relevance
Example Follow-along (web page, app, game, video produced by student)	Student follows directions to complete example application	Hands on experience, common, standardized experience

Teaching Strategies

Media Presentation

The use of media to present and facilitate information, ideas, training, and research via diverse

technological applications (Franzoni & Assar, 2009). Media may include: audiotapes,

videotapes, slide shows or PowerPoint, and multimedia graphic software.

Rationale – This teaching strategy will assist with meeting the objective of "use a college

learning management system in order to take an actual course through distance education." The

media examples will be utilized to present the course material in an online environment.

Surveys

A teaching strategy (usually given at the end of a class term or assignment), which utilizes tools

to gather opinions, interests, evaluations and recommendations for changes to the course or

assignment. Uses include: assessing usefulness of teaching materials, assessing instructor

performance, utilizing feedback to redesign course or assignment based on recommendations.

Rationale – Students can take the opportunity to evaluate the class and rate the teachers'

performance and whether the class material was well presented and perceived to be useful.

Conferencing

Instructional method where small groups of students can interact with or without the instructor

for learning (Franzoni & Assar, 2009). Purposes for meeting may include: support, discuss

upcoming assignments, initiate discussions, assess progress, point out strengths and/or

weaknesses, and consider solutions (Franzoni & Assar, 2009).

Rationale – this teaching strategy will help to meet the following objectives: developing

technical and communications skills, completing the collaboration project (students may initiate

a conference to discuss assignments and group work, completion goals, etc.), and gaining

exposure to electronic media design.

Written objectives/follow-up review

A teaching strategy in which objectives and goals are set for the course (may be either short-term or long-term), and the student is evaluated throughout the course to identify progress and areas of suggested improvement (Orlich et al., 2013).

Rationale – this process will provide direction and feedback, so that the students have an understanding of their progress and necessary improvements.

Learning Strategies

Discussion

Cooperative learning strategy where the students engage in purposeful and directed conversation (Orlich et al., 2013). They can either be facilitated by the instructor, or initiated by students to keep in contact in an online environment to assist with progression throughout the course. Students and instructors can utilize discussions to explore ideas, articulate thoughts, and respond to the thoughts of others (Orlich et al., 2013).

Rationale – The use of discussions will assist with meeting the objective of developing technical and communication skills to be successful in an online environment.

Reflective Journal

An independent learning strategy to encourage student reactions to texts, activities, learning experiences, self-identified areas of improvements and proposed methods of meeting these needs (Nuckles & Renkl, 2012). Reflections may be either formal or informal and include the concepts of analyzing, exploring, questioning, and interpreting new ideas or experiences (Nuckles & Renkl, 2012).

Rationale – Because online learning is a new process for these students, this learning strategy will give the students an opportunity to evaluate how they are handling the change.

They will also be able to assess whether the course materials have met their goals and needs, as well as how they have progressed throughout the course.

Peer Review

A learning strategy also known as peer evaluation, which involves active participation of a student in the formative evaluation of another student's work (Odom et al., 2009). The uses include: helping students identify strengths and weaknesses, develop and managing their learning processes, and working towards achieving the specified learning outcomes during the learning process itself (Odom et al., 2009).

Rationale – students in this course will be completing either an individual or collaborative project. This strategy is useful for meeting the objectives of the course, as well as encouraging student collaboration and improving communication.

Support Mechanisms

Student Support

Most students will be working with distance education for the first time while enrolled in STEM. The opportunity for collaboration is going to be key for student success. These students need to have an outlet for contact and discussion for their peers in order to help and provide feedback to one another. Students also need to have access to tutorials involving programming and design allowing them to feel comfortable and to encourage and keep students motivated in completing difficult courses. The students should also be receiving consistent feedback on their participation, attendance and grade and any other suggestions or feedback from the instructor. Support options include the following:

- Besides email, and telephone support, Canvas offers a five part support system for students to resolve course issues which can be accessed by clicking on the "Help" link in the upper right hand corner of the web browser. The following actions are available:

  - Ask Your Instructor a Question
  - Search the Canvas Guides
  - Report a Problem
  - Ask the Community
  - Request a Feature

- Help discussion board – There will be a discussion section specifically created for general questions about the course, modules and issues with the technology. The instructor, or other students if possible, will be able to answer questions posed on the discussion board.

Instructor and Facilitator Support

A lack of educators' comfortability with computers or technology awareness is a typical problem that is found in the world of education. As an educator, one must be willing to explore instructional support programs in order to better our teaching and expertise in the field. Instructors need support in the areas of software usage that in going to be attempted for use throughout the STEM program. These educators need to become experts on all of the technology being used in order to be better at service to their students. The STEM Distance learning program should offer and provide trainings for selected softwares and interactive technologies being used throughout the program. It will also be important for these instructors to continuously collaborate with one another in order to seek support and bridge the gap of the unknown.

USF Information Technology, Academy for Teaching and Learning, and Innovative Education, and College of Education iTeach Lounge will be available to instructor for support

and feedback. The UBMSC facilitator will be guiding the students at their campus computer lab, but will be able to ask questions or resolve concerns at any time by contacting the instructor via email, phone call, synchronous session, or another appropriate method or by contacting a USF department.

Technology Requirements (mainly already in place in college computer labs)

- Computer with audio capabilities
- Headsets with microphones for 20 students
- Computer with projector and internet capabilities to broadcast a lesson from the other campus live
- Reliable, high speed internet access
- Internet browsers such as Firefox, Chrome, Internet Explorer
- Adobe, Java, QuickTime, and other plugins to assist in viewing and interacting with content
- Access to major social media sites such as Facebook, YouTube, Twitter, Blog, etc.
- USF Netid available under VIP access if sponsored by USF STEM course instructor

Design and Development

The next steps for design and development are listed below:

1. Present plans and obtain constant feedback from UBMSC Program Director and adjust course accordingly
2. Create syllabus with daily task and associated delivery method
3. Plan and create worksheets, tutorials, demonstrations
4. Gather external online resources, such as videos, tutorials, reference sites, wikis, free courseware
5. Create quizzes
6. Create examples for each technology that students will follow step-by-step
7. Put all course information on Canvas
8. Finalize career tracks and line-up possible matches with professionals
9. Purchase equipment and handle hiring and payment details

10. Obtain netids for students with Canvas and Application Gateway access

11. Schedule course, instructor, facilitator, students, and guests

12. Begin "prototype" course June – July 2015

13. Survey at beginning, middle, and end of class

14. Make improvements during and after course

15. Assess outcomes

16. Scale up to two face-to-face courses where UBMSC and USFUB students collaborate across campuses to present their career track

17. Improve each year

Evaluation Methods

- Pre and Post as well as Weekly Online Quizzes

  Rationale: To ensure students are doing reading assignments and practice questions.

- Online Class Discussion

  Rationale: To allows students to discuss topics with class members and feel connected to their classmates and to course content.

- Anonymous Online Survey

  Rationale: To gather information from the students' perspective in order to evaluate the course and make adjustments in the future.

- Course Presentation

  Rationale: Students will present a topic on their career of interest using various forms of media. Teaches the students how to present online.

Administrative Issues

- Policies- Policies will need to be developed regarding online learning courses.
- Cost-Organization will need to do a cost assessment to allocate funds needed to support online learning course.
- Resources-Instructors and students will need to have technical support available to answer questions.
- Scheduling-Care needs to be taken to make sure that the course does not conflict with other courses in students' schedule, staff, and presenters must be scheduled
- Committee-A committee could be formed to address the needs of the distance learner.

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