

## **Improving Minority Students' Career Readiness Through Enhanced Senior Design Experiences**

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## **Improving Minority Students' Career Readiness Through Enhanced Capstone Design Experiences**

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### **Abstract**

The pathway to graduation can become confusing and lack the support needed for minority students to navigate their career goals successfully and gain the types of experiences that foster a successful career upon graduation in STEM majors. Capstone design course is a critical component in most engineering and science undergraduate curricula to prepare senior students for their future STEM careers. However, the quality of capstone design projects does not always meet the expectation due to the limited resources and support. Although capstone courses are now standard in engineering and science programs across the US, the associated required logistics and the availability of project ideas have not reached an optimum - particularly for small engineering and science programs, and for programs with limited ties with the industry. In this paper, it discusses the impacts of different enhanced activities on senior students' capstone design experience. Three major activities were provided to selected capstone design teams, including mini grants, professional development training, and financial literacy training. The program design and survey results are also discussed to share the experience on improving minority students' career readiness through the three major activities.

### **Introduction**

The undergraduate experience in STEM is greatly enriched by attaining research experience [1]. The performance on senior students' capstone design projects in the STEM field, is key for their career development. Due to the changing of educational standards and of credit hour shrinking for undergraduate degrees, the practical and hands-on aspects of engineering and science (such as design and experiment) have been gradually deemphasized, and nowadays curriculum is focused

more on theory, less on practice and real-world problem solving. To bridge the gap between concept and practice, engineering and science undergraduate programs have been pushed to incorporate capstone design courses in their curricula, where senior students can put their knowledge to practice through team projects. Capstone design courses at Texas A&M University-Kingsville (TAMUK), a Hispanic Serving Institution and a Minority Serving Institution, always involve capstone design projects, while each project team consists of 3-6 senior students. It is known that the educational quality of the senior capstone design experience is dependent on the possibility of validating and testing the prototypes designed and built by students. However, most of undergraduate minority students face a limitation in economic resources to achieve an experience that enhances their quality knowledge and skills during their capstone projects. As Wm. A. Wulf, president of the National Academy of Engineering (NAE), has noted, for the United States to remain competitive in a global technological society, the country as a whole must take serious steps to ensure that we have a diverse, well trained, and multicultural workforce [2]. To support undergraduate minority students enrolled in STEM fields, TAMUK promotes the Senior Design / Capstone Mini-Grant (SDMG) to senior students developing capstone projects as an integral part of their course program to complete its academic degree. The SDMG activity has an objective to help participants improving the senior design/capstone project experience of senior students, who share their learning experiences with freshman students in a university success course. It also enhances TAMUK engineering and science students' interests and performance in their curriculum and prepare them for future careers through streamlined education. This will also improve TAMUK engineering and science students' professional and personal skills to help them become responsible and productive citizens.

On the other hand, The Financial Literacy and Education Commission's plan for financial literacy calls on postsecondary institutions "to consider ways to raise the financial literacy levels of their students to help them avoid financial hardship due to mismanagement of credit and money" [3]. Subsequently, in addition to the SDMG activity, TAMUK pursues to support higher education students to become self-sufficient and achieve financial stability by providing online training in Personal Financial Literacy (PFL), assisting participants in ways to save money, manage a budget, pay bills, buy a home, pay for college, plan for retirement, raise credit score, and guide them to distinguish the difference between wants and needs. For this reason, TAMUK has made an available and free website, where students that perform in these courses can understand the importance of saving for a rainy day. To give incentive to students, TAMUK is able to provide a one-time stipend to qualified students who complete the required online training courses, aiming to increase the number of students participating in this activity.

During Fall 2019 and Spring 2020, 42 senior students in engineering and science majors, divided into nine teams, enrolled in the SDMG activity. However, because of the COVID-19 lockdown in March 2020, the teams could not complete their projects as planned, and their advisors looked for alternative ways for evaluation. During Fall 2020 and Spring 2021, even though TAMUK courses remained online, some senior teams developed capstone projects where the SDMG activity played a key role in their projects' performance. As a part of the SDMG activity, the awarded participants received access to the Explore Your Potential website as a part of their Professional Development training, which also contemplates assessment for their resume, cover letter and online sessions to develop practical exercises to build a strategic professional career plan for each participant. In addition, participants were required to complete six courses in the tamuk-igrad website, where

students were trained to get better at money management, make sense of their student loans, and understand credit reports, among other important finance topics. After completing the project, the SDMG participants were asked to complete a survey to rank the impact of the support received by the program regarding their Senior Design / Capstone experience, course grade, Professional Development and Financial Literacy training, freshmen presentation impact, preparation and readiness, and skillset for their future careers in engineering and science fields.

## Program and Course Design

The Senior Design Mini Grant activity is structured to support senior student teams enrolled in a STEM major for their project development under a faculty advisor supervision, submitting a detailed budget and a budget justification. The participants are responsible to determine the requirements for their project and to provide the information needed for the material procurement. The SDMG activity has an objective to improve the participant's project scope, providing an enhanced experience in their performance and a strategy for their professional career for each of its participants. At the end of the course, each SDMG team completes their projects with an assessment from a faculty advisor, submitting a project report and presentation. The instructors evaluate their students work at the end of the course, and the College of Engineering organizes a senior design conference and reward the best project in each academic year. One of those teams supported by SDMG won the first-place award for the Senior Design Conference in 2021. Table 1 shows the list of SDMG projects completed in Spring 2021, while Figure 1 shows the general structure of the SDMG program with main components.

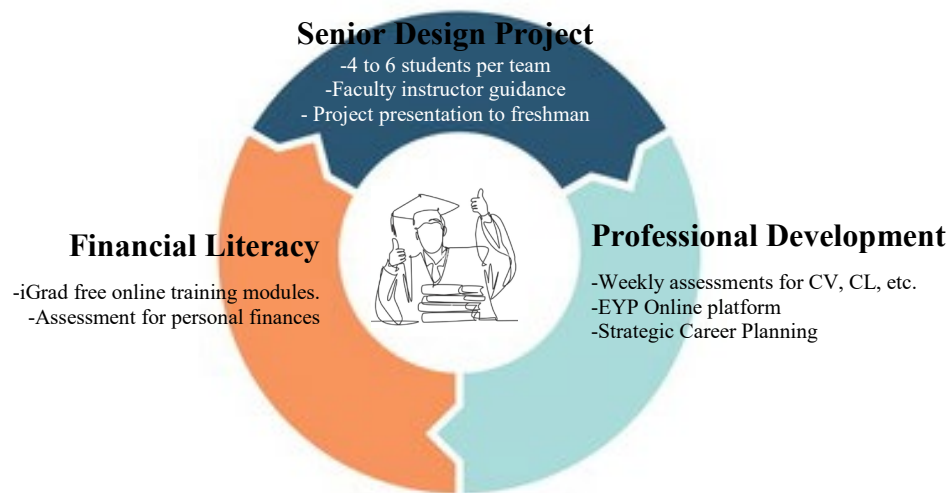


Figure 1: Overall Structure of the Senior Design Mini Grant activity

The participants are also required to complete six courses of Personal Financial Literacy in the iGrad website and also the course #1 of the Explore Your Potential website. The Professional Development training is carried out and supported with the Explore Your Potential (EYP) website exercises, and reinforced with weekly online assessment sessions with the objective of creating an enduring strategy for their professional careers. The exercises used from EYP website are designed to cover two major tasks:

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- 1) Search into their personal goals and define the resources required to achieve those goals.
- 2) Create an assertive strategy to define their objectives and the path that brings them closer to meeting their goals.

Table 1. List of SDMG projects completed for Spring 2021

<b>Project</b>	<b>Major</b>	<b>Focused Areas</b>
Occupational Therapy VR/AR Project (First prize on College of Engineering fair 2021)	Computer Science	Virtual & Augmented Reality. Patient care
South Texas Engineering Architecture	Architecture	Public buildings, 3D modeling
Continuing Education/Kingsville Community Project	Architecture	Environmental impact, HVAC&R systems design and construction
Banquete WWTP Improvement Project team	Environmental Engineering	Environmental Impact, Sanitary systems
Genomic Edit in Fruit-flies to Analyze Epilepsy	Biology	GEFS disease, Neuroscience research.

The professional development training in the SDMG activity has the objective to define and provide the skills to each participant to accomplish their professional goals and objectives, identifying their conditions, obstacles and resources, according to defined circumstances. The SDMG participants met with the project manager in weekly sessions during the entire SDMG program. In these sessions, the senior participants performed retrospective analyses and defined their own meaning as a professional individual. This facilitates them to identify their opportunity areas. It helps the SDMG participants determine the resources that will support their professional careers. In the Explore Your Potential website, the participants completed the 6 modules as part of the Course #1. These exercises helped participants find significant reasons that define them as professional individuals and strengthen the strategy to achieve the goals for their professional career. With this training, the SDMG participants were ready with precise strategies to follow and achieve their individual goals. The SDMG program allows the students to develop their full potential of professional skills including leadership, communication, team collaboration, project management, and entrepreneurship that are currently missing in the traditional STEM education. Furthermore, the SDMG participants were required to complete six online personal financial literacy training modules that took about two hours in total, including 1) budgeting, 2) behavioral finance, 3) scholarships, 4) repaying student loans, 5) federal student loans, and 6) using credit cards responsibly.

### **Program Evaluation and Assessment**

For the SDMG activity, surveys are also collected from students who have not participated in this activity to determine the level of interest on the part of students in receiving this type of support. In addition, voluntary surveys are collected from SDMG participants to define the influence received by the support of this program. Table 2 shows the demographic results of survey responses we received so far.

Table 2: Demographic Data of 13 Survey Participants of SDMG activity

Male/Female	Hispanic/Not Hispanic	Mechanical Engineering	Architectural Engineering
9 / 4	9 / 4	9	4

In the participant survey, about 70% of the participants agreed or strongly agreed that the support from the SDMG has a positive impact on improving their Senior Design / Capstone experience, while 77% of the participants considered the PD training (EYP website) a positive impact on improving their skill and knowledge related to professional development. About 85% of the participants considered the SDMG should be available to future senior design or research teams.

In addition, more than 50% of the participants agreed that the final presentation help increase freshmen student's preparedness on their future studies and the financial literacy training has a positive impact on improving their skills and knowledge related to personal financial literacy. About 85% of the SDMG participants considered themselves confident or very confident to be able to find an internship or Job in STEM fields, have teamwork or team collaboration skills, have project management skill, and have leadership skill. About 77% of the participants felt confident or very confident handling or repaying student loans, managing credit cards, about economic analysis skill, communication skill, professional etiquette dinner, and selling themselves during a job interview. About 70% of the participants felt confident or very confident about creating a budget and financial plan. These results illustrate the importance of the Personal Financial Literacy online training for the participants. Lastly, 70% of the participants agree or strongly agree that they have good knowledge about personal financial literacy. And above 90% of participants considered their skills increased in dealing with financial institutions, creating a budget or financial plan, and making investments in their future. They also, indicated how beneficial the stipend was to motivate the completion of the iGrad courses. Several students also indicated they started working on their courses, but once they paused it took them longer to retake the pace to complete the training. Therefore, it is recommended that students complete the courses on their own pace to achieve the number of certificates required to finalize this training.

In the non-participant survey, less than 50% of students acknowledged confidence or skill in any personal financial literacy subject (dealing with financial institutions, borrowing federal loan for education, buying a home, buying a car, create a budget, finding scholarships, protecting from scams, repaying students loans, managing credit cards, understanding health insurance, managing your paycheck). Regarding the importance of Financial Literacy (PFL) training, 70% of non-participants recognized that they need more information and training about PFL, but about 72% of them did not know the iGrad website for financial literacy training.

## Conclusion

The Senior Design Mini-Grant was structured to work under certain conditions before the COVID-19 pandemic. Therefore, it was essential to adapt this activity to provide support to the new operating conditions of the campus, which motivated the students and instructors to develop projects with virtual support for the completion of the objectives during the period corresponding to the academic course. Coordinating the team's objectives of their projects with their advisors is essential

to understand the scope and requirements and to elaborate a work schedule aligned with the project objectives. The materials procurement is preferably executed at the beginning of the project, for then it is imperative to have the budget approval from the team and their instructor to prevent any misunderstanding. Regarding the Personal Financial Literacy (PFL) training, participants indicated a considerable increase in their skills after completing the course. In addition, the iGrad website needs to be promoted so the students are aware of this resource and they can review this training every time they require it. TAMUK is also hosting campus-wide workshops to promote financial literacy among TAMUK students. More comparison studies will be conducted to evaluate the impacts on TAMUK students, especially Hispanic and female students.

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