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APPLYING DESIGN THINKING TO STUDENT OUTREACH PROJECTS: EXPERIENCES FROM AN INFORMATION SYSTEMS SCHOOL

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Abstract:

As countries turn into Smart Nations, Infocom Technology plays a key role in enhancing their competitiveness through high skilled workforces. Reaching to younger generations and attracting them to computing programs such as Information Systems (IS) and Computer Science (CS) is a key challenge faced by universities. Many high-quality students from junior colleges either don't choose IS programs or choose IS programs as their last option during the application process. A School of Information Systems (SIS) from a large metropolitan university decided to implement an innovative outreach program to attract high quality high school aka Junior College (JC) students. JC or high school students are those in 2-year program that transfers them to the 4-year university degree. In this project, we took a design thinking approach which enabled us to analyse the output of each stage of the design thinking process and make informed decisions for implementation. Our empathy stage showed that only 5% of top JC students were aware of Information Systems and we attribute this as the root cause of low numbers and quality of applications into IS schools. With empathy study and analysis, we ideated and implemented an innovative camp to bring awareness of IS to JC students. A team of twenty-nine faculty and staff worked on the project for twelve months and we have seen significant improvements in the number and quality of applications. This paper provides useful insights into using design thinking to re-engineer student outreach programs that can enhance the number and quality of applicants to a university program. We share the methodology, the details of each stage, and the outcomes of each stage.

Keywords: Outreach, Junior College Students, Information Systems, Design Thinking Methodology

I. INTRODUCTION

Outreach programs are the activities that bring services or information to people who might not otherwise have access to those information and services. A university outreach program involves marketing, instructional, and professional activities conducted by faculty and administrative staff. These programs can be broadly classified into two types, namely; organization outreach [Hearn et al., 2012; Perna, 2010], and individual outreach [Blum et al., 2008; Perna, 2010]. The audience, goals, design and implementation strategies, and challenges for these outreach programs varies widely.

Organization Outreach Programs (OOP) are mostly discursive in nature and are based on a healthy two way communication between practitioners and professors. The objectives of these outreach programs are manifold; to gain feedback from industry on curriculum, to provide networking opportunities for existing students, to market executive education programs, and to advice practitioners on new concepts and emerging technologies [Hearn et al., 2012; Perna, 2010].

Individual Outreach Program (IOP) activities encourage enrolment, especially for prospective students interested in pursuing first degree programs or continuing their

education in advanced specialized areas. These programs can also provide academic development services to high school students. Enrolment activities aim to provide awareness of university education and its role in enhancing an individual's career path. In this paper, we focus on IOPs.

Choosing what to study at a university is a major decision that significantly impacts a student's future. Students who have not made informed choices about what they want to study may not enrol at all or are more likely to enrol in a program that is not meaningful to them and thus end up withdrawing. IOPs tend to support high school students to determine where and what to study. The outreach activities are predominantly focused on providing students with information needed to make the right decisions. Yet, prior to enrolment students struggle to find out what they really want and what would be suitable for them [Holmegaard et al., 2014]. Universities could take on a stronger role in "helping students to clarify their personal objectives for undertaking higher education and improving the matching of interests and aptitude of students to particular fields of study" and to build capacity to navigate and use information in a useful way [Gale, 2010]. Such programs aid the students in making informed decisions in their university application process.

Camps, talks, workshops, campus tours, early academic preparation programs, and summer enrichment courses are some of the most popular outreach activities conducted by many universities to reach high school students [Garcia, 2015; Crick and Moller, 2015]. The design of the activities is aligned with the specific programs offered by a department within a university. For example, computer science schools design the outreach activities around code, programming and computational thinking aspects whereas nursing schools design outreach activities around community, patient care, social worker and senior centres. An IOP, where the main goal is to attract high school aka JC students to a BSc (Information Systems) (IS) program offered by a Singapore Management University (SMU) is the main focus of our paper.

To design a high quality and successful outreach program we implemented design thinking methodology for our project [Brown, 2008; Carlgren, 2013]. The main goal of the project was to "Improve the IOP to attract better quality students". Design thinking (DT) is an approach to innovation that helps create new user experience for any products, services, processes, events, software applications and even policies. It helps to ensure that the right solution is built and that teams building the solution are equipped to do so. The effort to understand and validate what the right problem minimizes expensive redesigns in later phases. The core concept of the DT process is the emphasis on addressing the needs of the users who will use the solution; hence, each stage of this method was strongly coupled with the students and drove the success of the solution.

In this paper, we share our experience in the design and implementation of an IOP that aims at attracting high quality junior college students. The outreach program supports the prospective students to make informed decisions during their university application process. We believe the design thinking process provides a structured pathway for Information Systems and Computer Science schools to rethink and reengineer their outreach programs. The remainder of this paper is organized as follows. In Section II we introduce the design thinking methodology. Section III presents a literature review of related work. In Section IV, we present a detailed description of how the design thinking methodology was applied to IOP to attract high quality applications for the BSc Information Systems degree program at our school. The final section presents the results, lessons learned, and conclusions that can be drawn from our work.

II. DESIGN THINKING METHODOLOGY

Design thinking is a methodology or a process that systemizes the prototyping of ideas and practices to solve problems [Brown, 2008; Carlgren, 2013]. By taking an organized approach to the creation of ideas and implementation of practices, it maximizes the chances of success. Design thinking involves developing new ideas and practices which are based on evidence and other successful ideas [Ratcliffe, 2009]. These ideas are refined and converted into practices, which are then rigorously tested to determine their efficacy.

Design thinking methodology has been used in a variety of different fields, including business, law, primary school education, sciences, and medicine [Seeber et al., 2015; Szabo, 2010]. Design thinking in legal firms enables lawyers to practice and build useable end products by cutting costs and improving collaborations [Szabo, 2010]. Designing healthcare products and equipment have been enhanced and made more patient-friendly [Ferreira, 2015; Kemnitzer and Dorsa, 2009; Seeber et al., 2015]. Companies like Procter & Gamble, Cirque du Soleil, and RIM use design thinking to produce breakthrough innovations and competitive advantages [Martin, 2009]. Design thinking in classrooms where students design and generate solutions using activity-based approaches enhances the teaching and learning process [IDEO, 2016; Scheer et al., 2012].

In our outreach project, the use of the design thinking helped to support the team in developing empathy for the students who will ultimately be impacted by the outreach program. Putting students at the centre of the design process suggests that a deep understanding of the students is required for the proper design of the outreach program. The understanding of the students involves aspects such as their profiles, behaviours, and the influencers, motivators, and barriers.

Design thinking provides opportunities to dislodge hidden assumptions and uncover the influence of biases and heuristics that may remain unarticulated using traditional methods of developing outreach programs. Understanding user behaviour and their choice of universities or programs through observational research can uncover opportunities for developing outreach programs that can enable students to make informed decisions. By taking a student-centred approach and placing the emphasis on their needs and motivations, DT has the potential to guide the outreach team away from solutions that, while seemingly are good ideas, are less likely to be useful to students in the decision making process. Depending on the availability of resources, the implementation of various steps of DT processes vary slightly. However, the concepts underlying these steps remain the same. We apply DT to outreach program projects by employing a five stage design thinking process: Empathize, Define, Ideate, Prototype, and Implementation. Finally, we measured outcomes of the project to discover the strengths and gaps.

III. RELATED WORK

Outreach programs are the activities that provide information and services to any population who might not otherwise have access to those information and services. In the past six years, a majority of outreach efforts focused on middle school and high school students, a majority of the reported events took place in the United States, and almost half had a goal of increasing gender diversity in computing [Decker et al., 2016]. In this paper, our focus is on outreach to attract high quality students to an Information Systems program.

Organization Outreach Program (OOP): An OOP involves instructional and professional activities conducted by faculty and staff with professionals and organizations whom are not enrolled in the institution. These outreach activities encourage enrolment especially from professionals interested in pursuing advanced degrees or continuing their education in specialized areas. In addition to fostering economic development and enrolment, an OOP can promote faculty development. Faculty interaction with practitioners can improve lines of communication and encourage faculty to consider the practical aspects of their research [Hearn et al., 2012]. The practitioners could provide feedback to the professors concerning “best practices and success stories”. This material could then be incorporated into classroom lectures. In return, the professors could advise practitioners in job related problems, new concepts, and changing technologies as discovered through academic research activities. These outreach activities are two way communications that help to enhance the curriculum and alignment with industry needs.

Individual Outreach Program (IOP): These programs are directed at individuals. They can include student development programs, early academic preparation programs, awareness programs, and information outreach programs. Student development programs aim at providing work experience to individual students through university academic preparation and internships for its undergraduate students. These programs provide opportunities for networking and future employment [Perna, 2010]. Early academic preparations programs

provide early experiences of university life to the potential students through exposure to university courses [Franklin, 2013; Lakanen and Isomöttönen, 2013]. Awareness programs play an important role in bringing awareness of university programs to students and high school teachers [Blum et al., 2008; Liu et al., 2012].

Information outreach programs provide primarily college information assistance and advising; these interventions are timed to address early awareness of college, college preparation, college entrance exams, test preparation, career prospects and financial aid. Some programs are day activities to bring awareness of curriculum and available opportunities [Garcia, 2015]. In particular, some programs aim to give students an understanding of what computer science is and what computer scientists do, and to get them to think about taking a CS1 course their first year in college [Gonzalez, 2011]. Technocamp is another outreach program that aims to give awareness to students on CS through technology exposure [Crick and Moller, 2015]. Some programs are also aimed at encouraging technology career for girls [Gannod, 2014]. Attracting good quality students is critical for computing programs [Sahami and Piech, 2016] and this was the focus of our outreach project.

IV. DESIGN THINKING APPROACH FOR THE IS OUTREACH PROGRAM

In this section we first present the overall design thinking process followed by the details of how each stage was implemented within the School of Information Systems (SIS) outreach program. Before embarking on the project it was first necessary to ensure that all the members of the outreach team had a good understanding of the design thinking methodology. In order to achieve this, an industry expert was invited to conduct a one day workshop on design thinking. Figure 1 shows the overview of the design thinking process. It comprises six stages; empathy, define, ideate, prototype, implement, and measure. After the outreach program was completed, the project outcomes were measured to evaluate the efficacy of the project.

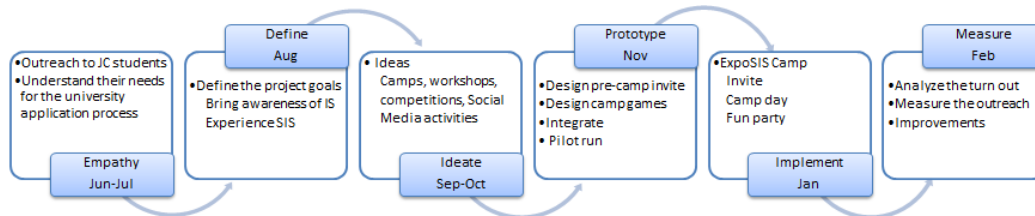


Figure 1: Outreach Program Project: Design Thinking Process

The empathy stage aids in understanding the students followed by the define stage that uses the findings from the empathy stage to help refine the main objectives of the outreach program. The ideate stage helps to generate innovative ideas for the outreach program. The prototype stage is directed at implementing the selected idea as a pilot run with mock students. The measure stage helps to collect metrics and to analyse the efficacy of the outreach program.

Empathy

The empathy stage is the first step of learning about the consumer or audience for whom we are designing the product or service, in this instance, the high school students. It plays a key role and internally the most important factor leading to great ideas. Empathetic research allows designers to understand the consumer. When studying the consumer, the emphasis is on putting oneself in the intimate space of the consumer, and then to seek to understand them much deeper than surface demographics and simple psychographics.

Recollect that the main goal of the project was to “Improve outreach to attract better quality students”. The SIS team planned to reach top Junior Colleges (JC) in the nation and gather the needs of the students who will be applying for universities. A team of faculty, staff and students conducted a research survey through interviewing JC students to understand how

and where they seek information from, regarding university programmes, as well as the process they undertake before applying for a university place of their choice. The students' feedback and suggestions were very helpful for designing and improving the outreach program. This information was obtained directly from the JC students, who were the potential applicants, which helped us to improve on how we shared information about SIS. The main tasks involved in this stage were survey preparation, obtaining permission from school counsellors, and the final step of conducting the survey.

Survey Preparation

Table 1 describes the survey preparations conducted by our outreach team.

Table 1: Survey Preparation

Component	Preparation
People	29 Faculty/Instructors/Staff + 4-6 Students, 10 sessions 4hrs each, 6-8 teams, target 450 JC students.
Budget	Vouchers - 400 each of \$5 vouchers, work study grant, transport, stationery, printing etc.
Time	Admin preparation - 2 weeks, training - 1 week, survey - 4 weeks.
Procedures	JC list, written approvals, oral text index card, Google survey forms, questionnaire, flyers, emails for approvals from JCs.
Policies	Institution Review Board approvals and oral consent forms.

Survey Questionnaire Framework

The survey framework was designed in such a way that the students' process of university applications and perceptions about information systems were captured together with their profiles. This approach to the survey design enabled us to study the correlations along the various dimensions.

The three main segments of the survey questionnaire were; profile, process and perception as described in Table 2. Profile questions helped to discover possible patterns in the user behaviour towards the university enrolment process. Process questions helped to discover the approaches or methodologies the students followed in their university application process. The third segment, perception, helped to discover the awareness of the various universities, programmes and in particular about the SIS Information Systems program.

Table 2: Sample Survey Questions

Survey Segment	Sample Question
Profile	Which subjects do you study? What career would you like to pursue? Age, Gender, Address (location), which JC, which year of study?
Process	Do you want to apply to a local university? Why? What do you plan to study/which discipline in university? What factors are important for you to choose the university/course? How would you like to find out more about a particular university/course? What are best timings to reach you?
Perception	Do you know the names of all the local universities? Which schools do you know in SMU? What do you know about SIS? What are your perceptions of SIS? How did you know? What would you like to know about SIS?

Define

The main goal of this stage was to redefine and focus the questions based on the insights gained from the empathy stage. The define stage took empathy stage content, and converted key ideas and trends into a design challenge. The outcome of this challenge was specific and provided the guidelines and criteria for the subsequent stages. The questions to answer during this stage were something such as “How might we...?”

Empathy Stage Findings

Figure 2 shows the major findings of the empathy stage on all three segments of the survey. 470 students participated in the survey. The findings show mathematics, economics, and chemistry were the top subjects that the students studied in their JC. These students were all suitable for the IS program.

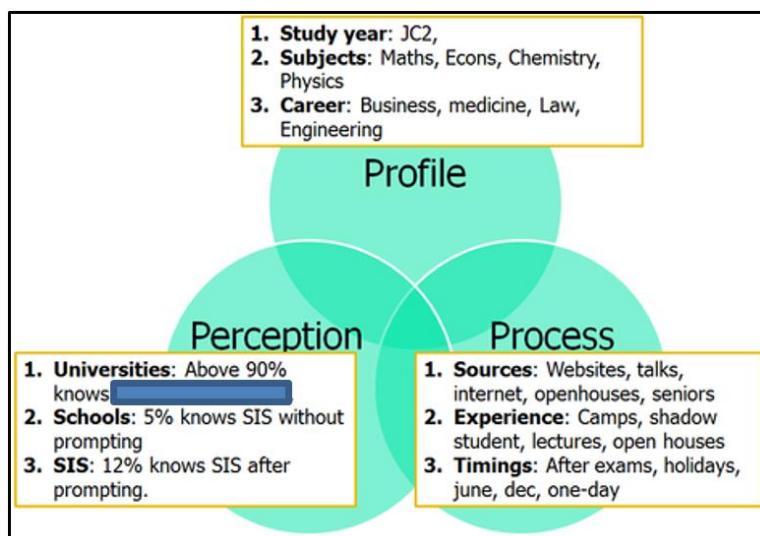


Figure 2: Empathy Stage Main Findings

Ninety percent (90%) of the students knew the main universities in our country and our university is one that is well known. However only 5% knew about the School of Information Systems (SIS). They also were unaware of the IS program offered at SIS. This showed that awareness was the first issue that should be tackled in our outreach. Furthermore, the main sources for university information were websites, university talks and open houses. Camps, shadow student programs and lectures were the most preferred university experiences, as observed from the student survey.

Detailed Goals of Outreach Project

The empathy stage survey showed that lack of awareness in three broad areas, namely; IS programs, SIS, and IS career opportunities, were our main impediments to attracting JC students. Based on these findings, the outreach team further refined the project goals using the following questions.

1. How might we bring the awareness of information systems to JC students?
2. How might we bring the awareness of SIS to JC students?
3. How might we bring the awareness of career facts about IS to JC students?

Ideate

The main goal of the ideate stage was to brainstorm and come up with creative solutions. The ideate phase of design thinking plays a vital role in the process. Here, designers strive for crazy brainstorming with possible and impossible idea generation. By getting out obvious ideas first, teammates can work together to generate innovative and extravagant solutions. Designers work in small teams to build from each other's ideas and create something special and unique. The SIS outreach team was broken down into small teams of 5-6 members. We then conducted focus group sessions and consolidated the ideas

across the various teams. Individual teams came up with the ideas, implementation approaches, and benefits. Each team came up with several ideas. Many overlaps were observed in terms of solutions, for example camps and workshops were proposed by multiple teams. Table 3 shows the summary of the ideation stage outcome.

Table 3: Ideation Stage Outcomes

Type of Task	Description and Purpose
Camps	Day camps with activities where the students are engaged by SIS students and faculty to bring awareness of IS and SIS.
Workshops	JC Counsellor workshops that provide a platform to network with schools and also share prospective IS career opportunities. Programming workshops that provide a platform for the JC students to experience programming in a “fun way”.
Competitions	Collaborate with Infocom Development Authority and conduct competitions for JC students.
Online Platforms	Create a SIS Facebook page for SIS outreach where SIS students and faculty actively participate and share their experiences and life at SIS. This also gives opportunities to discuss topics related to IS and SIS with the potential JC candidates.
Ad-hoc	JC talks and seminars by SIS faculty where the faculty will talk about the IS applications in real world to bring awareness of IS and its role in the business and society.

The ideas from this phase were consolidated and ranked by the outreach team members in terms of their appropriateness to the problem at hand, feasibility, and value to the school. “Camps” was rated the top by all the outreach project team members and we then moved on to the prototype stage to design the details of the “Camp”. The camp was named ExpoSIS and Figure 3 shows sample works of the individual teams for the camp prototype.

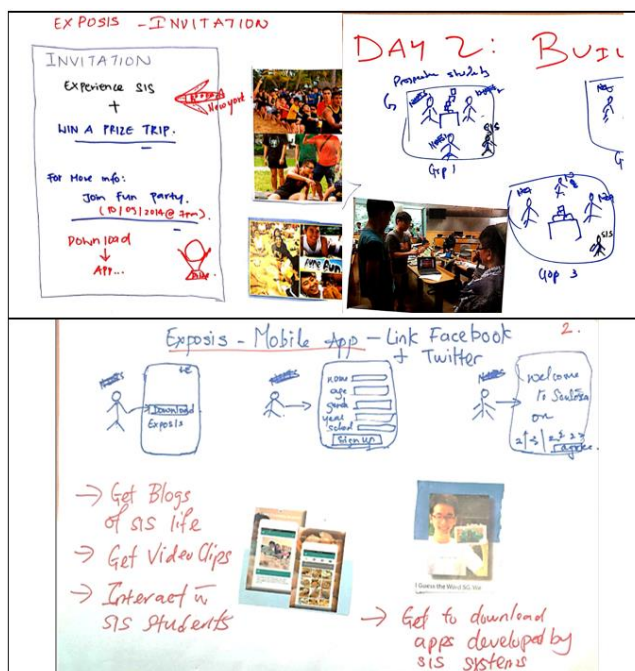


Figure 3: Sample Ideas from the Focus Group Discussions

Prototype

Based on the ideation stage discussions, the prototype of the complete half-day outreach camp was devised. Figure 4 shows the various phases of the ExpoSIS camp that was designed and organized by the SIS outreach team.

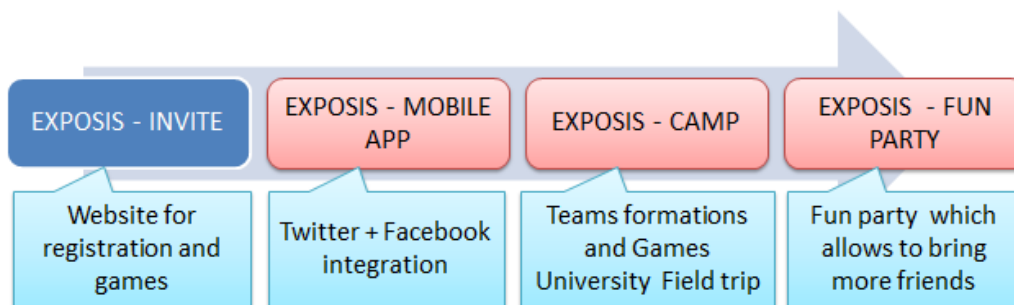


Figure 4: Prototype for the Outreach Camp – ExpoSIS

The first stage is the invitation where the goal is to provide a platform for students to register for the camp. To attract students, registration games are embedded in the site and students are given points to collect the prizes on the camp day. The second stage is the mobile app development for student interaction and engagement with SIS students and faculty via social media platforms; Facebook and Twitter. After the registration, students download the app and through the app, they continue to receive details about the camp. The third stage is the camp day where registered students form teams and participate in the games. Three games are designed to accomplish the three main goals of the project as described previously in this section. The first game is designed to get JC students to understand how IS innovates the “way we live, play, work and learn”. Students are asked to find hidden clues using a mobile app and QR codes to construct the details of an IS capstone project that was completed by existing students. The second game is designed to help the JC students to understand some technical topics, for example analytics and cybersecurity, and their relevance to solving real world problems. The third game is designed to help the JC students understand the job opportunities after completing the IS degree. The final stage is the fun party event where the students are encouraged to bring their friends. This enables the SIS staff to reach out to more students. The outreach camp games are designed with gaming and gamification strategies as described in Gottipati et al. (2018). Prizes are distributed to the winners and feedback for suggestions to improvements are collected.

V. Results, Lessons Learned, and Conclusions

The first run of the camp, ExpoSIS day, was well received, and 75 JC students attended the Camp day. Figure 5 shows some sample feedback from students who participated in the camp. Subsequent to implementing the outreach program, we observed a 38% increase in the number of applications from JC students compared to the previous year. We also observed improvement in the quality of the applications for the current academic year intake. A university admissions score cut-off is applied for all JC students applying for SMU. For 85-90 points and above, the number of applications increased by 35%, for 82.5-83.25 points, the number of applications increased by 36.4%, and for 80–81.25 points, the number of applications increased by 46.2%.

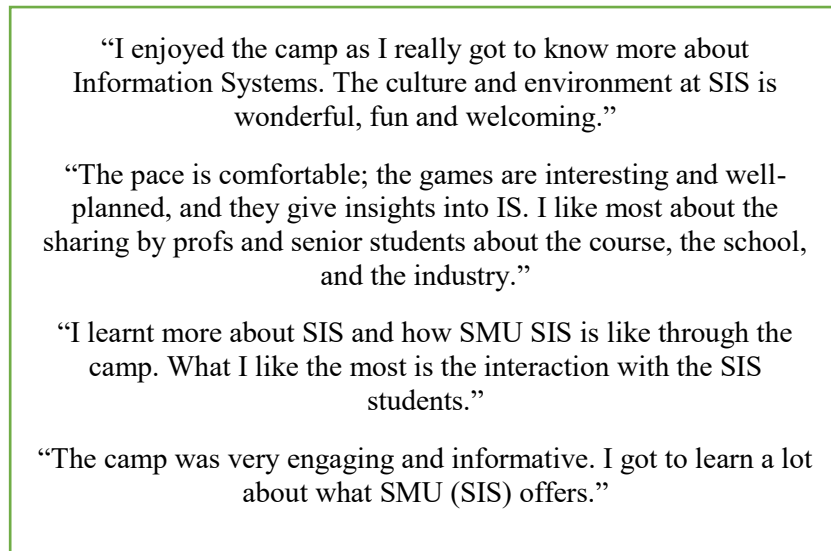


Figure 5: Student Feedback on ExpoSIS Day (Camp)

Following are some lessons learned from our experience in applying design thinking to the individual outreach program:

- A. The training workshop on design thinking played a major role in ensuring that all outreach team members had a common understanding of the problem and the process. In fact, the exposure to design thinking also had other unintended benefits. For example, the faculty began to apply the concepts in other areas such as curriculum redesign and administration process redesign.
- B. One of the main challenges encountered by the team was obtaining the necessary approvals from the University’s Institutional Research Board (IRB). SMU’s IRB secretariat follows strict procedures for collecting information from “human subjects”. The team had to work on several iterations of the IRB application form with regards to; the survey formats, questions, monetary rewards, and on seeking the participants’ consents. Starting early helped the team to ensure the IRB approval was obtained well before the date for conducting the surveys, and hence ensuring the project was on schedule.
- C. Another challenge was to design and develop games that accomplished our goals as discussed in section IV. At the start, having a large group did not help, since there were too many ideas and long discussions and no clear outcomes. In order to overcome this challenge, we formed sub groups to work on the details of the game for each section of the camp. The sub groups developed the games and members from other teams pretended to be the participants and tested the games. This process helped to remove some of the glitches with each game and further refine them. This process ensured a smooth execution of the games on the ExpoSIS day and resulted in accomplishing our goals of attracting better quality students to SIS.
- D. In the past, only a handful of people were actively involved in our outreach efforts. However, after this project, there was more enthusiasm and interest from a lot of faculty and staff. This behavior could be attributed to the design thinking team-based approach. Design thinking helped to build three significant components of common ground in the team, namely; shared vocabulary, tangible artefacts; and a trust-based team culture.

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REFERENCES

- Blum, L. et al. (2008) "The expansion of CS4HS: an outreach program for high school teachers", In Proceedings of the SIGCSE '08, pp. 377-378.
- Brown, T. (2008) "Design Thinking", *Harvard Business Review* (6)S, pp. 84–92.
- Carlgrén, L. (2013) "Design thinking as an enabler of innovation: Exploring the concept and its relation to building innovation capabilities", PhD Thesis.
- Crick, T. and F. Moller (2015) "Technocamps: Advancing Computer Science Education in Wales", Proceedings of WipSCE 2015.
- Decker, A., M.M. McGill, and A. Settle (2016) "Towards a Common Framework for Evaluating Computing Outreach Activities", In Proceedings of SIGCSE '16 ACM New York, NY, USA, pp. 627-632.
- Ferreira F.K. et al. (2015) "New mindset in scientific method in the health field: design thinking", Clinics.
- Franklin, D. et al. (2013) "Assessment of Computer Science Learning in a Scratch-Based Outreach Program", In SIGCSE '13, ACM.
- Gale, T. et al. (2010) "Interventions early in school as a means to improve higher education outcomes for disadvantaged students", National Centre for Student Equity in Higher Education.
- Gannod, J.E. et al. (2014) "Increasing awareness of computer science in high school girls", FIE 2014.
- Garcia, D.D. et al. (2015) "One-Day Activities for K-12 Face-to-Face Outreach". SIGCSE 2015.
- Gonzalez, M. et al. (2011) "Leveraging existing outreach programs to reach underrepresented minorities", *Journal of Computing Sciences in Colleges*, (26)4, pp. 190-196.
- Swapna Gottipati, Venky Shankararaman. (2018) Using Gamification in Outreach Camps: Experience from an Information Systems Program. In Proceedings of 48th Annual Frontiers in Education Conference (FIE), San Jose, USA, 2018 October 3-6.
- Hearn, W.M., J.L. Thomas, and R. Cobb (2012) "University outreach programs: service to the surrounding communities while developing faculty", *Research in Higher Education Journal*, (16)1.
- Holmegaard, H., L. Ulriksen, and L. Madsen (2014) "The Process of Choosing What to Study: A Longitudinal Study of Upper Secondary Students' Identity Work When Choosing Higher Education", *Scandinavian Journal of Educational Research*, (58)1, pp. 21-40.
- IDEO (2016) "Design Thinking for Educators Toolkit", Available at: <https://www.ideo.com/work/toolkit-for-educators>
- Kemnitzer, R. and E. Dorsa (2009) "Enhancing biomedical design with design thinking", Conference Proceedings of IEEE Eng Med Biol Soc.

- Lakanen, A.J. and V. Isomöttönen (2013) "High school students' perspective to university CS1. In proceedings of ITiCSE.
- Liu, J., C.H. Lin, and E.P. Hasson (2012) "Computer science learning made interactive—A one-week alicé summer computing workshop for K-12 teachers", *Frontiers in Education* 2012 – <http://ieeexplore.ieee.org>
- Martin, R. (2009) "The Design of Business". *Harvard Business Press*.
- Perna, L.W. (2010) "Understanding the working college student: New research and its implications for policy and practice", *Theology & Religion*.
- Ratcliffe, J. (2009) "Steps in a Design Thinking Process",. The K-12 Lab Wiki. Retrieved from <https://dschool.stanford.edu/groups/k12/wiki/17cff/>
- Sahami, M. and C. Piech (2016) "As CS Enrollments Grow, Are We Attracting Weaker Students", SIGCSE 2016
- Scheer, A., C. Noweski, and C. Meinel (2012) "Transforming constructivist learning into action: design thinking in education", *Design Technology Education*.
- Seeber, L. et al. (2015) "A design thinking approach to effective vaccine safety communication", *Current Drug Safety* (10)1 pp. 31-40.
- Szabo, M. (2010) "Design thinking in legal practice management", *Design Management Review* (21) pp. 44–6.