Batangas State University Method of Technopreneurship as an Outcomes–Based Education Tool Applied in Some Engineering and Computing Science Programs

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CONTEXT
Batangas State University (BatStateU) is a premier university in the CALABARZON Region (Region 4A) in the Philippines. It is composed of ten campuses, strategically located in the Batangas Province and caters to 45,860 students, 15% of which have engineering majors (AY 2015–2016). True to its motto of *Leading Innovations, Transforming Lives*, the university, thru the Center for Technopreneurship and Innovation launched its technology entrepreneurship (technopreneurship) program last 2nd Semester of Academic Year 2014–2015 and is now on its 4th run of building the technopreneurship and innovative mindset among its students and faculty members. Piloted in the BS Electronics Engineering, BS Computer Engineering, BS Computer Science and BS Information Technology programs, the technopreneurship course will eventually be included in the curriculum of all engineering, technology and computing sciences programs of the university.

PURPOSE
The researcher aims to determine how the technopreneurship course contributed in honing the entrepreneurial and innovative skills of Batangas State University engineering students and to determine the effectiveness and acceptability of the experiential teaching and learning techniques used.

APPROACH
The researcher conducted pre and post survey assessment and evaluation among students and faculty facilitators of the technopreneurship course to determine its effectiveness and acceptability in the engineering and computing sciences curricula. Aside from the experiential teaching and learning inside the classroom, the center also launched a challenge lab as another avenue to promote technopreneurship and innovation. The culminating activity of the course is the conduct of a demo day where participants pitch their Minimum Viable Products (MVP) to potential investors.

RESULTS
After three semesters of technopreneurship facilitation, a total of 848 students and 13 faculty facilitators were provided with hands–on skills in technopreneurship. From a traditional mindset of being an employee after graduation, students were equipped with a mindset that allowed them to think innovatively and hopefully have the courage to be employers of their own start–ups. A significant number of participants also showed interest in setting up their own business or start–up after taking up the course.

CONCLUSIONS
The Center for Technoprenuership and Innovation spearheaded programs that succeeded in developing a culture of technoprenuership and innovation among the students and faculty members of the university. A significant number of participants also expressed their acceptance and appreciation of the techopreneurship course, the format, content and manner of facilitation. The BatStateU method of technopreneurship also serves as an Outcomes–Based–Education (OBE) assessment tool that tests the students' ability to communicate effectively, thru the pitching activities; ability to function on multidisciplinary teams, thru team formation activities; and the ability to design minimum viable products that meet the desired needs within realistic constraints through MVP development and validation.

KEYWORDS
technopreneurship, minimum viable product, challenge lab.

Introduction

Technopreneurship is simply entrepreneurship applied in a technology–intensive context. It is often associated with innovation, which, in the context of technopreneurship is the union of technology and market needs resulting in the creation of value added products and services that are scalable and relevant. According to Banatao (2015) both entrepreneurship and innovation are tools and drivers for economic development.

The Philippines has seen constant growth in the Gross Domestic Product (GDP), over the years, of 6% and above and an increasing influx of foreign direct investment, thus achieving investment grade status. Banatao (2015) pointed out that some factors that can sustain the economic growth are a functioning market system, high levels of savings, public and private sector investment, resource mobility, innovation and political leadership. This paper discusses how BatStateU method of technopreneurship can contribute, through innovation, in the country's economic growth.

The BatStateU Center for Technopreneurship and Innovation (CTI) was established on August 2014 to assist potential entrepreneurs to take the first step in establishing their own business. The center is also tasked to spearhead programs that will bolster the culture of technopreneurship and innovation and provide an ecosystem where incubatees can harness their ideas and skills before they can put everything in the real world of enterprise.

The CTI provides opportunities for R&D results to be commercialized by encouraging more entrepreneurial activities and facilitating more commercial development of BatStateU's Intellectual Property Right (IPR).

Providing successful incubation for high–growth start–ups requires more than just providing space and funding but also an ecosystem to support the growth of the incubated companies. As such, the CTI helps its Technology Business Incubators (TBI) succeed by providing a supporting ecosystem that includes financing, mentoring, leadership, development, intellectual property protection and technology commercialization. The vast linkages and partners of the university also assist in providing core competencies to operate and manage the TBI.

Education becomes the first line of introducing the technopreneurship and innovative mindset among the student and faculty members. Backed by trainings sponsored by different agencies, the BatStateU CTI prepared an entrepreneurial curriculum suitable for students in the engineering and computing science programs.

Objectives

The general objective of the study is to perform assessment and evaluation of the effectiveness of the BatStateU Method of Technopreneurship in attaining selected student outcomes.

Specifically, the researchers aim to:

1. Implement the Technopreneurship curriculum in some engineering programs focusing on some student outcomes.
2. Perform pre and post evaluation of the effectiveness of the BatStateU Method of Technopreneurship in attaining selected student outcomes.

BatStateU Method of Technopreneurship

Part of the establishment of the BatStateU CTI is the actual immersion of its personnel into the technopreneurship pedagogy. Technopreneurship fosters collaboration, as such, the university forged linkages with local and international universities and other private agencies

which share the same advocacy of cultivating the technopreneurship and innovative mindset among students and personnel. Most notable are input from the Sutardja Center for Entrepreneurship and Technology (SCET) of the University of California Berkeley, the Enterprise of the University of the Philippines–Diliman, Start–up Aggieland of the Texas A&M University and the Philippine Development Foundation (PhilDev).

In recent years, there have been a shift of the teaching focus, from a teacher–student–transfer focus in which the subject is the only transported goods, to the student–subject–relation focus in which the teacher is only the medium used. This shift is illustrated in the didactic triangle shown in Figure 1 and are used in the studies of Sidhu, Singer, Johnsson and Suoranta (2015) and Johnson, Yang and Nilsson (2014).

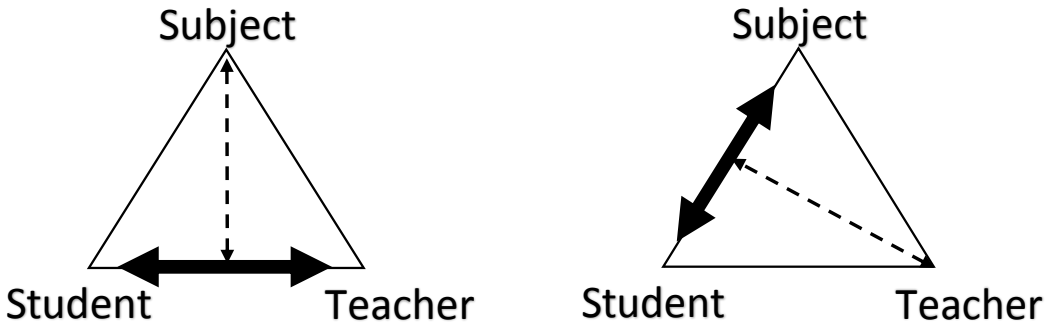


Figure 1: An illustration of Didactic Triangle showing a shift from the teacher–student–transfer focus (left) to the student–subject–relation focus (right)

According to Prince and Felder (2006), the teacher–student–transfer focus is also referred to as deductive teaching, whereas the student–subject–relation focus is referred to as inductive learning.

The Technopreneurship curriculum makes use of an inductive classroom where the facilitator presents or exposes the students to examples that show how the concept is used. The objective is for students to figure out how the concept can be used to address societal problems. The students should be able to demonstrate that they have understood the problem by proposing solutions in the form of Minimum Viable Product (MVP), that is technically viable and has potential for market.

In tehnopreneurship class, skills and attitude are equally or even more important than facts and raw knowledge, and an inductive learning approach is therefore more suitable. Examples of inductive learning approaches used in the technopreneurship class are game–based learning, role–playing and collaborative problem solving.

Technopreneurship as an OBE Tool

As an Outcomes–Base Education (OBE) practitioner, the university sees the opportunity to cultivate the culture of innovation and technopreneurship among its students and while at the same time meeting some student outcomes, such as:

- Ability to function on multidisciplinary teams,
- Ability to communicate effectively,
- Knowledge and understanding of engineering and management principles as a member and leader in a team, to manage projects and in multidisciplinary environments.

These student outcomes are assessed through the conduct of activities such as *Know How* ideation, one–day validation, scrum planning, Minimum Viable Product (MVP) design and development and product pitching. Different sets of rubrics were devised to evaluate the student outcomes for the different activities.

BatStateU Techopreneurship Course

Offered since 2012, the Technopreneurship format made a drastic change from a typical lecture type course, into an experiential type starting last 2nd Semester of Academic Year 2014–2015 (November to March). The improved curriculum was standardized and was piloted in the BS Electronics Engineering (BS ECE), BS Chemical Engineering (BS ChE), BS Computer Engineering (BS CpE) and BS Food Engineering (BS FE) programs with 111 students. In the following semester,1st Semester of Academic Year 2015–2016, the enrolees tripled with students coming from BS Information Technology (BS IT), BS Computer Science (BS CS), BS Instrumentation & Control Engineering (BS ICE) & BS Mechatronics Engineering (BS MexE). In the process, a total of 10 faculty members were trained to facilitate the Technopreneurship Class. The technopreneurship classis in its Fourth Batch this 1st Semester, AY 2016–2017 which is from August to December, following the new school calendar. Shown in Figure 2 is a graph showing the total number of students after three batches.

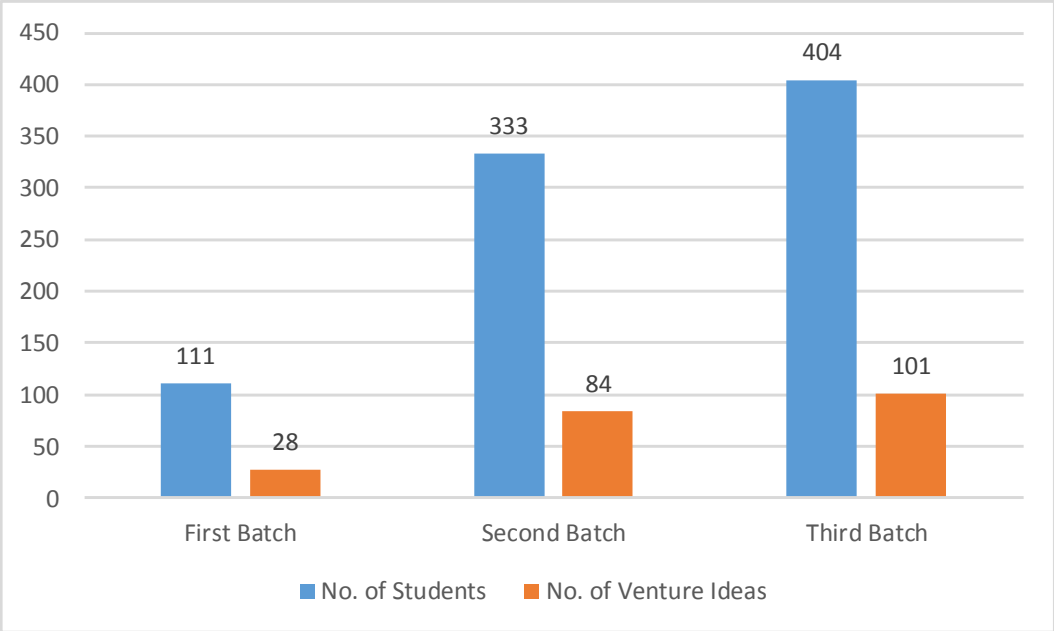


Figure 2: Total number of students and venture ideas after 3 batches of Technopreneurship 101

The BatStateU technopreneurship curriculum includes activities that motivates students in setting up their start–ups. The program typically runs for eighteen weeks wherein student teams, at the end of the program, conducts a demo pitch to selected external panel. During the demo day, the teams also get to showcase their MVPs. Following are short descriptions of the activities for the BatStateU technopreneurship curriculum.

Know How: This is a required activity where students perform self–assessment to identify individual skills and strengths. In this activity, students are required to fill up a database after self–assessment of individual roles. Note that this is not a mere role playing, since for a start–up to survive, it must be a collaboration of different set of skills, both technical and business.

Ideation: Everything starts with an idea. Students are encouraged, individually, to scan their environment of pain points or relevant issues where they can apply realistic solutions. The students may not start from scratch and are advised to examine previous technopreneurship class and a venture idea for a start–up. The potential of the ideas is determined by the class facilitators

considering innovativeness, scalability, marketability and significance.

One–Day Validation: After receiving the approval of the facilitator, the proponents are required to conduct a one–day validation to determine preliminary potential to market. Students are advised to go out of the building to ask the most important person: the potential customer. Also, the students are also encouraged to seek technical experts for comments and suggestions. The results of the one–day validation are discussed in class.

Team Formation: Once approved, the facilitators conduct team formation which is in the process of hiring. As in previous studies conducted by Wasserman (2008), and Vaughan (N.D.), for the start–up to succeed, it must be composed of both technical and non–technical members. A team may be composed of a hacker (technical software), maven (technical hardware), connector (market guy), designer (user interface, branding), scrum master (project manager). A team is composed of at least two and a maximum of seven members with at least one required technical member. If necessary, the team may include members outside the class.

Scrum Planning: Project management is another important aspect of the class. Scrum, according to James (2012), is a management framework for incremental product development using one or more cross–functional, self–organizing teams of about seven people each. It provides a structure of roles, meetings, rules and artifacts. Teams are responsible for creating and adapting their processes within this framework. Scrum uses fixed–length iterations called Sprints, which are typically two weeks or thirty days long. Scrum teams attempt to build a potentially shippable and properly tested product increment for every iteration.

Customer Validation: Validation is one of the most important activity because this is the avenue for the teams to test their venture ideas in the market. Perish or pivot becomes the name of the game as teams, based on the validation results, decide to continue with the venture ideas or pivot into a more viable concept. Aside from the features, the actual cost of the products or services in the market is also worth validating. The output of each teams can come from interviews or focus group discussions with potential customers.

Demo Day: Demo day is the final activity of the class, wherein the best teams get to pitch and demonstrate their ventures to a selected external panel. The panel is usually composed of industry leaders in the field, funding agencies or potential angel investors. The top four teams will receive merit prizes and an opportunity to be included in the incubation program of BatStateU CTI.

The BatStateU technopreneurship class runs for seventeen weeks with various inductive–type activities and guest lecturers who can share their experiences in managing start–ups. Games such as “rejection therapy”, “plan to fail”, “believe” and “diversity”. Majority of which are activities learned from Sidhu and Singer (2015) of the UC Berkley Sutardja Center for Entrepreneurship and Technology. The lecture topics are shown in Table 1.

Table 1: BatStateU Technopreneurship Course Outline

Week (Wk) Number	Activities / Topics
Wk 1	Kick–off Course intro, Tech startups and technopreneurs, Mindset, Deliberate Practice, Innovation, Lean Startup, Support ecosystem Know Who
Wk 2	Seeding panel, Opportunity identification, Innovation canvass, Self–profiling
Wk 3	Know How
Wk 4	Round–robin pitching, First pivot, LS Case Study, Ideas database
Wk 5	One–day validation, Team formation, 1st group pitch
Wk 6	1st pitch to mentors
Wk 7	Scrum plan, Customer hypothesis
Wk 8	2nd market validation, Business models
Wk 9	UI/UX design sprint
Wk 10	3rd market validation
Wk 11	Dev Sprint
Wk 12	Customer validation
Wk 13	IP and tech transfer
Wk 14	Financial plan, resource generation
Wk 15	Roles and valuation, Venture structure and agreements
Wk 16	Practice pitch
Wk 17	Demo day

Assessment of BatStateU Techopreneurship Course

The BatStateU CTI conducted pre and post survey assessments among the students of the Third Batch. The activity was explained during the first meeting and participants were encouraged to access the online survey portal. Respondents had an option not to fill–out their personal information. The online survey is designed to capture the students' perspective of Technopreneurship, before and after taking the class. The first part of the survey shows the students' profile and educational and family background as far as entrepreneurship is concerned. The next part investigates the factors that motivate students to pursue (or not) a technopreneurship career. A section is also included to determine the students' level of knowledge or skills in some areas of technopreneurship and in some of the identified student outcomes. The survey is given before and after the conduct of the technopreneurship class. The activity is conducted as part of the continuing quality improvement of the program. The result of the conducted survey is shown in the next section. Note that the data included were from the Third Batch only, which covers the 2nd Semester of Academic Year 2015–2016 were 150 of the 404 students participated. The researcher opted to use only the data of the third batch since data collected is more robust as compared with the data from the previous batch, since it was only during the third batch that sets of pre and post survey data were acquired.

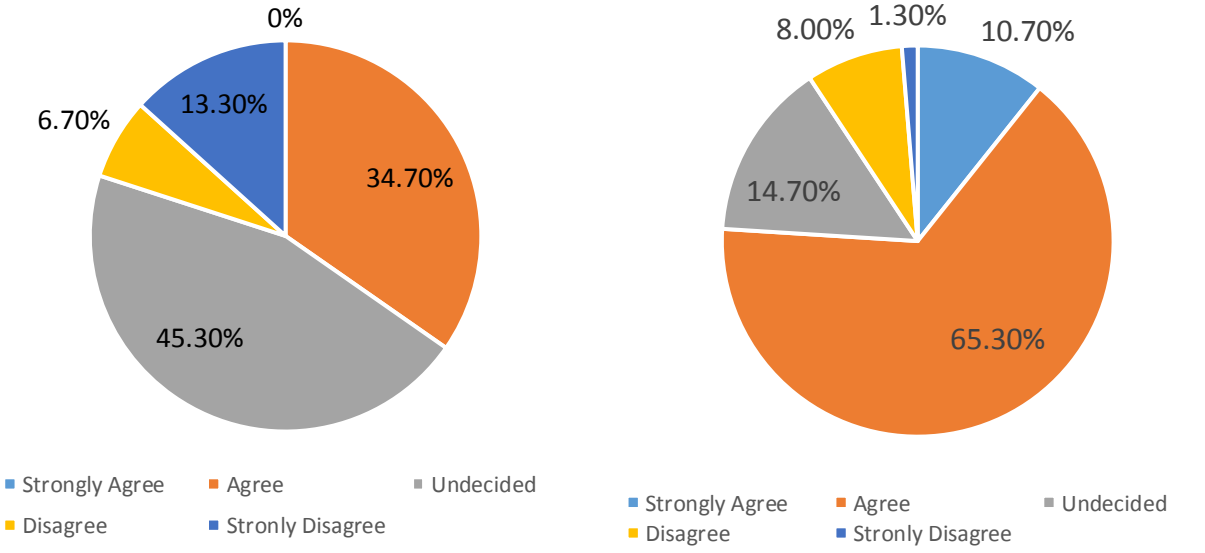
Summary of Results and Findings

Before the start of class, an online survey was conducted to gather baseline data to determine the level of understanding of students of the technopreneurship course. Following are the results of the pre–survey.

Based on the survey, majority of the participants in the third batch do not have relatives who are entrepreneurs. This is also true based on the results of the pre–survey assessment of the first and second batches When asked about their experience or knowledge about technopreneurship, majority said that haven't interned, worked or had entrepreneurial

experience. Although some had experience developing a product or technology, very few were familiar with intellectual property.

Options were shown to the respondents to determine their plans after graduation. Figure 3a shows data, before the start of the class, that when asked about the respondents' plan after graduation, 45.3% responded that they were still undecided to enter into business while 34.7% were considering to take the risk of starting a business. 6.7% did not like the idea while only 13.3% strongly considers being an entrepreneur. Majority of the respondents as shown in Figure 3b expressed that they prefer to be employed in a company.



a. Considers setting up a business after graduation

b. Considers working in a large firm or company after graduation

Figure 3 Pre Survey results showing students' plans after graduation

After the conduct of the technopreneurship class the facilitators conducted an online post survey to determine the change in the mindset of participating students in terms of some student ouctomes and their willingness to set–up their own start–ups. Following are the results of the post survey.

Based on the survey conducted among participating students, there is an improvement on the students' perspective when it comes to setting up a start–up after graduation. There is a large shift on the studets' understanding to start a business from being below average to above average as depicted in Figure 4.

Part of the activities in the technopreneurship class is the conduct of a series of venture pitch. Student teams were taught to perform a 30–second elevator switch and a 15–minute venture pitch. Typical contents of the pitch deck are the specific problem being addressed, the value proposition, the target market, the competitive landscape and the revenue streams. The teams are also encouraged to present the market validation conducted as well as a demo of the functionality and features of the Minumum Viable Product. The pitch is usually delivered by the team's validator or market guy which tests the student's ability to communicate effectively. The result of the pre–survey and post–survey with regards to the students' perspective when it comes to the improvement in terms of their ability to effectively deliver a pitch is shown in Figure 5.

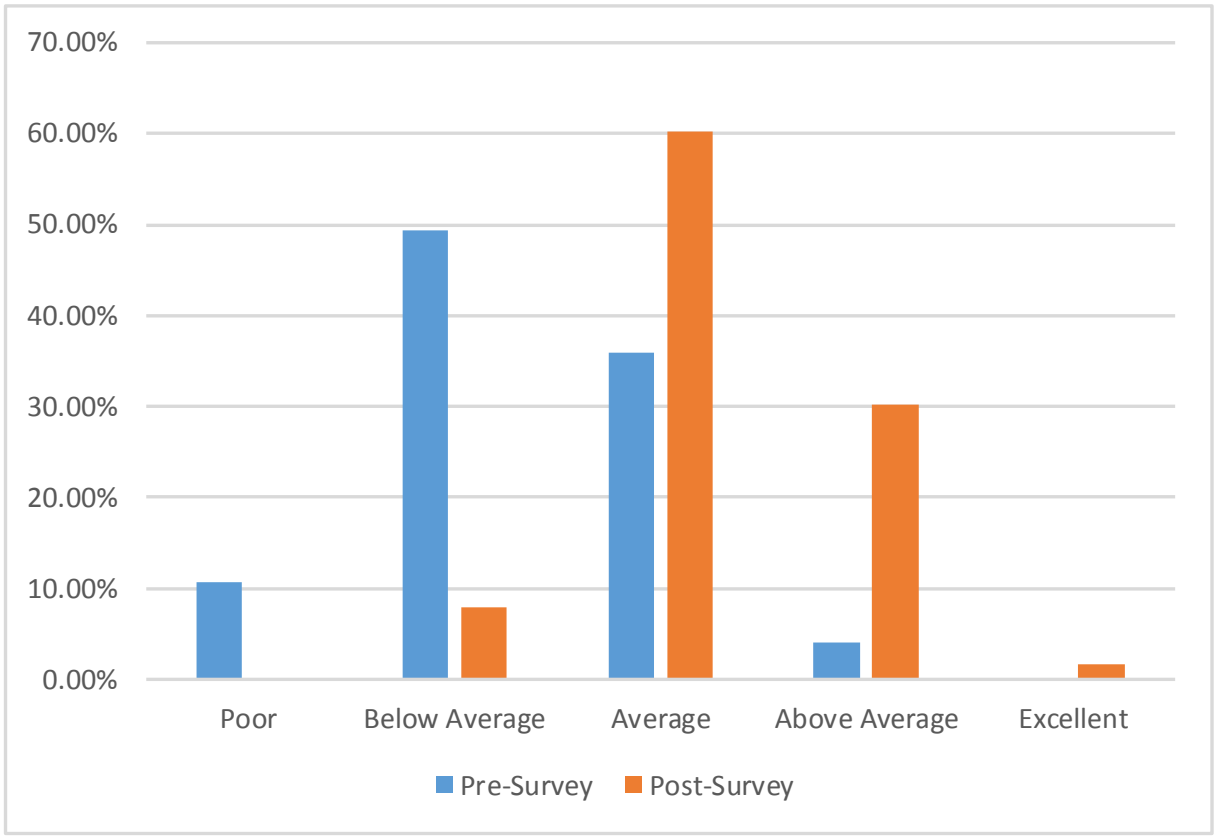


Figure 4 Results of pre and post survey showing confidence in starting a business

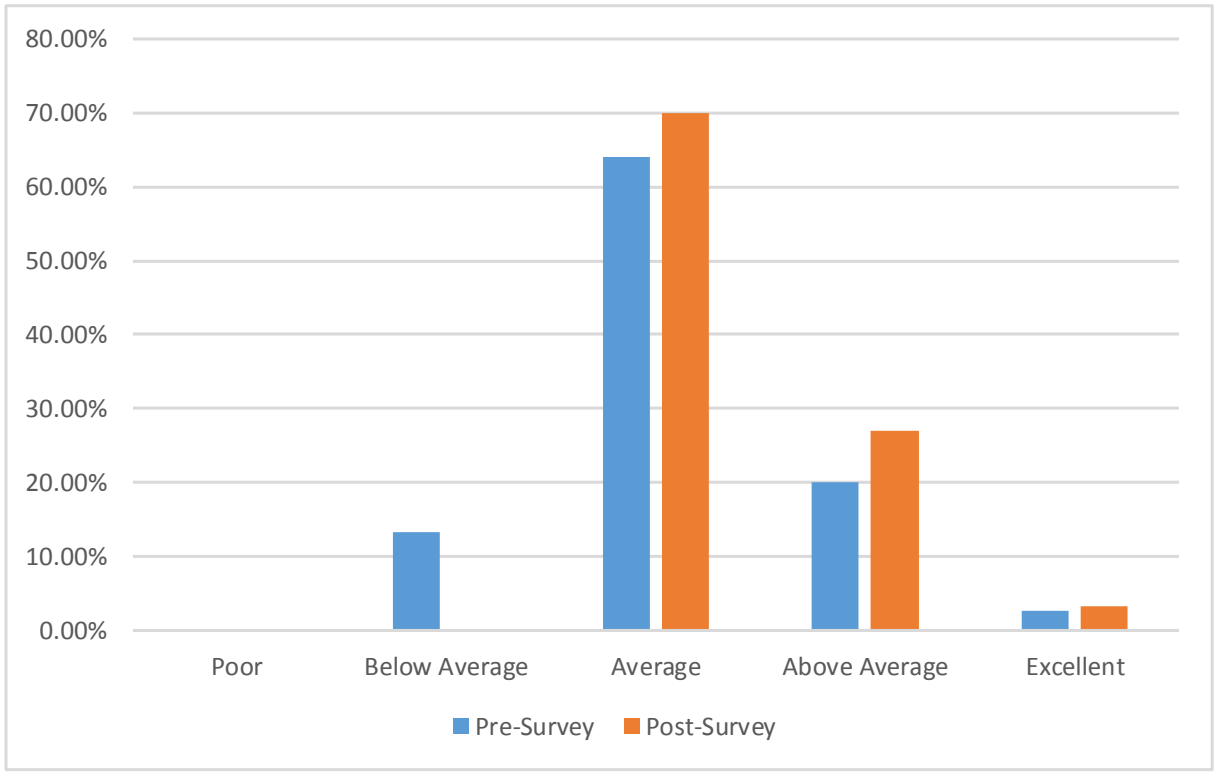


Figure 5 Results of pre and post survey showing confidence in delivering a pitch

The culminating activity of the technopreneurhip course is a demo day wherein the top fifteen, from the 101 teams, were carefully chosen to pitch to external partners, who were industry players and members of the local chamber of commerce and industry. As a facilitator of the class, the researcher saw the great improvement in terms of the level of confidence of the students after the conduct of each class. The activities allowed the students to express their thoughts more often and the regular practice pitch made them more prepared during the demo day. The different teams were assessed using a rubric to determine the following: Technical Viability of the MVP, Venture Pitch, Marketability, Team Execution and Relevance and Social Impact. Figure 6 shows the summary of results of the assessment for the Top 15 teams from the third batch. The scale used was 1: Poor, 2: Below Average, 3: Average, 4: Above Average, 5: Excellent. Figure 6 shows the result of the assessment.

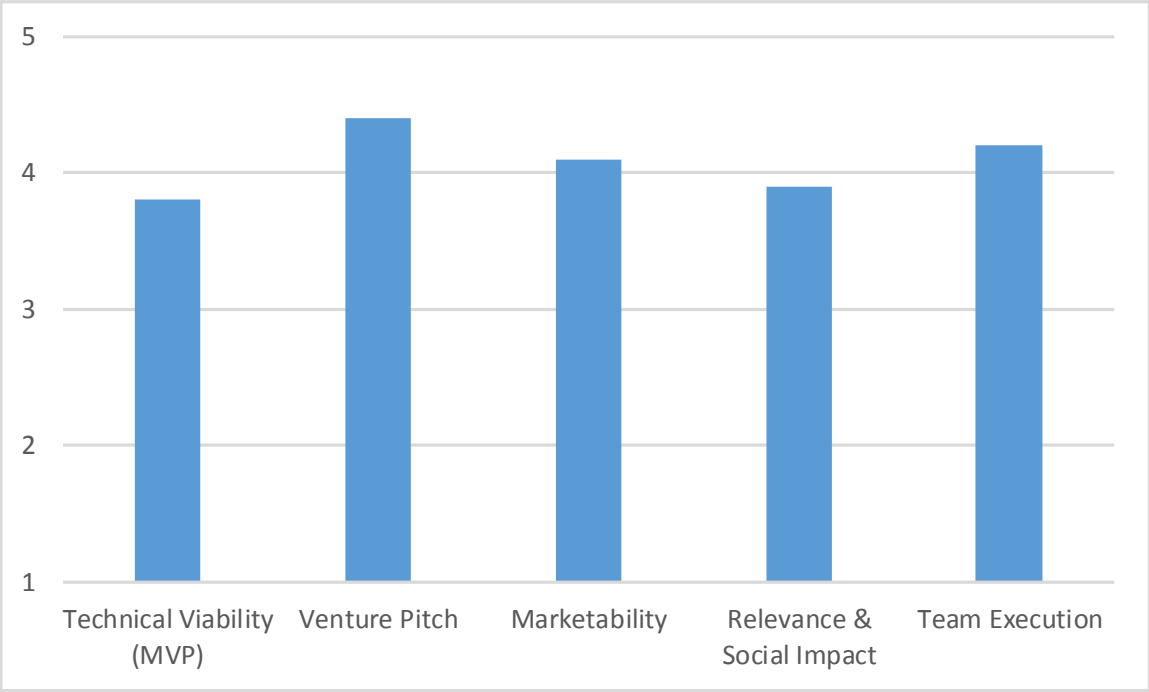


Figure 6 Average of the assessment result of the Top 15 teams of the third batch

Another Student Outcomes assessed is the student's ability to function on multi–disciplinary teams. It is important to note that the schedules allotted for the Technopreneurship class can be attended by students regardless of their program. For the Third Batch, the participating students were from the BS ECE, BS ChE, BS FE, BS IT and BS CS Programs. The diverse field of courses participating in the Technopreneurship classes allowed more collaboration of students with other disciplines, thus resulting into innovative venture ideas.

The result of the assessment reveals that for the top 15 teams, who pitched to external partners, attained an average score of 4.08 for all the metrics which is equivalent to an Above Average performance. As of this writing, four teams from the Third Batch are being incubated by the BatStateU Center for Technopreneurship and Innovation.

Conclusions

The following are the conclusions drawn with regards to the research conducted:

1. The university developed a Technopreneurship curriculum which included activities to attain some student outcomes.
2. The survey conducted, before and after the class, showed an improvement in the students' perspectives in terms of technopreneurship skills. The survey also showed

an increase in the number of students who wanted to take risk and set–up a start–up, after graduation, rather than being employed in a company.

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