Exploring the Impact of Project-Based Learning on Entrepreneurship Education for Engineering School Students in Mongolia - A Case Study of NUM Startup 2.0

Bilguun Batbayar

National Cheng Kung University, Taiwan, https://orcid.org/0000-0003-1590-3731

Abstract: Entrepreneurship is still young and developing in Mongolia, yet it is the main driver of the Mongolian economy. According to The National Statistics Office of Mongolia, small and medium businesses create 52.5% of all jobs in Mongolia. To ensure more qualified entrepreneurs join the labor market, educators and instructors can help with resources for their students that will enable them to create successful businesses. Entrepreneurship education can play an essential role in providing a qualified and skilled supply of entrepreneurs for the Mongolian economy. This paper will examine how project-based learning impacts engineering students' entrepreneurial mindset at Mongolia's university. The study will try to create awareness of the importance of entrepreneurship education and a project-based learning (PBL) approach for students with any engineering background. As a case study, this research will take "NUM Startup 2.0", a five-month program in that students can team up with their professors to build a startup company from the beginning. A qualitative research methodology will be used to conduct interviews with participants of NUM Startup 2.0. This research will use homogenous sampling to select students with similar backgrounds, and for a semi-structured in-depth interview, collected data will be analyzed using the thematic analysis method. Moreover, this research may provide valuable feedback to universities in Mongolia to develop more well-structured courses for students.

Keywords: Project-Based Learning (PBL), Entrepreneurship, Entrepreneurial Mindset, Engineering School, Mongolia

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Introduction

Entrepreneurs has been known for its role in value creation, creating jobs, increasing economic growth. Global Entrepreneurship Monitor (GEM) surveyed 65 different economics worldwide and, there are around 582 million entrepreneurs by 2017. Small business has created 10.5 million jobs from 2000 to 2019, compared to large corporate organizations its nearly twice. Figure 1.1 shows the percentage of adults in each economy who personally know someone who has started a company in the last two years.

In 2020, adults (ages 18-64) from 43 countries participated in GEM's Adult Population Survey(APS), and more than 40 percent knew who stopped business in 2020 due to COVID-19, on the other hand 25 percent knew who started a business amid a pandemic.(Bosma et al., 2021).

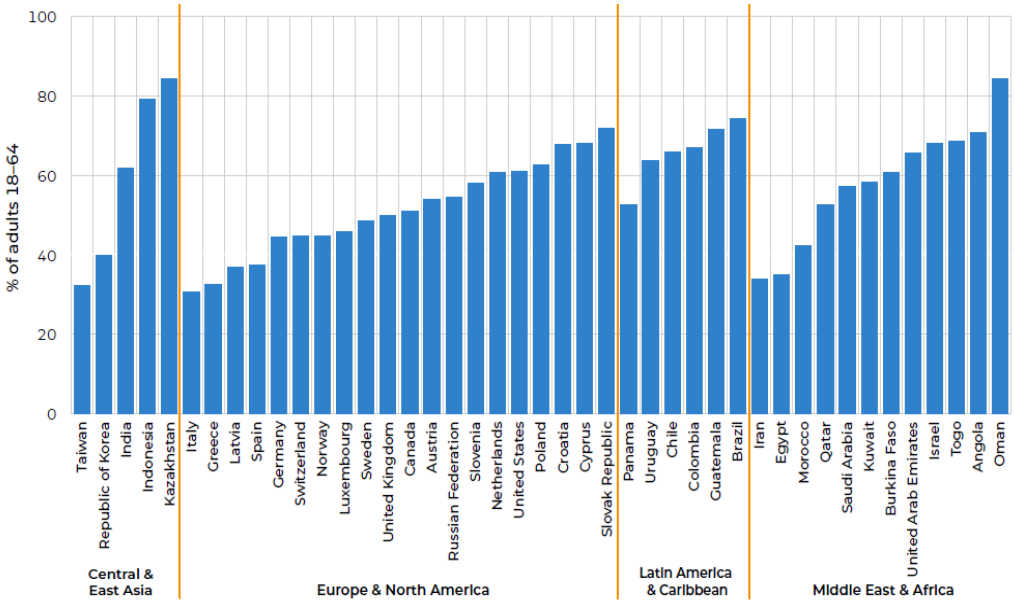

Figure 5. Percentage Of People Who Know Someone Created Business in Last Two Years

Source:(Global Entrepreneurship Monitor (2021)

(The GUESSS Project Global University Entrepreneurial Spirit Students' Survey) has been conducting surveys around the globe since 2003. The latest survey (2021) conducted in 58 countries with more than 267'000 students, "all-time high record for GUESSS". As shown in Figure 1.2 below, around 32 percent of the students wants to pursue entrepreneur career five years after their studies. In the other hand some (in total 32.6 percent) prefer to join medium-sized and large business organizations directly after studies (Sieger et al., 2021).

Research Motivation

The COVID-19 pandemic heavily impacted global economy and workforces. During the COVID-19, there has been a massive surge in amount of start-up businesses in United States. According to (Djankov & Zhang, 2020) study found that Americans started 4.4 million businesses in 2020. That is a 24 percent increase compared to 2019. Since the lockdown everyone was trapped at home, many businesses were set up online and people's screen time increased over the last years. In this digital age, the businesses have changed from physical into online. Entrepreneurs who are opportunities seekers (Shane & Venkataraman, 2000) sees pandemic as an opportunity. Without the cost of running a shop on street or having a stall at a market, having business online can be overall more cost-efficient. In 21 centuries, people can turn their creative ideas into business much easier than before. Through an increase in risk, time, creativity and online growth, businesses and entrepreneurship are clearly on the rise.

Many countries around the world are focusing their capital and resources on improving their national competitiveness through the development of a knowledge economy, advanced and high technology based on scientific and technological achievements. The experience of developed countries shows that universities, especially research-based universities, play a key role in creating an effective national innovation system that is the basis for the development of the knowledge economy.

In the case of Mongolia, the Government Action Plan 2016-2020 "... create conditions for the implementation of research-based university development policy and planning", the issue needs to be implemented within the framework of the national program. According to the article 3.3 of "National Research-Based University Development Program 2016-2020"

1. To support universities in establishing start-up companies and raising funds for research funding by owning shares in the charter capital of business organizations.
2. To support the university's innovation activities and create optimal methods of investment and financing for start-up business development.

Although the main goal of universities is become research-based university now, the next step is to build an entrepreneurial university. This research tries to study early stage of entrepreneurship education in Mongolia and explore students' perspectives of entrepreneurship education.

Research Objective and Questions

The aim of this research is to explore impact of project-based learning (PBL) on entrepreneurship. The focus will be to how project-based learning pedagogy influence student's entrepreneurial mindset. The main research objectives are as follows:

Objectives

1. To identify the development of entrepreneurship education and its related educational policy in Mongolia
2. To analyze project-based learning and their impacts on entrepreneurship education
3. To explore how the project-based learning of "NUM Startup 2.0" project influence entrepreneurship education for engineering school in Mongolia

To answer research objectives, following research questions raised

Questions

1. What is the current educational policy and evolution in Mongolia?
2. What is the current development of entrepreneurship education in Mongolia?
3. What is project-based learning in educational design?
4. How does project-based learning possibly influence the new entrepreneurship education in Mongolia?

5. What is "NUM Startup 2.0" project and how does it apply to project-based learning on entrepreneurship education?
6. How does project-based learning of "NUM Startup 2.0" project impact entrepreneurship education for engineering school and how can it be improved in Mongolia?

Literature Review

Current Challenges of Entrepreneurship Education in Mongolia

In today's technological centric world, science, technology, and innovation are regarded as one of the top contributors to the economic growth of the states (Science, Technology and Innovation in Mongolia, 2019). (Science, Technology and Innovation in Mongolia, 2019) claims that countries aligning STI with their social and economic priorities over the long term and integrating them into overall policy decision-making is a great way to boost economic growth. However, Mongolia has failed to follow this education plan.

The main challenge for Mongolian education system and its students currently is that the government is not ready to invest in the sector of entrepreneurship. Studies such as (Delgernasan M., 2015) and (Oyuntsetseg L. & Batkhurel G., 2015) have pointed out the same issue. Apart from that, (Oyuntsetseg L. & Batkhurel G., 2015) discovered that the universities in Mongolia are not having the technological infrastructure and socio-economic resources that are required to invest in STI to enhance entrepreneurship learning. Universities are now conducting mixed activities of teaching-research-entrepreneurship in order to develop the tendency of innovation so that they could be included in the list of entrepreneurial university in Mongolia (Oyuntsetseg L. & Batkhurel G., 2015).

Concept of Entrepreneurship

Entrepreneurship term doesn't come to any specific definitions. It is hard to define the term under one condition because the term appears in various fields. As economics, sociology, political science, and psychology use the term entrepreneurship or refer to it in some way (Mokaya et al., 2012). As (Taylor, 1947) said there is no absolute best way to define it. (Kouakou et al., 2019) studied different scholars' perspectives of entrepreneurship or entrepreneur and observed seven similar components.

The author regrouped these elements into three-level shown in Figure 2, each level shows the importance of components while studying a definition of entrepreneurship. Based on (Kouakou et al., 2019) study the most repeated component was opportunity recognition. Therefore (Shane & Venkataraman, 2000) definition is still significant. Scholars agree on opportunity recognition and exploration of entrepreneurial opportunity are the heart of entrepreneurship (Kouakou et al., 2019) (Shane & Venkataraman, 2000) definition of entrepreneurship "Entrepreneurship is an activity that involves the discovery, evaluation, and exploitation of opportunities to introduce new goods and services, ways of organizing, markets, process, and raw materials through organizing efforts that previously had not existed".

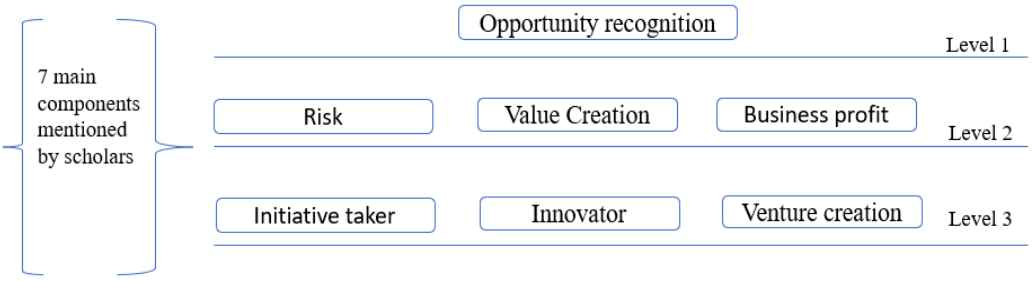

Figure 6. Elements Cited in the Definition of Entrepreneurship

Source: Adapted from (Kouakou et al., 2019)

Entrepreneurship Education

(Drucker, 1985) mentioned in his book "*Most of what you hear about entrepreneurship is all wrong, it's not magic; it's not mysterious; and it has nothing to do with genes. It's a discipline and, like any discipline, it can be learned*." Peter Drucker defined entrepreneurship as a "discipline".

Jamieson (1984) introduced three themes for entrepreneurship education: teaching "about", "for" and "through" entrepreneurship(Chaker & Jarraya, 2021). Courses and programs that focuses on teaching "about" entrepreneurship heavily relies on content of the subject, and their main goal is develop students' "skills" and increase their "awareness of entrepreneurship". In this teaching pedagogy students passively receive knowledge from educators and it is considered as "teacher-centered approach" (Chaker & Jarraya, 2021) (Alanazi, 2018). Second, teaching "for" entrepreneurship focuses on entrepreneurial intention and encourage students to become entrepreneurs in the future. By providing real environments that learners can practice real world examples. Lastly teaching "through" is similar to previously mentioned method. Additionally, it uses "experiential approach" to engage students to create or contribute to business creation (Chaker & Jarraya, 2021). Both are "student-centered" pedagogy, which instructor of the course play more facilitator.

Entrepreneurial Personality and Mindset

Scholars from area of entrepreneurship began to wonder either entrepreneur born with some special traits that helps individuals explore and recognize opportunities, or they grow mindset in during their lifetime. (Mathisen & Arnulf, 2013) mentioned that entrepreneurial mindset (EM) become individuals different from others, mindset grow and influenced by individuals' activities and environment. Since there are various definitions of entrepreneurial mindset. (Naumann, 2017) conducted synthetic literature review on EM, used comprehensive method to provide latest of entrepreneurial mindset concept and its development. The author mentioned definition of existing EM literature are "more or less" to each other According to the author definition of EM is fully connected with "thinking" and it is based on a "cognitive perspective".

Entrepreneurial Mindset Assessments

As mentioned in previous section there is no correct definition of entrepreneurial mindset (EM) and its components. To measure or assess students EM is same as defining it. There is not only one assessment plan to use in every case. Depending on how each university define EM in their courses and programs, an assessment plan should be developed. (Lichtenstein & Monroe-White, 2017)

(Lichtenstein & Monroe-White, 2017) reviewed total of 22 assessment instruments mentioned in literature. The review cover literature from 1989 to 2016. Among all 22 instruments, there are total of 63 components were mentioned as a part of EM. Here are some examples shown in Table 1 below.

Table 6. Components of Entrepreneurial Mindset Assessment

achievement orientation	attitude towards entrepreneurship	challenging Perspectives	confrontation tolerance done
networking	innovativeness	non-conformity	problem-solving
organizational leadership orientation	pro-activeness	risk-taking	self-efficacy
self-esteem, self confidence			

Source: Researcher (components chosen from (Lichtenstein & Monroe-White, 2017)

Definition and Origin of Project-Based Learning

The root of project-based learning (PBL) started with (Dewey, 1938)'s theory of "learning by doing" and (Kolb, 1984)'s "experiential learning". From (Dewey, 1938)'s educational point of view, students must interact with their environment in order to adapt and learn. In 1984, (Kolb) introduced his four stage experimental learning cycle and it is inspired by Dewey's educational model of "learning by doing". Kolb noted that "*Learning is the process whereby knowledge is created through the transformation of experience"* (Kolb, 1984, p. 38). Project-based learning is teaching model that students learning from and "around projects".(Thomas, 2000). Traditional classroom projects are extra to the curriculum, but PBL projects are central. With PBL approach students only focuses on one big project through the whole semester. Differences between traditional and PBL projects are students take ownership of the project, teachers play facilitator role, and PBL focuses on student centered learning. (Botha, 2010). According to (Thomas, 2000) definition of projects in PBL is "complex tasks that involve students in design, problem solving, decision making, and other investigative activities. PBL gives students the opportunity to work relatively autonomously over extended periods of time, and the students' work generally culminates in realistic products or presentations." (Thomas, 2000) addressed five criteria for PBL projects as "centrality", "driving question", "constructive investigations", "autonomy", and "realism" Figure 3.

Criteria for Project-based learning	Centrality	PBL projects are central, not peripheral to the curriculum.
	Driving questions	PBL projects are focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline.
	Constructive investigation	Projects involve students in a constructive investigation.
	Autonomy	Projects are student-driven to some significant degree.
	Realism	Projects are realistic, not school-like

Figure 7. Five Criteria for PBL Projects

Source: Adapted from (Thomas, 2000)

Concept and Principles of Project-Based Learning

Universities have been trying to offer students technical skills and "soft skills" such as team working, networking and commutation, and "problem-solving" skills. However, these skills are not easy to achieve by current teacher-centered pedagogy. In order to change this situation, universities should give an opportunity to students to practice their technical skills in a real-world problem (Guo et al., 2020). Project-Based Learning (PBL) is a student-centered pedagogy that students can apply their prior academic knowledge to a real-world problem. (Botha, 2010) adopted PBL framework developed by Law and Chuah (2004). The framework applied successfully to teach entrepreneurship in South African University. As shown in Figure 4 below, (Botha, 2010) demonstrated necessary PBL main components. Projects in PBL approach primarily "student directed", which means that students take ownership of the project, and instructors need play role as "facilitator and coaches". Students work as team to solve real world problem in extended period, preferably outside of classroom(Botha, 2010).

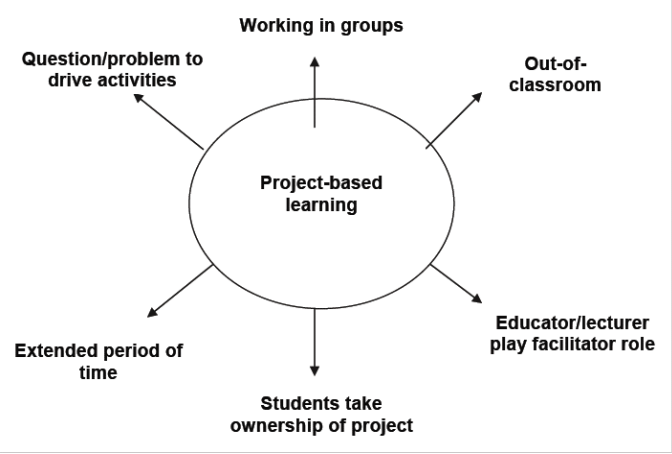

Figure 8. Components of Project-Based Learning (PBL)

Source: (Botha,2010)

Method

Research Design

This research aims to explore the impact of project-based learning (PBL) on entrepreneurship education of engineering students in Mongolia and to explore a change of students' entrepreneurial mindset. The research framework is illustrated below (Figure 5). To explore the change of engineering students' mindset within PBL, a qualitative research method will be conducted. As shown in Figure 5 below, this research divided into three phases. Literature review is to identify the development of entrepreneurship education its related educational policy and concept of project-based learning.

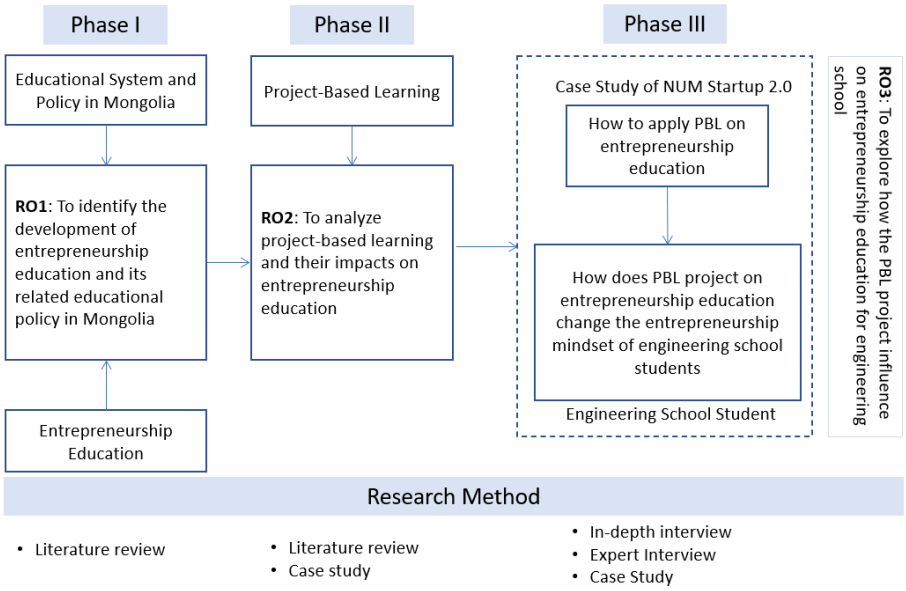

Figure 9. Research framework

Source: Researcher

Case Introduction

Criteria of Case Selection

There are five criteria that had to meet in order to collect correct and reliable data to explore students' entrepreneurial mindset and the impact on project-based learning. As the researcher mentioned earlier in this paper about PBL components based. These criteria are based on Figure 4 Components of project-based learing (PBL).

1. "Work in groups"
2. "Out-of-classroom"
3. "Educator/lecturer plays a facilitator role"
4. "Students take ownership of a project"
5. "Extended period of time"

Case Background

MIT Global Startup Labs (GSL) program helps developing countries to establish startup for university students. GSL trains science and technology background undergraduate and graduate students to teach their knowledge to other universities students. Every year GLS partner with regional best universities to offer intensive eight weeks bootcamp program. In 2016, GLS partnered with National University of Mongolia (NUM) and Mongolian University of Science and Technology (MUST) to help students to develop their business ideas into action. In 2017, NUM decided to launch own startup intensive program under the name of NUM Startup 1.0. The focus was to provide NUM students theoretical and practical knowledge of starting a business and to promote the startup business movement (NUM, 2017). NUM Startup 1.0 duration was three weeks and includes a series of classes such as entrepreneurial thinking and skills, "Business model", Things to consider when building a team (NUM, 2017). In 2018 NUM Startup 1.0 changed its program name to NUM Startup 2.0. The main feature of the change was students must team up with their professors to participate for the program. Next big change was the program duration dramatically increased from three weeks to five months with five phases.

Results and Discussion

Pilot Study Interviews

The researcher made an assumption that a teaching method of NUM Startup 2.0 is project-based learning (PBL). To ensure that and explore more about NUM Startup 2.0, the researcher conducted a pilot study. The researcher has conducted two interviews with students participated in NUM Startup 2.0 in 2019 and 2020. (See Table 2). The researcher adopted components of project-based learning (see Figure 4) based on literature review to develop further interview questions. The semi structured interview questions divided into four different parts

1. Overall experience
2. Teaching style
3. Team startup project
4. Stimulation of entrepreneurship

Table 7. Pilot Study Interviews

Interview	Major	Interview Form	Time Duration	Participated year
Interviewee A	Electronic Engineering	Online	1 hour	2020
Interviewee B	Bio-Technology Engineering/IT engineering	Online	1 hour	2019

Source: Researcher

Findings from the Pilot Study Interviews

The Pedagogy of NUM Startup 2.0 is Project-based Learning

1) Educators' Role in NUM Startup 2.0 are as Facilitators

Based on the findings, the criteria from literature review meets the findings. When the researcher given questions to the interviews on reviewing previous experiences, both interviewees agreed on agreed on most of the factors. One of the criteria is that educators must play facilitators role in the project or course. Both interviewees emphasized that working with educator was easy going and had a good atmosphere (see Figure 6).

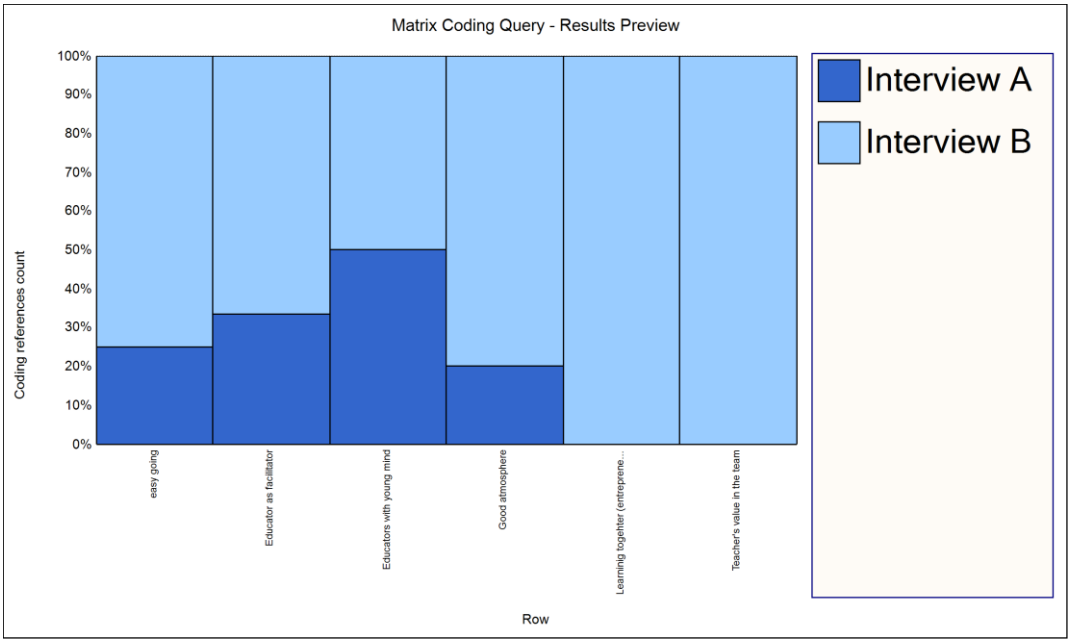

Figure 10. Educators role in NUM Startup 2.0

Source: Researcher

As a matter of fact, students working closely with educators helps them to achieve more greater results on their projects. They both think without a teacher the projects can not go through:

> *"I think since our project is related to bio engineer.... basically we can not do anything without a teacher help" (Interviewee B, 2022)*

2) Outside of Classroom

NUM Startup 2.0 is five months long summer project. Students joined the projects end of their spring semester and it ended around mid of fall semester. The project goal is every team participated must show a working product in the end of the project. Therefore, students need to spend more time together in the lab or outside of the school. The interviewees said that throughout the whole project they only went to the classroom for the lectures held by business mentors and teachers (see Figure 7). Both interviewees mentioned working outside of the classroom was a success:

> *"The school held ... two or three a whole day workshop from morning to evening in countryside... Which was really good experience for me and my teammates to communicate other teachers easily"... (Interviewee B, 2022)*

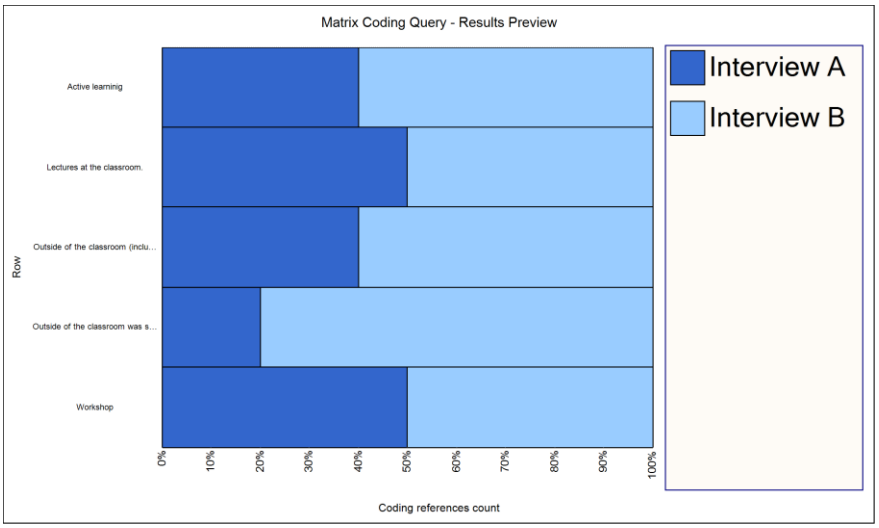

Figure 11 Working outside of the classroom NUM Startup 2.0

Source: Researcher

3) Work in Groups/Team Working

Based on the findings both interviewees strongly agreed that they could not finish the projects without a good team communication, trusting each other and getting motivated by work (see Figure 8). As a team coming up with brilliant idea was easy for the interviewees. But executing that idea into project was the most challenging part for the participants due to unexpected error and incidents may happen. To successfully finish their project team working was the most crucial part of the project:

> *Since I am the leader of our project I was responsible for everything… Because it was so long project some of our teammates almost gave up. But I was there for cheering them up… After that we participated the biggest Information and Communications Technology (ICT) expo. And we were so proud of ourselves (Interviewer A, 2022)*

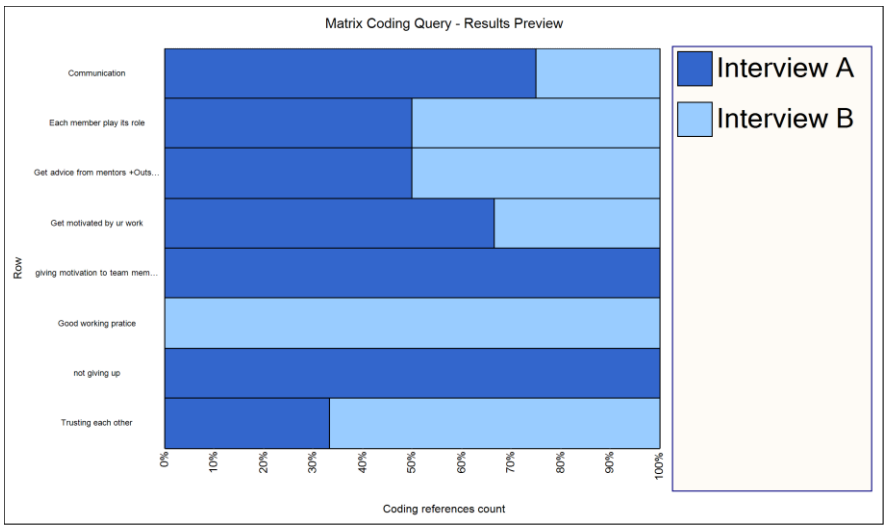

Figure 12 Team working NUM Startup 2.0

Source: Researcher

Conclusion

This is research is still ongoing. Case study with semi-structured interview will be conducted with participants of NUM Startup 2022. Based on the pilot study findings further in-depth interview questions will be developed. Thematic analysis will be used as qualitative approach to develop further findings. Based on the findings the researcher will develop another semi-structured interview questions for industry experts or teachers to validate the findings. How engineering student's entrepreneurial mindset changed after attend NUM Startup 2.0 is the expected outcome of this research. Hence contribute theoretically to teachers, educators, and experts to develop more well-structured courses for students.

References

Science, Technology and Innovation in Mongolia. Niras. (n.d.). Retrieved May 25, 2022, from https://www.niras.com/news/science-technology-and-innovation-in-mongolia/

Alanazi, A. (2018). *The Impact of Entrepreneurship Education Programs on Entrepreneurship Intention: Updating the Field of Entrepreneurship Education*

Bosma, N., Hill, S., Ionescu-Somers, A., Kelley, D., Guerrero, M., Schøtt, T., & the. (2021). *Global Entrepreneurship Monitor. 2020/2021 Global Report*.

Botha, M. (2010). A project-based learning approach as a method of teaching entrepreneurship to a large group of undergraduate students in South Africa. *Education As Change*, *14*, 213-232. https://doi.org/10.1080/16823206.2010.522059

Chaker, H., & Jarraya, H. (2021). Combining teaching "about" and "through" entrepreneurship: A practice to develop students' entrepreneurial competencies. *Industry and Higher Education*, *35*(4), 432-442. https://doi.org/10.1177/0950422221991005

Delgernasan M., A. A. (2015). Academic Career Perspective at an Entrepreneurial University. The international conference on innovation and entrepreneurship development – Proceedings,

Dewey, J. (1938). *Experience and education*. Macmillan.

Djankov, S., & Zhang, E. (2020). Startups boom in the United States during COVID-19. *Washington, DC: Peterson Institute for International Economics. https://www. piie. com/blogs/realtime-economic-issues-watch/startups-boom-united-states-duringCOVID-19, accessed*, *16*, 2021.

Drucker, P. F. (1985). *Innovation and entrepreneurship: Practice and principles. New York: Harper & Row.*

Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, *102*, 101586. https://doi.org/https://doi.org/10.1016/j.ijer.2020.101586

Kolb, D. (1984). *Experiential Learning: Experience As The Source Of Learning And Development* (Vol. 1).

Kouakou, K. K. E., Li, C., Akolgo, I., & Tchamekwen, A. (2019). Evolution View of Entrepreneurial Mindset Theory. *International Journal of Business and Social Science*, *10*. https://doi.org/10.30845/ijbss.v10n6p13

Lichtenstein, G., & Monroe-White, T. (2017). Entrepreneurial mindset. Assessment reviews.

Mathisen, J.-E., & Arnulf, J. K. (2013). Competing mindsets in entrepreneurship: The cost of doubt. *The International Journal of Management Education*, *11*(3), 132-141. https://doi.org/https://doi.org/10.1016/j.ijme.2013.03.003

Mokaya, S. O., Namusonge, M. J., & Sikalieh, D. (2012). The Concept of Entrepreneurship; in pursuit of a Universally Acceptable Definition.

Naumann, C. (2017). Entrepreneurial Mindset: A Synthetic Literature Review. *Entrepreneurial Business and Economics Review*, *5*, 149-172. https://doi.org/10.15678/EBER.2017.050308

NUM. (2017). *Num startup 1.0 хөтөлбөр амжилттай үргэлжилж байна [NUM startup 1.0 program continues successfully]*. https://news.num.edu.mn/?p=42221

Oyuntsetseg L., O. B., Baasandash Ch.,, & Batkhurel G. (2015, 05/15). Development of an Entrepreneurial University: Challenges of MUST. Proceeding of International Conference on Innovation and Entreprenuership Development:ICIED-2015,

Shane, S., & Venkataraman, S. (2000). The Promise of Entrepreneurship as a Field of Research. *The Academy of Management Review*, *25*(1), 217-226. https://doi.org/10.2307/259271

Sieger, P., Raemy, L., Zellweger, T., Fueglistaller, U., & Hatak, I. (2021). *Global Student Entrepreneurship 2021: Insights From 58 Countries 2021*.

Taylor, F. W. (1947). Scientific Management. Comprising: Shop Management; The Principles of Scientific Management; Testimony before the special House Committee,New York & London: Harper & Brothers Publishers.

Thomas, J. (2000). A Review of Research on Project-Based Learning.