A TOOL FOR ASSESSING CHANGES AND GROWTH IN ENTREPRENEURIAL MINDSET AND SKILL SETS GAINED THROUGH HIGHER EDUCATION PROJECT-BASED LEARNING

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Abstract

This paper introduces an assessment tool designed for higher education entrepreneurship program participants to understand their changes and growth in developing an entrepreneurial mindset and skill sets. The Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan initiated and completed a 3-year cycle of the Enhancing Development of Global Entrepreneur (EDGE) program. EDGE was carried out in various higher education settings, between 2014 and 2018. Hiroshima University (HU) was one of 13 universities to design and implement EDGE. We developed an original assessment tool to ensure its usefulness for program participants in understanding their changes and growth and to improve the program.

The goals of the EDGE program were to: 1) foster an entrepreneurial mindset and skill sets in participants; and 2) form and maintain an innovation ecosystem with participants and relevant internal and external human resources and organizations. To assess the first goal, we created an original tool with a 6-point Likert scaled-response format.

Program participants responded to the same set of questions at the start and end of the program. One hundred three (103) responses were collected from 3 EDGE participating universities between January 2015 to March 2017. Usable responses from 34 EDGE participants showed a statistically significant increase in the average scores for all 7 capacity areas. This indicated that the increase in assessment scores was unlikely due to chance.

An original assessment tool in 6-point Likert scaled-response format was based on previous international studies about entrepreneurial mindset and skill sets. It can be internationally used and modified by other entrepreneurship educators.

Keywords: Entrepreneurship Education, Assessment, Higher Education, PBL, Entrepreneurial Mindset, Entrepreneurial Skill Sets

1 INTRODUCTION

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan initiated and completed a 3-year cycle of the Enhancing Development of Global Entrepreneur (EDGE) program. EDGE was carried out in various higher education settings, between 2014 to 2018. Hiroshima University (HU) was one of the 13 universities to design and implement the EDGE program.

The goals of the EDGE program were to: 1) foster an entrepreneurial mindset and skill sets in participants; and 2) form and maintain an innovation ecosystem with participants and relevant internal and external human resources and organizations [1]. To provide a quality program that aligns with EDGE's goals during a grant cycle and beyond requires us to periodically evaluate and improve the program content [2]. As HU started to design the EDGE program, an evaluation approach was also examined to plan, design, and conduct.

Selecting an evaluation method depends on the purpose of the evaluation and the stage of a target program. Pancer and Westhues [3] describe 4 stages of the life of a program: Before Program Begins, New Program, Established Program, and Mature Program. The HU EDGE program fell into the New Program stage, and we selected a Process Evaluation from the Formative Evaluation category. This evaluation approach met the purpose of the evaluation of the program [3], [4], [5].

A formative evaluation is a method for assessing the worth of a program while the program activities are progress. It is also useful in analyzing learning materials, participant's learning and achievements [6].

The purpose of a process evaluation from the formative evaluation is to examine the program and determine whether the program was working and operating as planned.

In this study, the First EDGE program goal was selected for evaluation. Our focus was to understand whether program participants gained an entrepreneurial mindset and skill sets. We developed an original assessment tool with a 6-point Likert scaled-response format. This format is useful for seeing a change in growth of an entrepreneurial mindset and skill sets, and to improve the program.

The tool includes 56 questions in 7 capacity areas which were developed from findings and frameworks from previous studies. We conducted a literature review to learn when and how innovators and entrepreneurs think and take concrete actions when casting their ideas into shape, including the work done by Dyer, Gregersen, and Christensen [7], [8], [9].

We verified the validity of the assessment tool by analyzing usable responses from 34 EDGE participants. We found a statistically significant increase in the average scores for all 7 capacity areas. This indicated that the increase in assessment scores was unlikely due to chance.

The purpose of this paper is to introduce readers to an assessment tool designed for higher education entrepreneurship program participants to understand their changes and growth in an entrepreneurial mindset and skill sets.

2 METHODOLOGY

In this section, we provide the details of how we designed the assessment tool and collected information to verify its validity. We took three steps to conduct the process. First step was designing an original assessment tool. The second step was implementing the tool with program participants. Third step was collecting responses from the tool and analyzing the responses. We explain each step in the following sections.

2.1 Designing an original assessment tool

We chose to evaluate the Enhancing Development of Global Entrepreneur (EDGE) program's first goal of fostering an entrepreneurial mindset and skill sets in program participants. To design an original assessment tool, we conducted a literature review to learn how an entrepreneurial mindset and skill sets have been previously studied [10], [11], [12], [13], [14], [15]. We focused specifically on how we could design the assessment tool including capacity areas which introduce the entrepreneurial mindset and skill sets. The participants can understand which mindset and skill sets they already hold and aim to gain through higher education project-based learning.

2.1.1 Discovery skills: Behaviours forming innovators and entrepreneurs

A key concept identified in the literature review was when and how innovators and entrepreneurs think and take concrete actions when casting their ideas into shape. The work done by Dyer, Gregersen, and Christensen played a significant role in helping us design the capacity areas of an entrepreneurial mindset and skill sets [7], [8], [9].

Dyer, Gregersen, and Christensen found that specific patterns of behavior emerged to generate innovative ideas based on their extensive data collection and analysis with a grounded theory study. They identified a mindset and skill sets that help innovators and entrepreneurs come up with new ideas and become the source of innovation. These behaviors are categorized in 5 Discovery Skills that can be learned by people, rather than traits people are born with [7], [8], [9]:

- Discovery Skill 1, Associating: Associating means to connect unrelated questions, problems, concepts and ideas from different fields.
- Discovery Skill 2, Questioning: Questioning implies constantly asking questions to challenge common wisdom and senses.
- Discovery Skill 3, Observing: Observing is about inspecting common phenomena closely and thoroughly — particularly the behavior of potential customers.
- Discovery Skill 4, Experimenting: Experimenting includes actively trying out new ideas by creating prototypes and launching pilots.

- Discovery Skill 5, Networking: Networking suggests meeting people with different ideas and perspectives and thinking together across networks and disciplines.

2.1.2 Applying discovery skills to the first goal of Hiroshima University's Enhancing Development of Global Entrepreneur program: Seven capacity areas

Along with the overall EDGE's first goal, Hiroshima University (HU) set its first goal to support program participants in deepening and further cultivating the qualities of innovative and entrepreneurial mindset and skill sets, with 7 specific capacity areas: 1) Tenacity, 2) Decisiveness, 3) Problem Finding and Solving, 4) Risk Management, 5) Communication Skills, 6) Interdisciplinary Strengths with Networking and Collaboration Skills, and 7) Spirit of Challenge.

Our focus was to understand whether program participants gained the entrepreneurial mindset and skill sets presented in these 7 capacity areas. We developed an original assessment tool with a 6-point Likert scaled-response format. The tool includes 56 questions in 7 capacity areas which were developed from findings and behaviors introduced and presented in the 5 Discovery Skills studied by Dyer, Gregersen, and Christensen, in addition to other previous studies [7], [8], [9], [10], [11], [12], [13], [14], [15].

2.1.3 Validating the function of the assessment tool

We first asked a faculty member from the Social Psychology Department, Graduate School of Integrated Arts and Sciences at HU to confirm the design of the assessment tool. Wording and number of questions in the tool were revised after his review.

We then conducted pilot tests of the revised assessment tool with a total number of 17 people: 3 program participants and 1 teaching staff from HU EDGE program, and 10 program participants and 3 faculty members from Tokyo Institute of Technology EDGE program. With their feedback, we revised the tool to ensure its usefulness and understandability. We also kept in mind the importance of participants understanding their own changes and growth in developing an entrepreneurial mindset and skill sets.

Table 1 shows the most updated assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool) with a 6-point Likert scaled-response format with 56 questions in 7 capacity areas.

Table 1. EDGE: 7 Capacity areas self-assessment tool

– Develop behaviors and innovative ways of thinking.

7 Capacity Areas / [Mindset] Courage to tackle innovation						
Tenacity: Strength within oneself to keep going towards recovery	1	2	3	4	5	6
1. I don't drag out my failure.						
2. I think to myself, "I should be always capable."						
3. Even if work is not going well, I'm not going to stop immediately.						
4. I can create a situation where I can easily come up with ideas.						
5. I do not hesitate to ask questions and proactively ask the questions.						
6. I'm aware of skills that I don't have.						
7. I take criticism calmly.						
8. I can swallow my pride and ask for help.						
Decisiveness: Remain decisive while using different perspectives	1	2	3	4	5	6
1. I want to change the current situation.						
2. I can find people with the skills and competencies that I look for.						

3. At some point, I'm not afraid if a decision is not supported.						
4. When I try to solve a problem, if anything doesn't go well no matter what I try, I let it go.						
5. At some point, I'm fine if it's not perfect.						
6. I can team up with people with the skills and competencies that I look for.						
7. I am skilled in my work.						
8. I can propose an interesting approach that people accept without thinking.						
7 Capacity Areas / [Skill Sets] Capacity areas needed for innovation						
Problem Finding and Solving: Carefully observe the real world	1	2	3	4	5	6
1. I do not get caught by common sense.						
2. I observe things around me.						
3. I try to gain awareness from what I observe.						
4. I search consciously for what is unexpected.						
5. I'm interested in what people want to get done.						
6. I think about what is missing and look for a solution.						
7. I look around me by changing my perspective.						
8. I purposefully think about unconventional ways of doing things.						
Risk Management: Take a "smart risk"	1	2	3	4	5	6
1. I spend time to find ideas.						
2. I do not to make blind assumptions about results.						
3. When I come up with an idea, I "rethink" my idea repeatedly.						
4. I take risks when necessary.						
5. I proactively learn from failures.						
6. I don't leave my ideas unattended and put the ideas in action as soon as possible.						
7. If something doesn't work, I move on and try something else.						
8. I'm not afraid of swinging and aim for a home run!						
Communication Skills: Find a better question	1	2	3	4	5	6
1. I listen seriously to people's ideas.						

2. I recognize that “asking” holds the same value as “an excellent answer.”						
3. I make sure people understand correctly what I asked.						
4. I discuss with people different ideas.						
5. I always talk to various people.						
6. I ask about “who, what, when, where, and how.”						
7. I ask questions to help me to understand the current situation.						
8. I ask “what if….”						
Interdisciplinary Strengths with Networking and Collaboration Skills: Create and utilize a network	1	2	3	4	5	6
1. When I come up with an idea, I find out what other cases exist.						
2. I share my ideas with people from different fields and industries.						
3. I have a wide network of people with diverse backgrounds and ideas.						
4. I’m learning many from people with different ways of thinking.						
5. I try to understand the problems newly met people have.						
6. I try to find solutions to problems based on solutions and ideas developed in other industries, fields, and areas.						
7. There are people with whom I can consult when I make decisions.						
8. I actively contribute.						
Spirit of Challenge: Be curious about new things and proactively experiment with ideas	1	2	3	4	5	6
1. I like new challenges.						
2. I actively seek opportunities to change the status quo.						
3. I keep trying until the idea takes shape.						
4. I drive failure to drive forward.						
5. I help people understand their challenging attempts.						
6. I actively seek comments from people around me.						
7. I try a different way when I fail.						
8. I’m interested in various situations and try to find new things in my daily life.						

Note: The 6-point Likert scale reads; 1. Very Strongly Disagree, 2. Strongly Disagree, 3. Somewhat Disagree, 4. Somewhat Agree, 5. Strongly Agree, and 6. Very Strongly Agree.

2.2 Implementing the assessment tool

The second step was implementing the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool) with program participants. Three universities from the EDGE program — Hiroshima University (HU), Tokyo Institute of Technology, and Waseda University — used the assessment tool between January 2015 and March 2017. One hundred three (103) responses were collected from these universities.

2.2.1 Profile of program participants who used the assessment tool

Table 2 shows the profile of 103 program participants who used the assessment tool.

Table 2. Profile of program participants who used the assessment tool.

Status	Adult Continuing Education	Graduate School	Undergraduate	
	58%	30%	12%	
Gender	Male		Female	
	76%		24%	
Age	20-29	30-39	40-49	50+
	43%	31%	20%	6%

2.2.2 Procedures of using the assessment tool

Program participants responded to the same set of questions in the assessment tool at the start and end of the program. The tool helps the participants assess their entrepreneurial mindset and skill sets using two approaches. The teaching strategies used to support these approaches are discussed.

The first approach helps participants understand how innovators and entrepreneurs find their potential ideas and what point of view they focus on to add an innovative dimension. To support and promote their understanding, a teaching staff gave an interactive lecture after participants completed the assessment tool for the first time. During the lecture, they discussed their understanding about their entrepreneurial mindset and skill sets and what surprised them.

The second approach helps participants see the change and growth in their entrepreneurial mindset and skill sets. At the time when they completed the program, the participants compared their responses from the two sets of assessment tools. They saw what stayed the same and what changed and grew. A teaching staff gave an interactive lecture to help participants reflect on their responses. The teaching staff also conducted an individual interview with several participants to understand their learning.

2.3 Collecting and analyzing responses

The third step was collecting responses from program participants and analyzing the responses. All responses were collected by each university's EDGE program administrator in electronic medium or paper. The collected responses were sent to a teaching assistant (TA) at HU EDGE program who is one of authors of this paper. The TA entered the responses into a spreadsheet which followed the assessment tool's 6-point Likert scaled-response format with 56 questions.

One of the authors of this paper conducted a calculation of the t-test by using a database file. We also asked a faculty member from the Graduate School of Engineering / School of Engineering at HU, who was a teaching member of HU EDGE program, to verify the calculation of the t-test. His review confirmed the statistical tests.

Of the 103 program participants from 3 universities, we found 34 responses to be usable. Useable responses are defined as those whose program participants: 1) Responded to the two sets of questions in the same assessment tool at the start and end of the program in which they had registered; and 2) Responded completely to the questions in the assessment tool.

3 RESULTS

In this section, we state what we found by analyzing useable responses to the assessment tools (EDGE: 7 Capacity Areas Self-Assessment Tool) that were collected from 3 EDGE program providing universities.

Table 3 shows paired samples statistics for the 34 usable EDGE program participant responses on the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool).

Table 3. Paired samples statistics for 34 EDGE participant responses on the assessment tool.

		Mean	f	SD	SEM
Pair 1	[Average at Start of Program] Tenacity	3.838	34	.4476	.0768
	[Average at End of Program] Tenacity	**4.353**	34	.5227	.0896
Pair 2	Decisiveness	3.971	34	.6404	.1098
	Decisiveness	**4.386**	34	.5226	.0896
Pair 3	Problem Finding and Solving	4.048	34	.6314	.1083
	Problem Finding and Solving	**4.592**	34	.6376	.1093
Pair 4	Risk Management	3.912	34	.6019	.1032
	Risk Management	**4.471**	34	.6693	.1148
Pair 5	Communication Skills	3.930	34	.6651	.1141
	Communication Skills	**4.511**	34	.7388	.1267
Pair 6	Interdisciplinary Strengths with Networking and Collaboration Skills	4.029	34	.7966	.1366
	Interdisciplinary Strengths with Networking and Collaboration Skills	**4.449**	34	.7138	.1224
Pair 7	Spirit of Challenge	4.140	34	.6955	.1193
	Spirit of Challenge	**4.507**	34	.6381	.1094

Note: Frequency is indicated by f, Standard Deviation is indicated by SD, and Standard Error of the Mean is indicated by SEM.

Table 4 shows a report of paired samples test for 34 EDGE program participant responses on the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool).

Table 4. Paired samples test for 34 EDGE participant responses on the assessment tool.

		t	*df*	Sig. (2-tailed)
Pair 1	[Average at Start of Program] Tenacity - [Average at End of Program] Tenacity	-5.497	33	**.000**
Pair 2	Decisiveness – Decisiveness	-4.348	33	**.000**

Pair 3	Problem Finding and Solving - Problem Finding and Solving	-4.706	33	**.000**
Pair 4	Risk Management – Risk Management	-5.511	33	**.000**
Pair 5	Communication Skills – Communication Skills	-4.978	33	**.000**
Pair 6	Interdisciplinary Strengths with Networking and Collaboration Skills - Interdisciplinary Strengths with Networking and Collaboration Skills	-3.476	33	**.001**
Pair 7	Spirit of Challenge – Spirit of Challenge	-3.420	33	**.002**

Note: The *t*-test statistic is indicated by *t*, Degrees of Freedom is indicated by *df*, and Significance Level is indicated by Sig. (2-tailed).

4 CONCLUSIONS

In this section, we discuss our interpretation of results from useable responses to the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool) that were collected from 3 EDGE program providing universities. We also state the limitations of the assessment tool and future studies that need to be carried out.

4.1 Discussion of results

4.1.1 Interpretation of descriptive and inferential statistics in data

Analytic results from useable responses to the assessment tool showed that the average scores for the second assessment at the end of program increased from the average scores for the first assessment at the start of program in all 7 capacity areas: [Average at Start of Program] Tenacity mean=3.838, [Average at End of Program] Tenacity mean=4.353; [Start] Decisiveness mean=3.971, [End] Decisiveness mean=4.386; [Start] Problem Finding and Solving mean=4.048, [End] Problem Finding and Solving mean=4.592; [Start] Risk Management mean=3.912, [End] Risk Management mean=4.471; [Start] Communication Skills mean=3.930, [End] Communication Skills mean=4.511; [Start] Interdisciplinary Strengths with Networking and Collaboration Skills mean=4.029, [End] Interdisciplinary Strengths with Networking and Collaboration Skills mean=4.449; [Start] Spirit of Challenge mean=4.140, [End] Spirit of Challenge mean=4.507.

A paired samples *t*-test found that differences in the average scores between the start and end of program in 7 capacity areas were statistically significant: 1) Tenacity $t(33) = -5.497$, $p < 0.001$; 2) Decisiveness $t(33) = -4.348$, $p < 0.001$; 3) Problem Finding and Solving $t(33) = -4.706$, $p < 0.001$; 4) Risk Management $t(33) = -5.511$, $p < 0.001$; 5) Communication Skills $t(33) = -4.978$, $p < 0.001$; 6) Interdisciplinary Strengths with Networking and Collaboration Skills $t(33) = -3.476$, $p < 0.05$; and 7) Spirit of Challenge $t(33) = -3.420$, $p < 0.05$.

4.1.2 Summary of data interpretation

Using the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool) we were able to capture program participants' changes quantitatively. There was no tool to evaluate 7 capacities which include the entrepreneurial mindset and skill sets altogether at the same time. We confirmed that program participants' entrepreneurship mindset and skillsets in 7 capacity areas, which were developed from previous studies, showed increases in the average scores at the end of program.

The interpretation of both descriptive and inferential statistics in data indicated that the increase in the average scores for the assessment tool was unlikely due to chance.

The assessment tool is considered to be a valid assessment tool for two purposes. The first purpose is to understand program participants' changes and growth in entrepreneurial mindset and skill sets gained through higher education project-based learning. The second purpose is for participants to self-assess

their changes and growth by self-assessment in order to foster their entrepreneurial mindset and skill sets.

4.2 Limitations and future studies

Two approaches are considered as guidance for future examination and refining of the assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool).

The first approach is that we need to conduct further investigation of the assessment tool with a control group who does not participate in the EDGE program. With data from a control group, we could examine if EDGE program participants have changed in their entrepreneurship mindset and skill sets in 7 capacity areas only as a result of participating in the EDGE program.

The second approach is that we continue to examine the effectiveness of all questions in the assessment tool by conducting a factor analysis.

4.3 A suggestion for usage of the assessment tool

The purpose of this paper is to share an assessment tool (EDGE: 7 Capacity Areas Self-Assessment Tool) designed for higher education entrepreneurship program participants to understand their changes and growth in entrepreneurial mindset and skill sets.

The assessment helps program faculty and teaching staff understand participants' changes and growth, and it helps them evaluate and improve the program content if necessary.

The tool also benefits program participants by:

- Helping them understand their entrepreneurial mindset and skill sets at the beginning of the program.
- Helping them see the changes and growth of their entrepreneurial mindset and skill sets.
- Informing program improvement for future participants.

We verified the validity of the assessment tool which was designed with the 6-point Likert scaled-response format and based on previous international studies about entrepreneurial mindset and skill sets. It can be internationally used and modified by other entrepreneurship educators for program participants in entrepreneurship education in higher education settings.

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REFERENCES

[1] Ministry of Education Culture, Sports, Science and Technology, Enhancing Development of Global Entrepreneur (EDGE) Program, Accessed 19 September, 2019. Kawase M, translator. Retrieved from http://www.mext.go.jp/a_menu/jinzai/edge/1400289.htm

[2] M.Q. Patton, *Qualitative research evaluation methods*. Thousand Oaks/CA: Sage Publishers, 1987.

[3] S. M. Pancer and A. Westhues, "A developmental stage approach to program planning and evaluation," *Evaluation Review*, vol. 13, pp. 56-77, 1989.

[4] R. H. Rossi, M. W. Lipsey, and H. E. Freeman, *Evaluation: A systematic approach*. Thousand Oaks/CA: Sage Publications, 2004.

[5] E. Norland, From education theory to conservation practice, *Annual Meeting of the International Association for Fish & Wildlife Agencies*, September, 2004. In *Building our understanding: Key concepts of evaluation* (S. S. Weaver), N.A. Retrieved from

https://www.cdc.gov/nccdphp/dch/programs/healthycommunitiesprogram/tools/pdf/eval_planning.pdf

[6] W. M. Guyot, “Summative and formative evaluation,” *Journal of Business Education*, vol. 54, no. 3, pp. 127-129., 1978.

[7] J. H. Dyer, H. Gregersen, and C. M. Christensen, “Entrepreneur behaviors, opportunity recognition, and the origins of innovative ventures,” *Strategic Entrepreneurship*, vol. 2, no. 4, pp. 317-338, 2008.

[8] J. H. Dyer, H. Gregersen, and C. M. Christensen, “The innovator’s DNA,” *Harvard Business Review 87*, no. 12, 2009. Retrieved from https://hbr.org/2009/12/the-innovators-dna

[9] J. H. Dyer, H. Gregersen, and C. M. Christensen, *The innovator's DNA: Mastering the five skills of disruptive innovators*. Harvard Business Review Press, 2011.

[10] Z. A. L. Pihie and A. S. A. Sani, “Exploring the entrepreneurial mindset of students: Implication for improvement of entrepreneurial learning at university,” *Journal of International Social Research*, vol. 2, no. 8, pp. 340-345, 2009.

[11] Y. A. Samuel, K. Ernest, and J. B. Awuah, “An assessment of entrepreneurship intention among Sunyani polytechnic marketing students,” *International Review of Management and Marketing*, vol. 3, no. 1, pp. 37-49, 2013.

[12] C. Morales and P. S. Marquina, “Entrepreneurial skills, significant differences between Serbian and German entrepreneurs,” *Business and Economics Research Journal*, vol. 6, no. 1, pp.129-141, 2013.

[13] P. P. Nandamuri, “Entrepreneurial Management Capabilities-The Differential Effect of Role Model,” *Journal of Entrepreneurship and Management*, vol. 4, no. 4, pp. 22-29, 2015.

[14] V. Muthukumar and S. Kumarm, “A study on entrepreneurial mindset and skills among young undergraduate students in Bangalore to Kristu Jayanti College,” *International Journal of Business and Administration Research Review*, vol. 3, no. 19, pp. 25-27, 2017.

[15] V. Loboda, I. Ostrovskyi, and I. Katernyak, “Developing entrepreneurial mindset in university undergraduates,” *E-methodology*, vol. 5, no. 5, pp.114-131, 2018.