# DEVELOPING ENTREPRENEURSHIP ECOSYSTEMS FOR POST-COVID 19 EMPLOYMENT CREATION

ZERO2ENTREPRENEUR

BY PROF. RAJESH NAIR, INNOVATION & ENTREPRENEURSHIP CENTER, ASB

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# EXECUTIVE SUMMARY

**What Will The Future Look Like Post Covid-19?**

The pandemic has revealed that the world's economic and social infrastructures are not prepared to contend with the unprecedented crisis or looming recession. We are currently faced with the world's most severe employment crisis since the Second World War. With a reduction of an equivalent of over 195 million full-time workers globally. Malaysia is also bracing for a similar challenge with Bank Negara warning of an overall increase in overall unemployment rate by 4% with certain hard hit sectors displacing up to 38% of their workforce.

Malaysia has already announced stimulus programs to reignite the economy and employment. Typically a lot of it goes to help struggling corporations and to support those who lost their jobs. But how do we create sustainable jobs with this stimulus fund?

How can the funds be invested to create 'jobs that create jobs'?

**Entrepreneurs To The Rescue**

Entrepreneurs are a significant source of employment. They use creative approaches, new tools and technologies to solve existing or future problems faster, cheaper, and better. Companies like Uber and Airbnb solved age-old problems in creative ways with technology while producing extraordinary outcomes.

Moreover, studies have shown that new companies inject the majority of the new jobs into the market compared to their older, longer established counterparts. In fact, they create approximately two-thirds of the new jobs in the market annually while solving an existing problem and creating wealth for their stakeholders. Each of these successful startups have entrepreneurs who dreamed of a venture and made it real.

**Creating Entrepreneurs from the Ground Up**

Research done by Prof Rajesh Nair at the Innovation and Entrepreneurship Center in Asia School of Business and at Massachusetts Institute of Technology has shown that with the right kind of intervention, youth from the general population could develop the mindset and skills set necessary to take on entrepreneurship as a career.

His experiments with university students demonstrate that innovation-driven entrepreneurs can be created, and helped create an innovation and entrepreneurship ecosystem that created 21 ventures in a matter of four years. All from a college that had one student startup in the previous twelve years since their founding.

**The Process**

The Zero2Entrepreneur program is a six months long program created at ASB goes through a multi-step process to create innovators, entrepreneurs and a sustainable ecosystem. This experiential program exposes them to:

1. Creativity: Ideation and Design
2. Technology: Mechanical, electronic, & software design of products
3. Fabrication: 3D printing, circuits, coding, assembly
4. Design Thinking: Ability to identify customer needs, developing solutions
5. Entrepreneurship: Basics of turning the opportunity into a venture
6. Ecosystem: Training and mentoring others, building the community

The ecosystem attracts candidates from the general population and trains them in innovation to solve real problems. Entrepreneurship mentoring further helps them commercialize and monetize these innovations. The ecosystem creates a support system for participants to learn, fail and recover on their journey to become a successful entrepreneur.

# INTRODUCTION

## A. IMPLICATIONS OF COVID ON JOB SECURITY AND EMPLOYMENT

With the recent onset of COVID-19, the International Labour Organization (ILO) has identified this period as the "most severe (employment) crisis since the Second World War)[1]. It estimates that social distancing measures globally have affected 2.7 billion working population. This represents approximately 81% of the global workforce. With the lockdown in place for many countries globally, the ILO approximates that there will be a reduction in 6.7% of the working hours, which is 195 million full-time workers. The sectors most severely affected by this include retail trade,

| Economic sector | Current impact of crisis on economic output | Baseline employment situation (global estimates for 2020 prior to COVID-19) | | | |
|---|---|---|---|---|---|
| | | Level of employment (000s) | Share in global employment (%) | Wage ratio (av. monthly sector earnings/av. total earnings ) | Share of women (%) |
| Education | Low | 176560 | 5.3 | 1.23 | 61.8 |
| Human health and social work activities | Low | 136244 | 4.1 | 1.14 | 70.4 |
| Public administration and defence; compulsory social security | Low | 144241 | 4.3 | 1.35 | 31.5 |
| Utilities | Low | 26589 | 0.8 | 1.07 | 18.8 |
| Agriculture; forestry and fishing | Low-Medium* | 880373 | 26.5 | 0.72 | 37.1 |
| Construction | Medium | 257041 | 7.7 | 1.03 | 7.3 |
| Financial and insurance activities | Medium | 52237 | 1.6 | 1.72 | 47.1 |
| Mining and quarrying | Medium | 21714 | 0.7 | 1.46 | 15.1 |
| Arts, entertainment and recreation, and other services | Medium-high* | 179857 | 5.4 | 0.69 | 57.2 |

[1] International Labour Organization, ▶ ILO Monitor 2nd edition: COVID-19 and the world of work Updated estimates and analysis, 2020.

| | | | | | |
|---|---|---|---|---|---|
| Transport; storage and communication | Medium-high* | 204217 | 6.1 | 1.19 | 14.3 |
| Accommodation and food services | High | 143661 | 4.3 | 0.71 | 54.1 |
| Real estate; business and administrative activities | High | 156878 | 4.7 | 0.97 | 38.2 |
| Manufacturing | High | 463091 | 13.9 | 0.95 | 38.7 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | High | 481951 | 14.5 | 0.86 | 43.6 |

**TABLE 1: ILO's Assessment of Workers At Risk[2]**

accommodation and food services, as well as manufacturing. The Table 1 shows sectors most affected in terms of economic outputs.

Predominantly in the low and middle income countries, a large proportion of the workforce is employed within hard-hit sectors, with a large percentage of them informally employed. Without sufficient policy measures put in place, these workers are at risk for falling into poverty. With recommended and compulsory workplace closures affecting 80% of the global workforce, University graduates as well as people employed within the hard-hit sectors are most at risk for job security.

# B. STIMULATING ENTREPRENEURSHIP AS AN IMPORTANT AND COST EFFECTIVE SOLUTION

Research has shown that most new jobs are created by newly established start-up companies compared to their older more established counterparts[3]. In fact, firms aged between 1 and 5 years of establishment create approximately two-thirds of all new jobs annually. Table 2 below shows the number of job creation in relation to firm age.

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[2] International Labour Organization, ▶ ILO Monitor 2nd edition: COVID-19 and the world of work Updated estimates and analysis, 2020.

[3] Dane Stangler and Robert E. Litan Ewing Marion Kauffman Foundation, *Where Will The Jobs Come From?*, 2009.

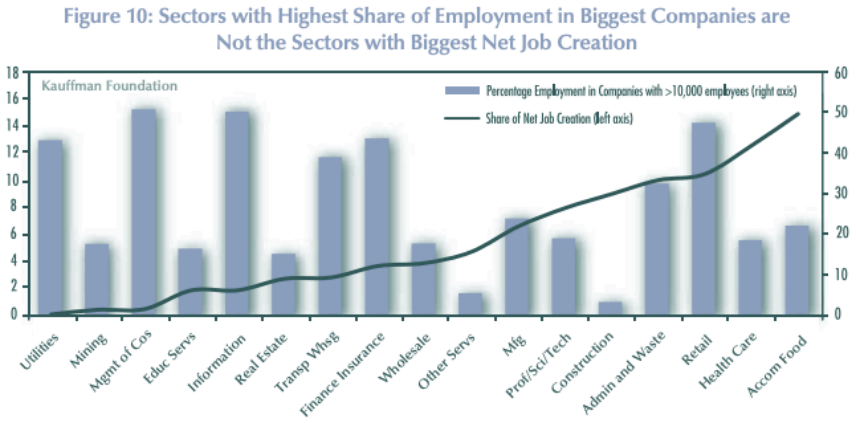



**Figure 1: Figure from Kauffman Foundation's Research Series: Where Will The Jobs Come From?**

It has been shown that newly started firms are most effective in creating jobs in sectors such as retail, accommodation and food services as well as professional, scientific and technical services. Most of these sectors happen to coincide with the COVID-19 top hit sectors as laid out in Table 1.

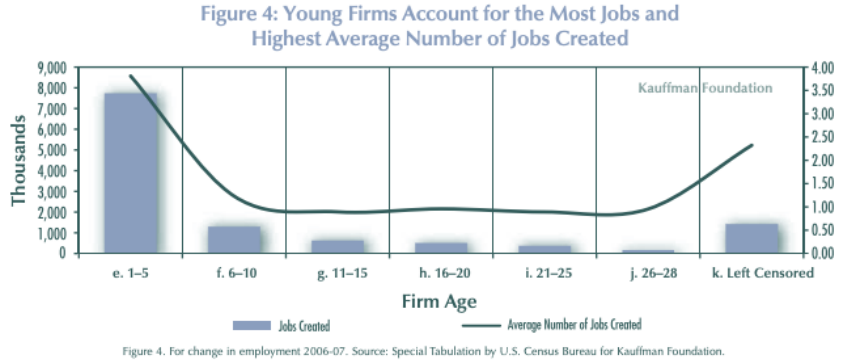
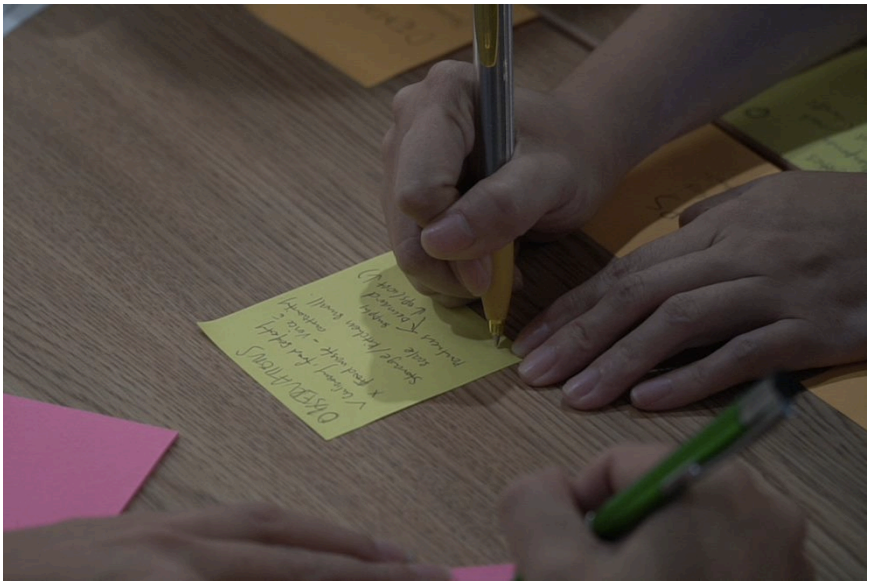



**Figure 2: Figure from Kauffman Foundation's Research Series on Sectors with Highest Share of Employment**

Research has also shown that investing in education is one of the most cost effective ways to curb unemployment[4] with maximal wages and benefits created from the resulting employment and therefore most sustainable investment in the long term.

# C. THE ZERO2ENTREPRENEUR ECOSYSTEM DEVELOPMENT PROGRAM

The Zero2Entrepreneur Ecosystem Development Program (Z2E-EEDP) is a program aimed at cultivating entrepreneurs, who would create new firms that would inject new jobs, especially in the highest employment impact sectors from the COVID-19 pandemic. This program was developed by Prof Rajesh Nair at the Asia School of Business and Massachusetts Institute of Technology, and could serve as an important intervention needed to reinvigorate the displaced workforce as a result of combatting the pandemic.



[4] University of Massachusetts Amherst, The U.S. Employment Effects of Military and Domestic Spending Priorities, 2007.

# BACKGROUND

## A. THE ASIA SCHOOL OF BUSINESS

The Asia School of Business (ASB) was founded by MIT Sloan School of Business and the central bank of Malaysia, Bank Negara, in 2015. ASB was founded in response to the need for highly-qualified, industry ready talents to fill the needs of the growth opportunities of Asia.

## B. INNOVATION AND ENTREPRENEURSHIP CENTER

ASB's Innovation and Entrepreneurship Center (IEC) was set up to provide innovation and entrepreneurship programs that increase problem solving, critical thinking as well as creative skill-sets and mindsets of individuals, with the aim to develop creative cultures and ecosystems within companies and communities throughout the world.

ASB's IEC programs are research-backed and have been conducted in schools, companies and with communities. The research helps understand the process and effectiveness of strengthening participants' innovation and entrepreneurship (IE) skill-sets and mindsets.

# C. THE FRAMEWORK

The Zero to Entrepreneur (Z2E) framework that was developed by Prof Rajesh Nair at MIT and ASB, and tested at several interventions, breaks down the developmental phases of an innovation-driven entrepreneur. The Z2E learning methodology has shaped over 50 workshops conducted in 7 countries for more than 2,500 learners. This model focuses on five key stages of IE development:

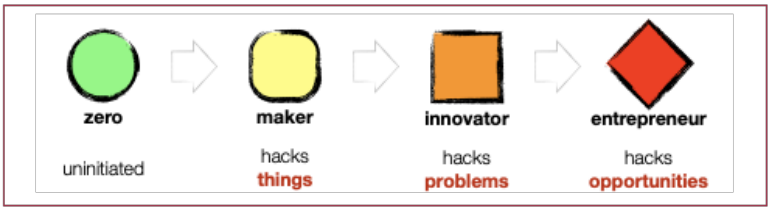



**Figure 3: The Zero to Entrepreneur Framework**

**ZERO**: the majority of uninitiated population, with unrecognized potential, pursuing an ostensibly steady job.

**MAKER**: the creative thinker and doer, one who thinks outside safe spaces, connects disparate ideas, and designs and makes things.

**INNOVATOR**: a problem solver who can synthesize observations and interactions to identify unmet community or human needs, and create and validate desirable solutions for social impact or financial gain.

**ENTREPRENEUR**: The value creator who converts a problem into a commercial opportunity through creating an organization, a team, suppliers, and sales channels, all from resources that she did not possess.

**ECOSYSTEM**: building a vibrant community, consisting of makers to entrepreneurs as role models and mentors, that attracts new candidates and nurtures them through their developmental process of becoming a Pre-Entrepreneur.

# THE ENTREPRENEURSHIP ECOSYSTEM DEVELOPMENT PROGRAM

## A. EXPECTED OUTCOMES

The Zero2Entrepreneur Entrepreneurship Ecosystem Development Program (Z2E-EEDP) is one of IEC's programs designed to create entrepreneurs who would create jobs that create more jobs as a response to the employment shock from the COVID-19 pandemic. The program will be focusing on the following outcomes:

A. Improve participants' preparedness for the 4th Industrial Revolution through increasing problem solving, critical thinking and creativity skills

B. Increase confidence in tackling challenges through a hands-on approach at solving real problems

C. Building a creative and innovative environment in the community through collaboration and sharing of experiences

D. Build nurturing ecosystem in their communities that attracts and trains the participants to become innovators and entrepreneurs thereby creating jobs for the economy

# B. OUR APPROACH

Our method of teaching is grounded on the following principles to maximize participants' experience and improve learning outcomes:


**Figure 4: The Z2E-EEDP Approach**

- **Problem-based Learning** - a dynamic pedagogical approach in which learners gain knowledge and skills by working for an extended period of time to respond to authentic, engaging, and complex questions, problems, or challenges;
- **Action Learning** - merging theory and practice, Action Learning refers to hands-on "learning by doing" approaches following MIT Sloan's framework: think, act, reflect, repeat;
- **Collaborative Learning** - enabling a small, diverse and agile group of people or organisations (oftentimes not having worked before) to effectively work together to complete a task or to achieve goals.

# C. THE METHODOLOGY

There are three important components to the EEDP that allows the program's efficacy in achieving the outcomes:

(1) **Resources**, referring to software and hardware tools , computers, components, devices, fabrication materials, and access to learning tools and libraries, that allow design and creation of solutions for needs;

(2) **Community**, referring to the makers, hackers, and mentors who collaborate and share ideas, technologies, and designs with each other to reinforce a maker culture; and

(3) **Space**, referring to a physical set-up where a community can collaborate - these are sometimes called maker-spaces and fabrication (fab) labs[5]. Maker Movements rapidly accelerate the act of "making" artefacts through collaboration, rapid prototyping, and learning by doing.

Resources, Community, and Space, serve as the foundations of the Maker Movement and allow for better accessibility to the process of prototyping products. As individuals create business prototypes and gradually learn to develop products and solutions as Innovators that are useful to their immediate environments to address specific needs, applying these lessons to create and capture value leads to future entrepreneurial activities as a natural transition[6].

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[5] Browder, R. E., Aldrich, H. E., & Bradley, S. W. (2017, January). Entrepreneurship research, makers, and the maker movement. In *Academy of Management Proceedings* (Vol. 2017, No. 1, p. 14361). Briarcliff Manor, NY 10510: Academy of Management.

[6] Browder, R. E., Aldrich, H. E., & Bradley, S. W. (2019). The emergence of the maker movement: Implications for entrepreneurship research. *Journal of Business Venturing*, *34*(3), 459-476.

# PROGRAM STRUCTURE

The program is structured to maximize understanding of factors affecting innovation and entrepreneurial attitudes in participants and participants' progress through the Z2E framework. The phases of the program are outlined below:

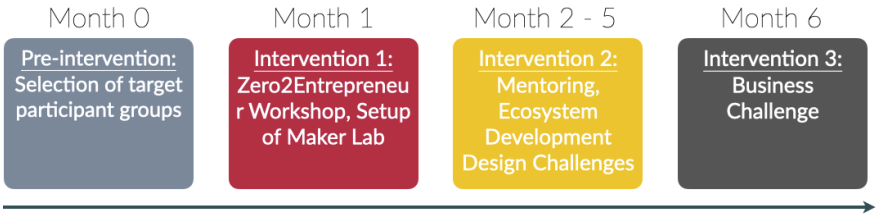


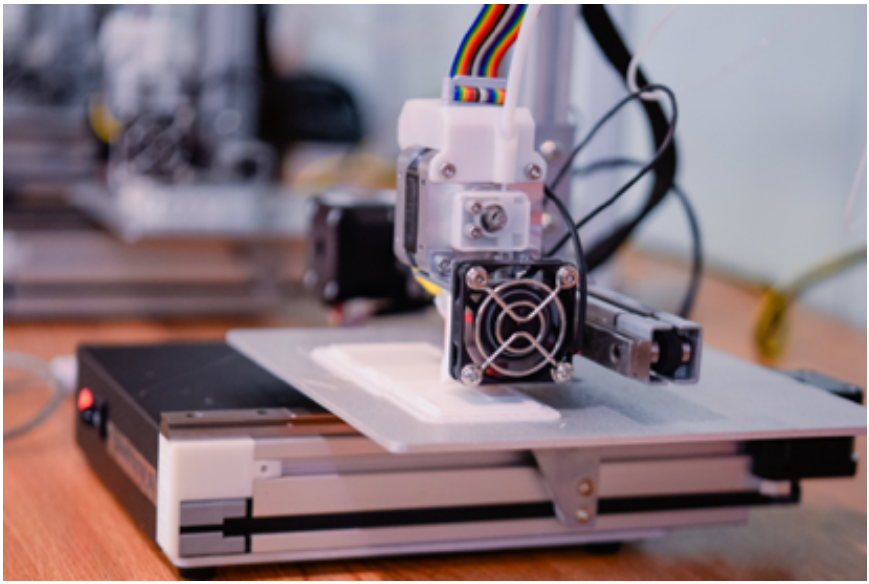

**Figure 5: Outline of the Z2E-EEDP Program Structure**

# PRE-INTERVENTION: SELECTION OF PARTICIPANT GROUPS

- **Selection of Communities** - We plan to select program sites based on the ease of access to our methodology components; namely, Resources, Community and Space. These communities can be educational institutions, town/ community centers, co-working spaces or any space that allows learners to get together to facilitate conducive learning environments.

- **Selection of Participants** - Opportunities for participating are advertised through the communities and interested participants can apply to be part of the program. Participants showing highest commitment to and benefits from the program will be selected. We plan to target university students and under or unemployed youth.

- **Formation of Teams** - Teams of 5 to 6 are formed within each community based on gender, as well as background experience.

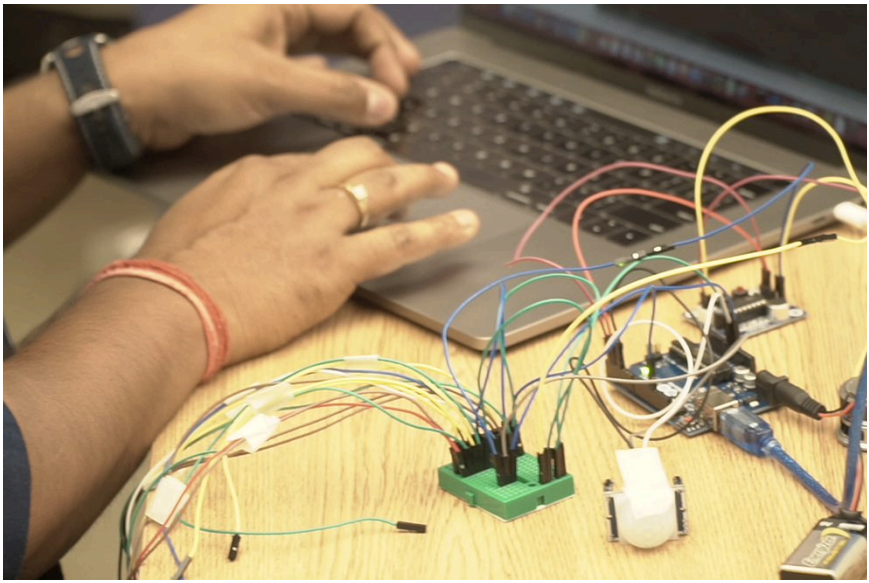


A minimum of one team per selected community must be formed in order for the community to participate in the program.

# INTERVENTION 1: Z2E WORKSHOP

The program starts with a 5-day Zero2Entrepreneur workshop where participants are taken through the basics of ideation, design, making, design-thinking, and basics of entrepreneurship. This will be an intense first exposure to the process of innovation through hands-on activities to learn outside their zone of competence to build their self-efficacy in working beyond safe and conventional ideas or directions.

Each community will receive a Makerlab-In-A-Box (Appendix B: Makerlab-In-A-Box) which contains necessary tools and materials that they will use at the workshop. ASB will train the participants on maintenance and inventory management of their lab. This Makerlab-In-A-Box is what they will use to set up their Innovation Lab back in their community upon completion of the first intervention with support from ASB.



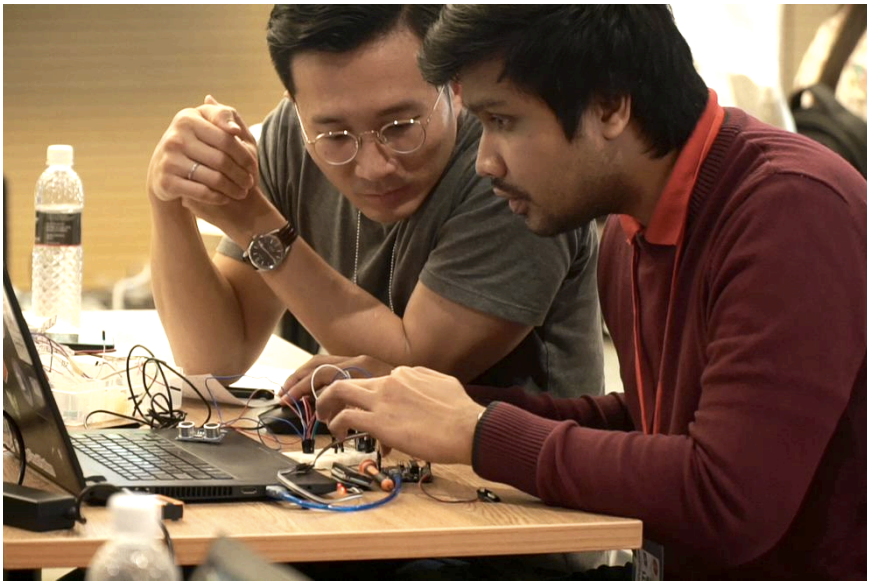
Through this intervention, participants will:

1. Be introduced to basic ‘making’ skills useful for designing and fabricating products, such as, electronics, coding and 3D printing
2. Learn Need-Definition, Critical-Thinking, and Problem-Solving
3. Learn about important skills such as innovation, making and design thinking
4. Be familiarised with the components in the Makerlab-In-A-Box, basic maintenance and inventory management
5. Mentor other participants in these skills to create a community
6. Understand the program structure, support channels of the EEDP

# INTERVENTION 2: MAKER LAB SET UP AND Z2E-EEDP DESIGN CHALLENGES

Participants will set up the lab that they received from Intervention 1 in the community space provided. From there, teams will apply the learning from the workshop to identify needs in the community, come up with business ideas to solve them, create

prototypes of their products, and validate them for technical feasibility, market desirability, and business viability. From there, teams will go through multiple design iterations that expose them to technical aspects as well as problem solving processes under ASB's online mentorship. These design projects from all teams will be submitted through an online portal to be shared with all participants and reviewed by ASB and the Z2E mentorship network.



Through this intervention, participants will:

1. Develop their product design abilities
2. Hone their critical thinking, problem solving skills and creativity skills
3. Learn to work and communicate in a team
4. Strengthen their understanding of different business functional areas
5. Receive feedback and support from the Z2E community through the online portal on their projects
6. Build their confidence in solving a variety of problems/ challenges through having hands-on experience

# INTERVENTION 3: Z2E BUSINESS INNOVATION CHALLENGE

The program culminates in a business innovation challenge and exhibition that brings together communities from across the program to showcase their business ideas and innovations. The exhibition is aimed at recognising the communities with the biggest progress, graduating participants of the program as well as engaging the larger community on the IE endeavours that have emerged from friends and/ or families.

Through this intervention, participants will:

1. Connect the ecosystem with local industry, academia, government and funding agencies

2. Connect with industry and community to source impactful problems to work on solution
3. Showcase their business projects to the larger community for support and funding

# PARTICIPANTS DATA COLLECTION

All participants are required to complete surveys at different stages of the program to measure changes in multiple factors in their skills. The survey instrument also captures demographic information to increase the granularity of future data analysis.

# MEASURES

1) **Entrepreneurial attitudes (EA**) is measured using Athayde's (2009)[7] instrument and is an appropriate scale since the original study is intended for latent entrepreneurs. This scale is an 18-item tool that measures leadership, creativity, achievement, and personal control – all of which are relevant to maker education workshops conducted. Also, a 2-item scale measuring entrepreneurial identity adapted from Hagger and Chatzisarantis (2006)[8] is used and complemented by self-development items that capture career preference and their certainty in pursuing these options. These measures are critical components that build the theory of pre-entrepreneurship.

2) **Innovation skills (IS)**: The first direct objective of Maker Education and the Maker Movement is to stimulate and promote so-called "Maker Skills", i.e., the capacity of creating something.[9] Following Bandura (1977), we asked the participants to self-report their self-efficacy in this respect. Self-efficacy can be understood as a person's confidence in their ability to perform a specific task. For Making Skills, we used three items:

(a) How good is the participant with making things with locally available materials?

(b) How good is the participant with providing new services for the local market?

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[7] R. Athayde, R. Measuring enterprise potential in young people. Entrepreneurship theory and practice, vol 33, no 2, 2009, 481-500.

[8] M. S. Hagger, N. L. Chatzisarantis. "Self-identity and the theory of planned behaviour: Between-and within participants analyses." British Journal of Social Psychology, vol 45, no 4, 2006, pp. 731-757.

[9] Browder, R. E., Aldrich, H. E., & Bradley, S. W. (2019). The emergence of the maker movement: Implications for entrepreneurship research. *Journal of Business Venturing*, *34*(3), 459-476.

(c) How is the capability of the participant to invent and design new products or services?

3) **Social engagement (SE)**: The Maker Movement highlights the importance of the community's role in advancing goals and outcomes, which makes it appropriate to measure changes in how participants perceive the role of their work in relation to the community. The study uses Grant's (2008)[10] 4-item instrument to measure changes in prosocial motivation.

4) **Academic performance (AP)**: Increased exposure to maker activities may impact a participant's interest in studying and pursuing similar subjects. The research asks students about their favorite subjects and sees if there are changes for a preference towards science, technology, engineering, arts, and mathematics (STEAM) courses after exposure to maker education. Furthermore, attitudes related to learning goal orientation and learning from errors are measured using VandeWalle's (1997)[11] and Rybowiak (1999)[12] .

Garst, Frese, and Batinic's (1999) respective instruments to measure the change in overall learning attitudes in line with maker education learning principles. Lastly, school grades from STEAM-related subjects are gathered to support analysis.

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[10] A. M. Grant. "Does intrinsic motivation fuel the prosocial fire? Motivational synergy in predicting persistence, performance, and productivity." Journal of applied psychology, vol 93, no 1, 2008.

[11] D. VandeWalle. "Development and validation of a work domain goal orientation instrument." Educational and psychological measurement, vol 57, no 6, 1997, pp. 995-1015.

[12] V. Rybowiak, H. Garst, M. Frese, B. Batinic. "Error orientation questionnaire (EOQ): Reliability, validity, and different language equivalence."Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior, vol 20, no 4, 1999, 527-547.

# RESEARCH MODEL

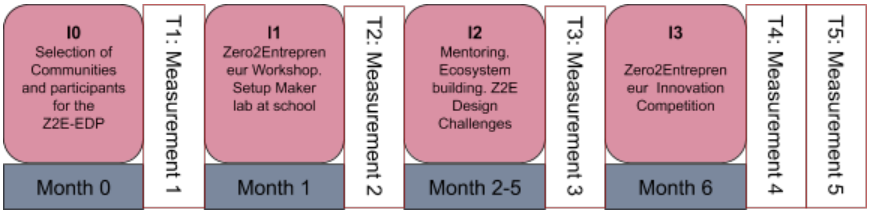


**Figure 6: Guiding research model**

The operating model of the research adapts a longitudinal approach that staggers data collection across 5 time periods:

1) T1 – baseline survey for all groups
2) T2 – post-training survey immediately after intervention 1 (I1) workshop for treatment group
3) T3 – post-training survey administered after a series of design workshop challenges and will measure innovations created, business ideas generated and start up activities
4) T4 – post-training survey administered at I3 will measure the health of the ecosystem created, impact on participants and community, potential number of startups and needs of the entrepreneurs
5) T5 – post-training survey administered six months after I3 will study the scaling effect of the ecosystem

# COST ESTIMATES

The cost to train and set up an ecosystem in each community is **MYR 250,000**. The program will need to run for a minimum cluster of **five** communities to maintain this cost structure.

This cost covers:

- Makerlab-in-the-box (refer to Appendix B)
- Intervention 1 Workshop content preparation, training materials and workshop delivery
- ASB visits and engagements to each community during Intervention 2 the program for mentorship and technical support
- Engagement in Z2E-EEDP virtual community engagement system
- Intervention 3 business challenge content preparation and delivery

Other details on each step of ASB's engagement support:

**Step 1:** Identifying candidate communities for Z2E-EEDP

**Step 2:** Selection of communities by region to group five to ten together at a time. This may be repeated for other regions

**Step 3:** Z2E workshop held at ASB or at a local venue

**Step 4:** Communities set up their labs with the Makerlab-in-a-box that are given. ASB and other mentor teams will visit communities to initiate and run the programs

**Step 5:** ASB offers online mentoring for analyzing identified business opportunities and developing products and solutions. This repeats till month 6.

**Step 6:** All Ecosystems are linked over an online social platform for free exchange of ideas and partnering.

**Step 7:** In Month 6 local events are held for showcasing innovators, entrepreneurs, and their products and business plans for raising funds and local support from industry and investors.

# APPENDIX A

**Appendix A: Mainstream Entrepreneurship Education and Training**

Entrepreneurship Education and Training (EET) is often the most common learning approach used to attain better IE human capital outcomes. EET refers to programmatic interventions that aim to impart entrepreneurial knowledge, skills, and attitudes for its participants. A review reveals that current EET programs are often designed for nascent and active entrepreneurs, most of whom already possess sufficient levels of IE human capital to conduct IE-related activities.[13] This focus, however, excludes a significant proportion of the existing population who have no clear intention (yet) to learn IE related skills but are equally capable future innovators and entrepreneurs. Our experience tells us that targeting the few existing entrepreneurs does not help scale the growth of IE fast. Also, adults often face social pressures and expectations of stability that pull them more toward stable jobs than entrepreneurship. Hence to scale up the population of IEs, we need to target school children since they have several years to build their skills before becoming adults and have less fear of learning new things or failing. This formative window is an untapped opportunity, especially for countries with younger populations (i.e., often developing countries) that can benefit from maximizing the IE potentials of its working population. Shifting the focus of EETs, however, is not a simple process. Significant changes to content and delivery are needed to make these interventions appropriate for uninitiated individuals. Training this group of individuals earlier could provide a significant feedstock to the next phase of EET programs.

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[13] Martin, B., McNally, J., & Kay, M. (2013). Examining the formation of human capital in Entrepreneurship: A Meta-Analysis of Entrepreneurship Education Outcomes. *Journal of Business Venturing, 28*(2), 211-224,

In this respect, initiatives that build on studies by Athayde (2009) and Gohmann (2012) on latent entrepreneurship leads us to believe that there is a critical step between latent and nascent entrepreneurship that will be valuable for institutions interested in IE human capital outcomes. “Pre-entrepreneurs” are individuals who have built innovation skills such as creativity, divergent thinking and problem solving, and entrepreneurship attitudes such as self-efficacy, self-learning, and the ability to see problems as opportunities. They are the ideal candidates for EET programs. They are ideal candidates for EET programs. Figure A1 shows how we situate the concept of pre-entrepreneurs.

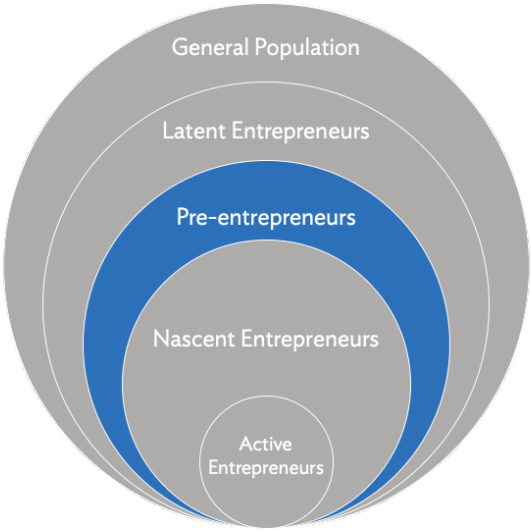


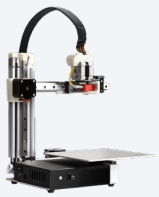

**Figure A1. Situating Pre-entrepreneurs**

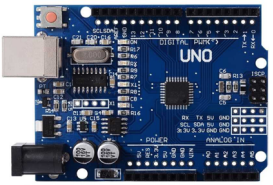
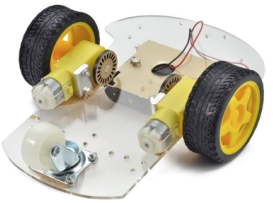
# APPENDIX B

The Makerlab-In-A-Box is a starter kit for any group of makers to build their own lab. The kits allow users to create and prototype any product/ design ideas and will be used throughout the Z2E-EEDP.


**Figure A1. Situating Pre-entrepreneurs**

**List Outlining the types of tools included in the Makerlab-In-A-Box**

| Category | Brief Explanation | Sample photo |
|---|---|---|
| **Digital Fabrication Tool** | A Cetus MK3 3D printer is included in the kit, enabling participants to print out their personal digital designs. This will also include a starter set of the filament needed to operate the printer. |  |

| | | |
|---|---|---|
| **Electronic Materials** | Multiple Arduino* micro-controller boards are included to introduce students to basic coding and tinkering. Various sensors and actuator modules come with the kit and open the possibility of creating a wide range of products.<br>The kit includes hundreds of input devices such as sensors for temp, light, distance, force, sound, light etc., output devices such as, motors, displays, sound generators, light sources, and communication devices such as bluetooth, WiFi, RF transceivers. |  |
| **Robotics Components** | Building electric-powered products that move and turn using code is possible through a variety of motors, chassis, and gears that come with the kit. |  |
| **Hand Tools** | Screwdrivers, hacksaws, allen keys, glue gun, soldering iron, and similar tools are necessary to help students piece together and complete their envisioned products. Selected tools are safe to use with basic training and guidelines. |  |
| **Craft Supplies** | Different kinds of craft supplies will also be provided to speed up the process of iteration and support the creative development of each students' product. |  |

*Note: With the exception of the Cetus MK3 3D printer and Arduino Uno, photos included are for display purposes only. The actual product may come from a different brand.*

*The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.


**Our Faculty:**
**Prof. Rajesh Nair**
Professor of Practice, Innovation & Entrepreneurship
Director of Innovation and Entrepreneurship Centre
Asia School of Business
rajesh.nair!asb.edu.my

Prepared by: Mei Kok
Senior Program Manager
Innovation and Entrepreneurship Center
Asia School of Business
mei.kok@asb.edu.my