DEVELOPING A YOUNG INVENTREPRENEUR THRU FORWARD LEARNING APPROACH

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Abstract

This paper explores the enhancement of creative problem-solving skills in young minds using the License 2 Inventrepreneur (L2I) method, which aligns with national education goals. The study provides a detailed introduction to the L2I framework and its practical application through case studies involving elementary students. Methodologies employed include design thinking and TRIZ (Theory of Inventive Problem Solving). Data collected from the pilot program indicate substantial improvements in the inventrepreneurial skills of students. The findings suggest that the combination of comprehensive mentorship and hands-on projects within the L2I method significantly boosts students' abilities to devise innovative solutions.

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1.0 INTRODUCTION

The development of young inventrepreneurs through a forward learning approach is a crucial aspect of preparing the next generation for success in an ever-evolving world of creativity, technology, and innovation (Ho *et al.,* 2018). Utilising an integrated strategy that combines invention and entrepreneurship education, marketing, and the fostering of soft skills empowers young generations to cultivate an inventrepreneurial mindset, enabling them to thrive in an increasingly competitive global economy.

National education goals emphasise raising the creative capabilities of young minds, a necessity in today's rapidly changing world. The acquisition of core inventrepreneurship competencies is instrumental in nurturing young minds to become critical and creative thinkers. These competencies enhance scientific literacy and stimulate creativity, encouraging students to become inventive. However, there is a pervasive lack of familiarity among teachers regarding inventrepreneurship and its classroom importance. Teachers require further professional development to improve their competencies in designing and implementing inventrepreneurship curricula that align with national standards.

Furthermore, teachers should possess a foundational reserve of STEAM (Science, Technology, Engineering, Art, and Mathematics) interdisciplinary knowledge to guide students in thinking creatively and solving practical problems. STEAM education, an interdisciplinary approach, provides young minds with opportunities to apply academic concepts in real-world contexts, fostering critical thinking, reasoning, teamwork, and investigation skills. These skills, alongside 21st-century skills such as creativity, communication, and collaboration, are essential for young minds to succeed in the modern workforce and remain competitive in the era of information and knowledge.

In response to this educational imperative, public schools are increasingly focusing on enhancing instruction and facilitating connections between student achievement and career interests in mathematics and science. Recognising the importance of preparing students for the demands of the 21st-century workforce, many federal and state agencies are funding STEAM and inventrepreneurship education programs and research. This initiative positions Malaysia as a potential global leader in invention and entrepreneurship competitiveness.

Given this context, it is crucial for teachers to possess comprehensive STEAM interdisciplinary knowledge and skills to guide young minds in thinking creatively and solving practical problems. Consequently, further professional development is necessary for teachers to effectively incorporate inventrepreneurship learning in the classroom, nurturing scientific literacy and creative thinking abilities among young students. As noted by Osman and Saat (2014), "all young minds need to develop their capabilities in science, technology, engineering, art, and mathematics to levels much beyond what was considered acceptable in the past."

Recognising this need, the License 2 Inventrepreneur (L2I) method was developed to nurture creative thinking skills. L2I is a structured educational framework designed to foster inventrepreneurial skills among young minds. This method integrates elements of design thinking, creative problem-solving methodologies such as TRIZ (Theory of Inventive Problem Solving), and entrepreneurship principles. By providing students with the necessary tools and mindset, L2I aims to empower them to innovate and develop solutions aligned with real-world challenges.

TRIZ provides structured methodologies for systematically generating creative solutions. Within the L2I method, TRIZ principles help young minds identify and solve contradictions,

thereby enhancing the effectiveness of the problem-solving process.

In conclusion, developing young inventrepreneurs through the L2I method aligns with national education goals and addresses the demands of an innovation-driven future. Investing in comprehensive professional development for educators and integrating forward learning approaches in education are essential steps towards equipping young minds with the skills necessary to navigate and succeed in the 21st-century landscape.

The L2I method employs a comprehensive approach to foster creativity, problem-solving, and entrepreneurial skills among young minds. This method integrates various educational components, as illustrated in Figure 1.

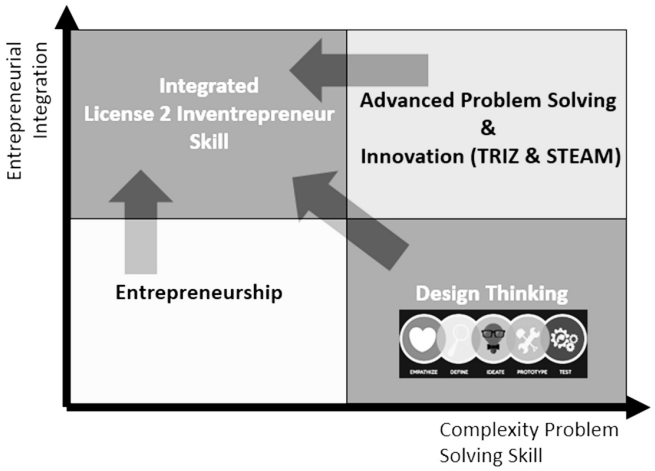

Figure 1: Integrated educational framework for young inventrepreneurs

Each quadrant addresses a unique aspect of the educational approach: 1) Entrepreneurship - focuses on fundamental entrepreneurial skills such as business planning and financial literacy. 2) Design Thinking - encourages empathetic and creative problem-solving through stages like empathise, define, ideate, prototype, and test. 3) Advanced Problem Solving & Innovation which incorporates TRIZ elements and STEAM principles to tackle complex problems with innovative solutions. And finally, 4) Integrated License 2 Inventrepreneur Skills - represents the holistic integration of entrepreneurship and advanced problem-solving methodologies.

By integrating the L2I method into the forward learning approach, educational institutions can create a robust framework that prepares students for future challenges. This comprehensive strategy not only nurtures academic knowledge but also fosters innovation, creativity, and entrepreneurial spirit, thereby developing well-rounded individuals.

2.0 FORWARD LEARNING APPROACH

Young inventrepreneurs are a crucial component of our future economy. Nurturing their interest in innovation and business from an early age is pivotal for their development. Forward learning approaches center on promoting critical thinking, problem-solving skills, and creativity. By integrating real-world challenges and addressing them through programs like Young Entrepreneur in the elementary curriculum, young minds can think outside the box and gain a profound understanding of the practical application of their knowledge (Martin, 2015).

One effective method to foster young inventrepreneurs is to provide them with mentorship opportunities and hands-on experiences. Encouraging students to explore their interests and passions while guiding them through the process of bringing their ideas to life can have a transformative impact. Moreover, imparting knowledge about business fundamentals such as market research, technology trends, product development, costing (profit and loss), and marketing strategies equips them with the essential skills needed to succeed as future entrepreneurs.

An entrepreneurial mindset is cultivated by fostering resilience, adaptability, and a willingness to take calculated risks. It is critical to create an environment where failure is seen as a learning opportunity, and where persistence and determination are celebrated.

By embracing a forward learning approach through the License 2 Inventrepreneur (L2I) method and providing the necessary support and resources, we can inspire and empower the next generation of inventrepreneurs to make a positive impact on the world. The L2I method teaches young minds to think critically, solve problems creatively, and embrace inventrepreneurship as a key aspect of their educational journey. Through project-based and hands-on learning, students can apply their creative knowledge and skills in a practical and meaningful way. The forward learning approach can be visually represented as shown in the following Figure 2.

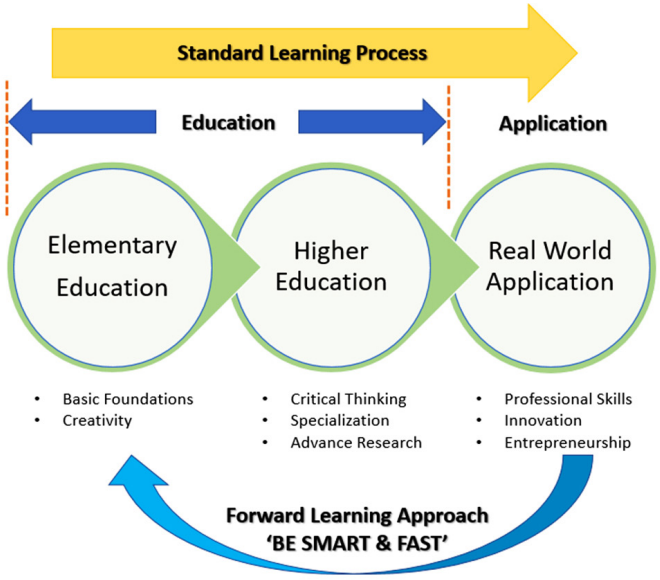

Figure 2: The forward learning approach

This figure illustrates the progression from elementary education to higher education, culminating in real-world application. Each phase highlights key components and skills developed at each stage. The integration of the L2I method at early stage of education ensures that students are equipped with a comprehensive set of skills, blending academic foundations with practical, entrepreneurial, and innovative competencies.

As part of this integrative approach, students work collaboratively in teams, experiment with new ideas, and develop a deeper understanding of the subject matter. Design thinking methodologies, such as empathising with the problem, defining the problem statement, generating ideas, and prototyping, enable young minds to approach challenges from diverse perspectives and devise innovative solutions (Brown, 2009; Kelley & Kelley, 2013). These skills are invaluable not only for future entrepreneurs but for individuals navigating their personal and professional lives (Pink, 2006).

Therefore, it is essential for educators to integrate these approaches into the curriculum and provide young minds with the necessary tools and guidance to develop their critical thinking, problem-solving, and entrepreneurial abilities. To enhance young minds' creative problem-solving abilities and foster an entrepreneurial mindset, it is crucial to address barriers they may face in starting businesses, such as a lack of business skills, fear of failure, and limited access to resources (Meitriana *et al.,* 2020).

Through the L2I method's design thinking phases, students develop essential skills such as empathy, problem definition, ideation, prototyping, and testing. These competencies are critical for both individual and collaborative inventrepreneurial projects, positioning young minds to thrive in an increasingly complex and dynamic world.

2.1 Design Thinking

The License 2 Inventrepreneur (L2I) method incorporates a design thinking approach that creates a flexible learning environment, where young minds take responsibility for their own learning while fostering essential inventrepreneurial skills such as creativity, problem-solving, self-confidence, and collaboration (Val *et al.,* 2019). By utilising the design thinking approach, students are empowered to identify the root causes of problems and explore a variety of potential solutions (Briggs, 2013). This process not only boosts their confidence and critical thinking abilities but also trains them to think creatively (Sorensen & Davidsen, 2017). In essence, design thinking holds significant potential for nurturing inventrepreneurial attitudes among future professionals.

Design thinking consists of five basic phases (Figure 3): 1) Empathise – get to know the humans you are designing for, 2) Define – come up with answers for the problems or problem statements (root cause analysis), 3) Ideate – get creative and generate as many ideas as possible, 4) Prototype – create a demo of what you want to produce, and 5) Test – validate the prototype with actual users.

Empathise means to profoundly understand, and it is the centerpiece of human-centered design thinking. To create an inventive solution to a problem, it is essential to observe and engage with the users. This process builds a comprehensive understanding of how individuals think and feel, what they value, and how they perceive things beyond the immediate focus area. Empathy almost always involves some form of direct engagement with the people affected by the problem. Methods of engagement can include in-depth conversations, interviews, or detailed step-by-step observations on how individuals perform certain tasks. By immersing themselves in the users' experiences, designers can gain invaluable insights that drive the creation of truly meaningful solutions.

Figure 3: 5 basic phases of design thinking

The Define phase involves precisely articulating the meaning, scope, and nature of the problem statement. Insights gained during the empathy phase often lead to a reassessment and redefinition of the originally perceived problem. This phase is critical as it requires concentrating on the core issues with depth and clarity, ensuring that the problem statement is clearly framed and actionable. Defining the problem involves being clear about the criteria for evaluating competing ideas and ensuring that the problem statement remains within the domain of actionable insights. Often, we may assume that we know what the problem is, but this phase allows us the time and space to develop, refine, and reframe the problem statement until we uncover the actual issue that needs to be addressed.

Meanwhile ideate means to form or create an idea or innovation. In this stage the young minds with design thinking skill will spark off ideas with a combination of L2I method. Ideas generated through some creative activities namely 1) thinking out of box, 2) connecting the dots, 3) Simplify and make efficient (trimming) 4) exploring technology trend (S-Curve), 5) devil's advocate which to identify contradiction and finally 6) TRIZ 40 inventive principles which is known as solution bait. Now you have understood users and their requirements / need in empathise stage and have analysed observation in the define stage. Having this solid stage or foundation, the problem solver can start to think out of the box, to identify new solution and alternate way to view the problem statement. The critical point in this phase is where we want to focus on novelty over relevance. Novelty means something new and fresh, while relevance means something significant or important. If we have novel ideas which is relevance, then that is the sweet spot where we get to innovate. In ideation, the focus would be on novelty first than the relevance.

A prototype is a simple experimental model of a proposed solution, used to test and validate ideas. In other words, it is a mock-up of what we aspire to create. Young minds should build representations of one or more of the proposed ideas to be showcased. Why prototype? We use prototyping to explore and confirm that the problem we have identified, the solution we have ideated on, and the problem we are attempting to solve are aligned. This approach encourages young minds to gather more data on what works and what doesn't. It provides an opportunity for discussion about their creations, promoting a deeper understanding of the design process. Embracing potential failures is crucial, as it helps students become comfortable with experimentation. They should create as many variations as possible and refine them through iterations.

A prototype is a rough conceptual model that can be built using readily available raw materials. It can take forms such as a paper prototype, an animatic (where graphics or animations demonstrate the movements), a storyboard, a role-play activity, or even a wall post with sticky notes.

Finally, testing provides the crucial opportunity to gather feedback on your solutions, refine them, and continue learning about end users. While a prototype is a preliminary model you believe to be correct, testing is where you expose it to potential errors and areas for improvement. The testing phase is conducted to refine both the prototype and the solutions, aiming to deepen the understanding of end users and continually iterate on the design. This phase may involve activities like launching, publishing, and debugging to evaluate the proposed solutions comprehensively. Testing is part of design thinking's infinite loop, signifying that improvement is a continuous process. It requires consistent refinement, reflection, and learning from the tests conducted to enhance the solution continuously.

The forward learning approach emphasises developing young inventrepreneurs through the design thinking framework. By fostering creativity and problem-solving skills, we empower young minds to think critically, innovate, and explore new possibilities (Marsela *et al.,* 2024). Through hands-on activities and collaborative projects, we encourage them to embrace a holistic approach that includes empathy, experimentation, and iteration. By nurturing a growth mindset and providing a supportive environment, we aim to inspire the next generation to become visionary thinkers and creators, equipped with the essential skills needed to navigate and overcome future challenges.

2.1.1 Experimentation of Forward Learning

The forward learning approach using the design thinking method, as described in the previous section, was piloted at an elementary school in Penang, Malaysia, involving young minds aged 11 to 12 years. This initiative was launched through the 30th Young Entrepreneur (YE) Program for the year 2023, with the support of the Penang Education Department, Junior Achievement (JA) Malaysia, and Flextronics, which served as the northern region area chair for the year. The pilot effort aimed to:

a. Assess the relevance of the method and tools for both educators and young minds,
b. Measure the effectiveness of the L2I method on invention and entrepreneurial skills, and
c. Evaluate the perception of inventrepreneurship among the participants.

Traditionally, the YE program has focused on secondary school students aged 13 to 17 years. The YE'23 program concluded with a total of 441 students aged 13 to 17, 18 students aged 11 to 12 as part of the pilot program, and participation from 64 teachers and 75 corporate advisors, totaling 598 participants (Figure 4).

For the first time, younger students were exposed to the program and mentored by corporate advisors through the design thinking phases. They were asked to bring actual problems they observed around them. These problems were well-defined and streamlined based on the relevance of the case study, which helped them work as a team to ideate and invent. This paper will share two case studies illustrating the application of the L2I method by these elementary students.

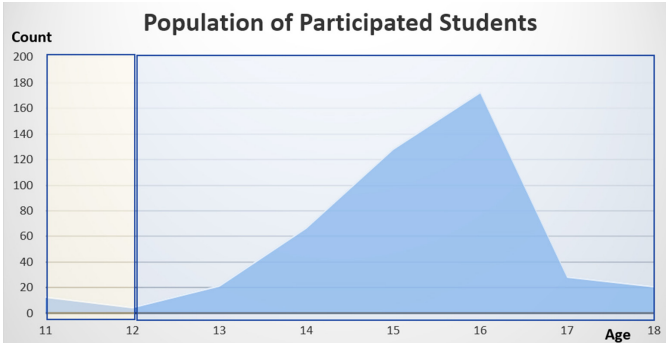

Figure 4: Population of participated students YE'23

a) Case Study 1:

One of the projects undertaken by the student team addressed a common, yet frustrating problem: the habitual misplacement of essential items such as keys, purses, and wallets by a student's mother. This issue was brought to the team's attention during their brainstorming sessions.

To better understand the problem, the students conducted interviews with the primary user—the student's mother. This thorough engagement helped the team empathise with her daily challenges, grasping the inconvenience and stress caused by losing important items frequently.

Once they had a clear understanding, the team investigated existing technologies and historical solutions to tackle the issue. They employed an S-Curve analysis to evaluate past technological trends and anticipate future innovations in item-tracking solutions. This methodical approach enabled them to identify gaps in the current market and opportunities for innovative advancements.

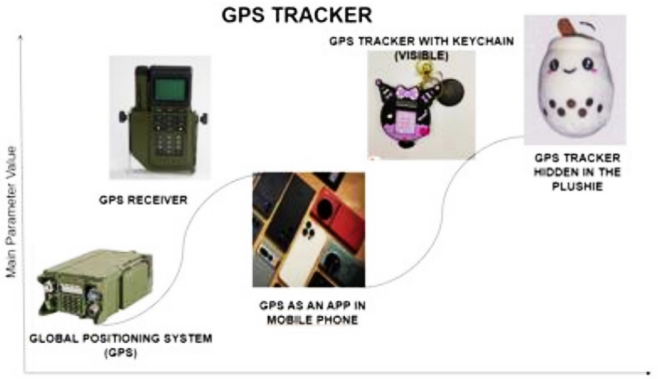

Figure 5: Technology trends of GPS tracker

Through comprehensive brainstorming sessions, the team developed an S-Curve (Figure 5) as part of their solution-finding process. They focused not only on creating an innovative product but also on ensuring it met key STEAM criteria: it had to be safe, effective, and affordable for everyday use.

Leveraging their insights, the students designed a GPS tracker tailored to the needs identified in their research. The product was prototyped and rigorously tested to ensure it was user-friendly, reliable, and met the desired safety and affordability standards.

The GPS tracker team successfully managed to sell over 50 units, achieving a 100% sales profit. Among the seven STEAM inventive creations developed during the program, the GPS tracker emerged as the most popular product. This success highlights not only the ingenuity of the students but also the practical impact of their efforts.

In summary, this case study underscores the effectiveness of a methodical approach to problem-solving and innovation. By thoroughly understanding user needs, evaluating existing technologies, and focusing on safety and affordability, the students were able to create a highly marketable and useful product. This success story serves as a testament to the potential of young inventrepreneurs to address real-world challenges with creativity and practical solutions.

b) Case Study 2:

Students observed difficulties in maintaining visibility while writing in low-brightness environments. Although options such as adding more tube lights or additional table lamps existed to remedy the situation, these solutions posed a cost-increase challenge. The root of the problem was the need for a cost-effective brightness solution. To address this, the team of students generated ideas through the S-Curve method (Figure 6) and conceived a creative solution: a built-in light source within a holder.

The students began prototyping their design through initial sketch drawings (Figure 7) and gained approval from their team, teacher, and corporate advisors.

During the prototyping phase, the team encountered challenges. The first functional prototype was cumbersome due to the weight of the battery and switch, and the raw materials were costly. To make the solution affordable, the students sought out lighter and cheaper materials, successfully reducing material costs by 24%. Another issue arose with the use of a soldering machine to connect wires, which was both dangerous and skill-intensive. The team innovatively replaced this method with hot glue, only to face feedback regarding poor connections. They overcame this by enhancing the product with adhesive 3M tape and strong glue, resulting in a robust and easy-to-assemble design.

The product was sold at RM15 during the YE'23 Sales Fair. Though some customers initially felt the price was high, the team managed to make a profit. With approximately 16 units of stock remaining, the team ingeniously decided to target internal customers—students—by marking down the price to clear the stock with minimal profit.

The youngest managing director remarked, "Creative and inventive thinking in handling business issues involves the ability to adapt, experiment with ideas and possibilities, and continuously seek ways to improve products. For instance, we've invented products from scratch such as the writing light holder, GPS tracker, can-drink recycled keychains, and glow-in-the-dark bookmarks."

The L2I method is a dynamic approach that fosters creative problem-solving, empathy, and innovation. It encourages inventrepreneurship in young minds by equipping them with the necessary skills and mindset to identify and tackle real-world challenges, develop innovative solutions, and establish successful ventures. Through the L2I approach, students learn to solve problems from a user-centered perspective, understanding the needs and desires of their target audience. This empathy-driven approach empowers them to gain valuable insights into customers' experiences, identifying opportunities for inventrepreneurial ventures. Additionally, L2I fosters creativity by encouraging students to explore multiple possibilities through ideation and prototyping (Nagappan, 2022).

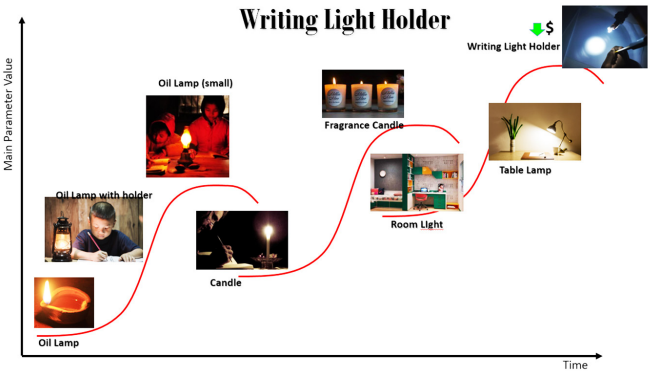

Figure 6: Technology trends of writing light holder

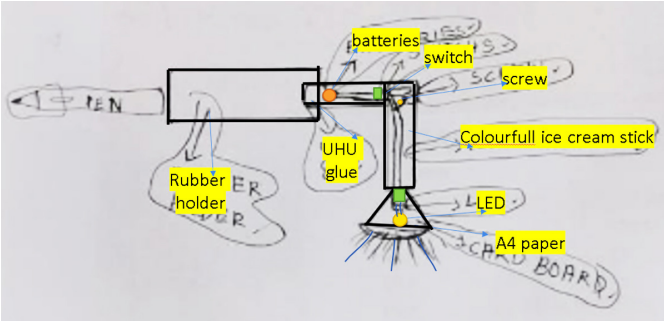

Figure 7: Prototype sketch writing light holder

3.0 CONCLUSION

The overall approach elaborates on the national education goal of enhancing the creative capabilities of young minds and underscores the importance of generating innovative solutions in challenging situations. The author discusses the inherent inventiveness of young minds and stresses the necessity for entrepreneurial motivation among students. Additionally, the author highlights the critical role of problem-solving skills, emotional management, and creative thinking, facilitated through ideation and design thinking methodologies. The concept of "License to Inventrepreneurship" (L2I) is introduced as a forward-learning approach designed to cultivate creative problem-solving and entrepreneurial skills in students.

The L2I method employs a forward-learning approach that synergises STEAM (Science, Technology, Engineering, Art, and Mathematics) and design thinking with the core principles of inventrepreneurship. This methodology integrates these interdisciplinary subjects with principles of invention and entrepreneurship, providing students with a holistic understanding of the interconnectedness of these fields while nurturing their problem-solving and creative thinking abilities. Through this approach, young minds are given the opportunity to engage with real-world scenarios and develop practical problem-solving skills.

In essence, the L2I method is an educational initiative aimed at equipping young minds with a comprehensive education that prepares them for future challenges. Beyond providing a well-rounded academic foundation, the L2I method seeks to nurture an inventrepreneurial mindset in students. This mindset encourages critical thinking, risk-taking, and the confident pursuit of their ideas (Brown, 2018). The L2I method guides young minds through a series of stages, which include identifying and analysing problems, generating potential solutions, acquiring necessary knowledge, making informed decisions, developing prototypes or products, testing and evaluating solutions, and ultimately socialising and completing their projects.

In summary, the License to Inventrepreneurship (L2I) method offers a robust educational framework that not only enhances academic knowledge but also fosters innovative thinking and entrepreneurial spirit. By guiding students through comprehensive stages of problem-solving and product development, the L2I method aims to create a generation of visionary thinkers capable of navigating and addressing the complexities of the future.

4.0 ACKNOWLEDGMENT

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PROFILE

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