Applied STEM Education Programs – Learning for Life in the 21st Century

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Abstract. Actura's applied STEM education programs are taught through hands-on and inquiry-based learning processes which focus on solving real-world authentic problems. The effectiveness of Actura's programs comes from the seamless integration of STEM disciplines and the translation of theoretical material into easily accessible and directly applicable material. This relatable form of delivery helps students solidify their foundation skills while keeping students engaged and importantly encourages STEM participation in their future years. Through Actura's applied STEM education programs, students form the ability to solve problems, create opportunities, and achieve goals. Moreover, complementary to Actura's applied STEM education programs is 21st century learning. This is the development of a highly valuable skill set - the Seven Survival Skills by Harvard Professor Dr. Tony Wagner. Required for future success, students develop critical thinking, creativity, communication, collaboration and more.

The following outlines the meaning of STEM, why STEM is important especially with young students and through scientific research demonstrates the methodologies behind the effective development and delivery of Actura's applied STEM education programs.

What is STEM? STEM is an approach to learning that integrates the areas of science, technology, engineering, and mathematics and was developed to answer 21st century challenges (Rifandi & Rahmi, 2019). Through incorporating STEM into education students are not only improving their cognitive intelligence but more importantly students are developing a highly valuable skill set required for their future success - the Seven Survival Skills by Harvard Professor Dr. Tony Wagner. The Seven Survival Skills include:
- Critical thinking and problem solving
- Collaboration across networks and leading by influence
- Agility and adaptability
- Initiative and entrepreneurialism
- Effective oral and written communication
- Accession and analysing information
- Curiosity and imagination

STEM skills are essential in today's changing times. The global economy is changing. Current jobs are disappearing due to automation, and new jobs are emerging because of technological advances. As our industries change, so do the skills they require.

By 2030, automation, globalisation and flexibility will change what we do in every job (Foundation for Young Australians, 2017). Internationally, there is a growing concern for developing STEM education to prepare students for a scientifically and technologically advanced society (English & King, 2015). According to PwC Australia (2015) 75% of jobs in the fastest growing industries require workers with STEM skills. The need for STEM education is more prevalent than ever.

Actura and STEM. Actura recognises the importance of STEM education. With a mission to empower youth to master the critical STEAM related skill sets for their future success, Actura are leaders in the modern evolution of STEM education. The key to delivering engaging and life-changing educational programs is through 'applied STEM'. Actura has an array of programs which includes CASE Space School, CASE Ocean School, FlipRobot Academy and CASE Space Academy all of which follow the applied STEM teaching methodologies.

Academic vs Applied STEM Programs. Traditional academic STEM programs tend to be abstract and theoretical. Researchers including a study by Rosicka (2016) from Australia's Council for Education Research shows that the nature of academic STEM courses has the tendency to discourage and disengage students. Academic STEM programs lack connection between the concepts taught and its real-world application making it difficult for students to understand the importance of STEM in their lives (Rosicka, 2016). The question asked by students often arises – *"When will I ever use this in real-life?"*

STEM education is far more than teaching students about the four disciplines. Rather, STEM is curriculum-based and encompasses real-world, inquiry-based, and problem-based learning that integrates the disciplines cohesively (English & King, 2015).

Actura uses an applied STEM education approach. Applied STEM education programs are taught through a hands-on and engaging process focusing on building skills that relate directly to the students and to real-world problems. Applied STEM education programs are effective in translating theoretical material into easily accessible and directly applicable material. This importantly helps students to solidify foundation skills while also encouraging STEM participation in the future (Sublett & Plasman, 2017).

Experiential learning, or the process of learning through experience, combined with theoretical learning is fundamental in Actura's successful applied STEM education programs. Combining the two helps students contextualize information leading to better self-confidence in the students' STEM skills, a greater understanding of the importance of STEM which leads to an increase in their interest in STEM learning overall (Rosicka, 2016).

The early introduction of Applied STEM – 'Belief in oneself is key to success'. *"STEM education can begin from the earliest years and fundamental STEM skills should be established in primary school. The primary years are a time where students are developing a self-belief in their ability as a STEM learner"* - Australia's Council for Education Research (Rosicka, 2016)

Research shows that developing and nurturing a student's interest in STEM in primary years leads to many important foundation skills and ideologies which students can then continue to nurture and cultivate. Arguably one of the most important is the self-belief that an individual student does have the ability to succeed in STEM. The Australian Department of Education (2020) highlights that an early introduction also broadens students' future thinking and begins to create skilled investigators, innovative thinkers, problem solvers and communicators.

Actura's key elements for delivering effective applied STEM education programs. Backed by research by Rosicka (2016) and Sublett & Plasman (2017) Actura's applied STEM education programs incorporate the following six methodologies. Actura has found these key elements lend themselves to the greatest achievement of students participating in, engaging in, and understanding STEM.

1. **Integrated interdisciplinary approach** - An integrated approach to STEM can teach more than the skills, competencies, and knowledge of the four domains taught in isolation of each other. Integrating all disciplines of STEM provides a chance for students to deepen their capabilities to include critical thinking, creativity, communication, and self-direction.
   - *The theming of Actura's applied STEM education programs (Space, ocean, and robotics) naturally and seamlessly integrate STEM disciplines.*

2. **Active learning** – Active learning, also known as inquiry-based learning involves students using multiple senses and interacting with other people and materials to solve a problem. Students are also required to take responsibly for their own learning. With guidance from the facilitator providing structure and support, students build from their natural process of inquiry and form a desire to know more which motivates and deepens their learning.
   - *Actura's focus is to ensure students have an immersive and active experience which cannot be replicated in the classroom. This broadens students' minds giving them a chance to see STEM in a different frame of mind.*

3. **Provide real-world challenges** – Focusing on real-world authentic and contextual problems helps students understand why they are learning STEM subjects and directs their attention to where they can apply their newly found knowledge outside the classroom or home.
   - *Contextualizing STEM is of utmost importance to Actura. Their programs adapt and change on a regular basis to ensure content is relevant and up to date.*

4. **Allow students to learn from failure** – The real-world active learning has a natural process of repetition, evaluation, and reflection. This process helps students see that failure is an important part of the learning process. Students' ability to evaluate their work and look for improved solutions also develops their critical thinking and the ability to reflect on their actions and learning. Analysing failure leads to continuous improvements.
   - *Through fun challenges, new experiences and teaching the engineering design process, students learn to learn from failure. Actura also incorporates personal and leadership development training in all courses which help to build students' resilience and acceptance of failure as a learning tool. Constructs include the Growth Mindset by Professor Carol Dweck or the Seven Habits of Highly Effective Teens by Sean Covey.*

5. **Nurture curiosity and questioning** – Tapping into the natural curiosity of young students who are inclined to test out ideas, 'have a go' and who are less averse to failure is key. These natural attributes are important in the STEM learning process. Curiosity can be nurtured through inquiry-based integrated STEM activities.
   - *Students who participate in Actura's applied STEM education programs find themselves experiencing and discovering things they may have never done before. This new exposure no doubt sparks student's curiosity and ignites their passion.*

6. **Explore and highlight careers in STEM** – Exposing students to STEM-related industries and career paths creates awareness for future study and sparks enthusiasm and excitement.

- *Actura partners with industry leaders and through exclusive presentations and webinars students see how STEM is applied in the real-world. They hear from experts who are currently working in the STEM industry.*

Conclusion. Actura, an organisation with a passion and drive for educating today's youth in STEM, are leading the way in effective STEM education through the methodologies of applied STEM education programs. Adapting to changing times and backed by research, Actura continues to grow, develop and deliver STEM programs that give the youth of today the opportunity to grow to be successful individuals capable of problem solving, creating opportunities and achieving their goals.

Citations

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