# A Comparative Study of Approaches in the Engineering Education System in Malaysia, Singapore, and Finland

**Article history**
Received
*4 June 2024*
Received in revised form
*24 June 2024*
Accepted
*24 June 2024*
Published online
*30 June 2024*

***Muhammad Ariff Nurdin, Jufri Haikal Suhaimi, Nurul Fazlin Nazwa, Nurhasyimah Abd Aziz, Wan Fathul Hakim W. Zamri****
*Faculty of Engineering and Built Environment,*
*Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.*
**wfathul.hakim@ukm.edu.my*

**Abstract**
This review compares engineering education in Malaysia, Singapore, and Finland, exploring their unique approaches. The purpose of this paper is to discuss, examine, and compare how the learning structure, teaching methods, and challenges in the engineering education system in three selected countries. In Malaysia, the curriculum involves pre-university education and internships, tailored to meet industry requirements. This paper also examines holistic education initiatives of two high-performing education systems—Finland and Singapore. Finland and Singapore are two nations enjoying enviable rankings in international testing benchmarks for academic subjects at all levels. Singapore emphasizes STEM education and a student-centred curriculum. Meanwhile, Finland distinguishes itself with innovative, student-focused learning, promoting collaboration and problem-solving. Teaching methods in Malaysia involve discussion, inquiry, and emerging tech like Augmented Reality. Singapore focuses on STEM, student-centred learning, and 21st-century skills. Finland prioritizes personalized, problem-based learning and collaborative projects. While each country has its strengths, challenges persist. Malaysia aims for a dynamic curriculum, facing issues like teacher competency. Singapore needs a more tech-driven system and industry-academia collaboration. Finland addresses globalization, teacher attraction, and funding for educational improvements. Overall, the study presents the outcome that can help to understand learning structure, teaching methods, and challenges in the engineering education system in Malaysia, Singapore, and Finland.

**Keywords**: engineering, methods, education, challenges, learning structures.

## Introduction

The importance of engineering education cannot be overemphasized in today's rapidly changing technological world. This extensive review examines and compares the engineering education systems of three different countries: Malaysia, Singapore, and Finland. Finland and Singapore are two nations enjoying enviable rankings in international testing benchmarks for academic subjects at all levels (Lidé, S., & Cheong, S. K., 2010).

Malaysia, a fast-expanding country, has achieved considerable advances in engineering education to suit the needs of its burgeoning industry. Singapore, renowned for its strong educational system and technical competence, provides a distinct combination of academic and practical engineering education (C. Lek & C. Kwan, 2017). Finland, on the other hand, is known for its creative and student-centred approach to education, which offers a distinct viewpoint on engineering education (Anne et al., 2010). Each of these countries, with their own socioeconomic, cultural, and historical backgrounds, takes a particular approach to engineering education. The article will analyse these systems, throwing light on their learning structure, methodologies, and challenges in education.

The comparison is not limited to surface-level examination. We look in depth at each country's curriculum, instructional methodologies, industry-academia collaboration, and the balance of academic knowledge and practical abilities. Furthermore, we look at how each country's particular difficulties and possibilities have influenced its approach to engineering education.

This detailed research is not only a great resource for educators, students, and politicians, but it also initiates a discussion about the future of engineering education. It encourages readers to think about these various systems and evaluate what features can be useful in their own circumstances. There are 3 main sections that will be discussed in this journal as in Figure 1.

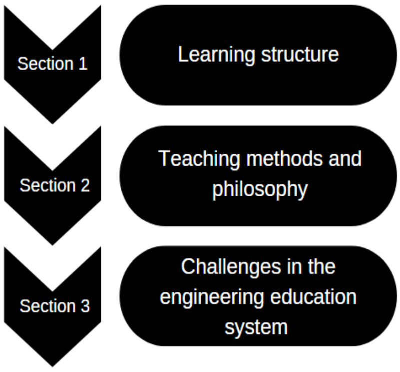


**Figure 1. Three main sections**

## Learning Structure

*Malaysia*

In Malaysia, engineering programs are offered at both the undergraduate and postgraduate levels. Before entering university, students must complete pre-university programs such as the Malaysian Higher School Certificate (STPM), Matriculation, A-levels, or any other comparable certification. These pre-university programs serve as a foundation for students to acquire the necessary knowledge and skills required for engineering studies. Upon completion of the pre-university program, students must proceed to the undergraduate program. Students can choose to pursue a bachelor's degree in engineering at various universities in Malaysia. These programs typically take four years to complete and cover a wide range of engineering disciplines, such as civil, mechanical, electrical, and chemical engineering. Additionally, some universities also offer specialized engineering programs like aerospace or biomedical engineering. One requirement for the students to graduate is that they must do an internship or industrial training to gain practical experience in their chosen field. The first local university in Malaysia to offer engineering degree programs is Universiti Malaya (Megat Mohd Noor et al., 1999). There are a few attributes that the Board of Engineers Malaysia (BEM) considers necessary in preparing for contemporary engineering practice, which is the ability to apply mathematics, science, and engineering science in solving engineering tasks, the ability to understand environmental, economic, and community impacts on development, and the ability to communicate effectively and ethically in discharging duties (Megat Mohd Noor et al., 2002). After earning a bachelor's degree, students can continue their education with a master's degree in engineering, which typically takes one to two years. A Ph.D. in engineering is an option for those who are interested in research and academia.

*Singapore*

In Singapore, there are various levels of study forengineering in Singapore. One of which is pre-university education, undergraduate education, internship, and post-graduate education. Before attending university, students in Singapore frequently do an engineering programme. Taking GCE Advanced Level (A-level) examinations or pursuing other similar credentials such as the International Baccalaureate (IB) certificate are common examples. Nanyang Technological University (NTU) is one of Singapore's top institutions for engineering education and research (C. Lek & C. Kwan, 2017). NTU's College of Engineering is made up of six internationally recognised engineering schools, each with its area of expertise. The engineering schools are focused on technology and innovation, and all six are routinely ranked among the best colleges in the world. Internships are frequently included in engineering programmes to expose students to real-world engineering practices. This industry cooperation allows students to apply classroom information in a professional context and learn vital practical skills. All Nanyang engineering undergraduates in their third year of study participate in 24 weeks of attachment in industry, either in Singapore or overseas (Lee, 2005). Postgraduate education is available, including master's and Ph.D. programmes in the engineering profession. Postgraduate studies may entail more specialized research and in-depth study of certain areas. For example, National University of Singapore (NUS) offers Master of Science (M.Sc.) and Master of Engineering (M.Eng.) programs in various engineering disciplines, such as Electrical and Computer Engineering, Chemical Engineering, and Mechanical Engineering.

*Finland*

In Finland, the history of formal engineering education dates back approximately 150 years, while the profession itself has over 200 years of history. The first Finnish engineers were men of practice, trained by the apprenticeship system, and used the title The Factory Master. Germany's system is the model for Finland's higher education system. There are two recognized categories of education: universities and Ammattikorkeakoulus, which translates to "Vocational College" but is also sometimes called "University of Applied Sciences" (Tulkki, 1999). In Finland, children start their education in a voluntary preschool program, provided up to age six through neighborhood centers called "päiväkoti." Following that, students must attend a nine-year comprehensive school (peruskoulu) for compulsory education from the age of seven to sixteen. Following this, students have the option of applying to a vocational school, senior secondary school (Lukio), or directly entering the workforce.

Students attending senior secondary school often prepare for higher education in ammattikorkeakoulu (AMK), or polytechnic, or a yliopisto, or university. The bilingualism between Finland and Sweden is preserved, and students are required to speak both Finnish and Swedish. Many also study English. All education in Finland is cost-free, including lower school supplies. In higher education, students pay minimal fees, and receive government-guaranteed study loans, housing allowances, and financial grants. Finland's universities grant only the equivalent of Master's and Doctorate engineering degrees. Only the AMKs offer bachelor's degree programs, with typical programs requiring 160 credit units (CU) of study (King, 1999).

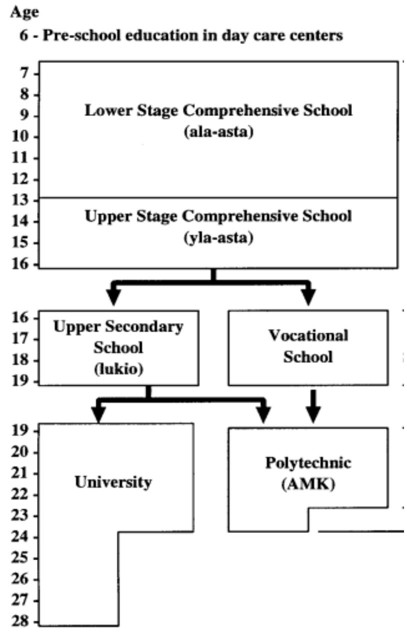


**Figure 2. The Finnish Education System (King, 1999)**

For four years, the students average 25 hours per week of classroom study with a lecturer. The university master's degree program requires 185 CUs or involves five years of 25 hours per week of classroom work. In the case of an engineer, fundamental studies consist of approximately 17 courses, encompassing three courses each in calculus and physics, four courses in a foreign language, and additional coursework in statistics, economics, and information technology (King, 1999). Practical experience, known as work placement, is a mandatory part of the program and typically spans four to six months of full-time work at a Finnish or international company. This practical work experience is generally undertaken after around two and a half years of study.

## Teaching Methods and Philosophy

*Malaysia*

The teaching and learning methods used by engineering educators in Malaysia are discussion, inquiry, remembering, and imitating (Yunos et al., 2020). In alignment with the Malaysia Education Blueprint 2013-2025, enhancing to achieve the transformative goals outlined in the education blueprint and most modern engineering education combines traditional in-person classes with online learning (Low et al., 2021). A teaching method known as Problem-Based Learning (PBL) started gaining more recognition. The fundamental concept of PBL revolves around the notion that learning occurs through the exploration of solutions to real-world problems, instead of theoretical problems in the classroom (Wangel, 2021).

**Table 1. Comparison between Malaysia, Singapore and Finland in learning structure.**

| Aspect | MALAYSIA | SINGAPORE | FINLAND |
|---|---|---|---|
| **Pre-university** | Malaysian Higher School Certificate (STPM), Matriculation, A- levels or equivalent. | GCE Advanced Level (A-level) examinations or International Baccalaureate (IB) certificate. | 9 years comprehensive school (peruskoulu). Then, vocational school, senior secondary school (Lukio) or entering the workforce. |
| **Duration of bachelor's degree** | 4 years to complete | usually around four years for a bachelor's degree | programs at Ammattikorkeakoulus (polytechnics) typically require four years |
| **Duration of internship** | usually 10 weeks-6 months | 24 weeks of industry attachment in the third year of undergraduate study. | typically spans four to six months after around two and a half years of study |
| **Credit hours of engineering course** | 140-150 credit units | 160 credit units to fulfill the graduation requirements | 160 credit units (CU) of study |

## Teaching Methods and Philosophy

*Malaysia*

The teaching and learning methods used by engineering educators in Malaysia are discussion, inquiry, remembering, and imitating (Yunos et al., 2020). In alignment with the Malaysia Education Blueprint 2013-2025, enhancing to achieve the transformative goals outlined in the education blueprint and most modern engineering education combines traditional in-person classes with online learning (Low et al., 2021). A teaching method known as Problem-Based Learning (PBL) started gaining more recognition. The fundamental concept of PBL revolves around the notion that learning occurs through the exploration of solutions to real-world problems, instead of theoretical problems in the classroom (Wangel, 2021).

The teaching and learning methods used by engineering educators in Malaysia are discussion, inquiry, remembering, and imitation (Yunos et al., 2020). STEM approach refers to an educational method that combines the knowledge, skills, and values of Science, Technology, Engineering, and Mathematics to address challenges related to everyday life, community, and environment (Shahali et al., 2017). In the context of teaching and learning, STEM knowledge refers to the incorporation of ideas, concepts, principles, theories, and understanding within the STEM field that is integrated into the curriculum of all STEM subjects. The designed and developed curriculum strives to provide students with knowledge, skills, and values through activities facilitated by teachers, whether conducted inside or outside the classroom setting (Bahrum et al., 2017).

Engineering education specifically involves the use of laboratory equipment and apparatus which needs safety protocol and significant financial investment. The recent global pandemic has also impacted the instructional and learning aspects of engineering education as all classes and laboratory sessions are being conducted through online distance learning (ODL) methods (Enzai et al., 2021). Augmented Reality (AR) learning method is introduced. A well-planned AR is expected to improve the learning process, especially for science and engineering subjects as they involve substantial amounts of equipment and apparatus (Enzai et al., 2021).

*Singapore*

Singapore Teaching Practice (STP) is a foundational component of Singapore engineering courses' teaching techniques and philosophy. It is a paradigm that sets out a clear foundation for good teaching and learning in Singaporean schools (Ministry of Education, 2022). The STP is based on the concept that teaching is a profession that requires an in-depth understanding of how students learn and how teachers may promote this learning successfully (Ministry of Education, 2022). It reflects the collective expertise of Singapore's educators, acquired over years of practice and research.

The emphasis on STEM education is an important part of Singapore's engineering schools' teaching techniques and philosophy. STEM, which stands for Science, Technology, Engineering, and Mathematics, is a multidisciplinary subject in which students learn about all these topics in one course (Teo & Choy, 2021). STEM education's idea is to teach skills and subjects in ways that are relevant to real-world problems (Teo & Choy, 2021). This approach to education is growing into an integrated curriculum designed to prepare students for the problems of the 21st century.

The Singapore Curriculum Philosophy also influences the teaching techniques and philosophy in engineering courses. This ideology reflects the teaching fraternity's essential principles about learning, placing each student at the center of educational decisions (Ministry of Education, 2022). These ideas influence curriculum design and execution, ensuring that it is student-centred and promotes successful learning.

These principles drive the teaching techniques and philosophy of engineering courses in Singapore. The goal is to train students to be creative and inventive problem solvers, researchers, engineers, and designers (Rajandiran, 2020). This strategy guarantees that students are well-prepared to face real-world challenges and make valuable contributions to the profession of engineering. In addition to these, Singapore's Ministry of Education has identified specific 21st-century capabilities that the STEM education strategy addresses (Ministry of Education, 2023). These include critical thinking, creative thinking, communication, cooperation, and informational abilities (Ministry of Education, 2023). STEM education not only prepares kids for their future vocations but also promotes in them a love of learning.

Finally, the methods of instruction and philosophy used in Singapore engineering courses are intended to give students with a thorough, real-world practical, and interesting educational experience. They want to provide students with the skills and information they need to succeed in their future employment and contribute to the growth of engineering. This comprehensive approach to education guarantees that students are not only academically competent but also have the abilities required to negotiate the complexity of the real world. It demonstrates Singapore's commitment to developing a future-ready generation of engineers.

The most widely recognized and promoted teaching philosophy in Singapore vocational education is the student-centred teaching concept. This teaching concept focuses on the development of students' personalities, the cultivation of self-learning ability, and the embodiment of the learning effect. It is found that students take an active role in the learning process rather than being passive recipients of information from teachers (Ding, L. 2023).

*Finland*

Finnish engineering education is known for its innovative and student-centered approach to teaching and learning. Personalized learning is given top priority in Finnish engineering courses, where students are urged to assume control over their education. With this method, students can work at their own pace and concentrate on their unique strengths and shortcomings (Anne et al., 2010). Finnish university sector adapted the German model and thus the Humboldian understanding is deeply rooted in Finnish universities (Hölttä, S., 2000).

Finnish engineering courses put a strong emphasis on student collaboration, which encourages learning from one another and helps students build their abilities to collaborate. The teaching methods in Finnish universities, particularly in engineering, prioritize student engagement and participation. The focus on developing critical thinking abilities and a love of learning is evidence of a philosophy that encourages students to take an active role in their own education. These programs' strong feeling of community is consistent with the idea that collaborative learning environments improve students' overall educational experiences. A learner-centred approach, for instance, is demonstrated by the University of Eastern Finland Teacher Training School, which emphasizes the significance of striking a balance between various goals, tactics, and instructional resources. This method is part of a larger educational philosophy that acknowledges the differences in the demands and learning preferences of teachers and students.

In general, Finnish engineering education emphasizes practical, student-focused, Problem-Based Learning (PBL) and collaborative learning approaches through its teaching methods and philosophy. As Finnish engineering courses prioritize hands-on learning experiences, institutes are encouraged to incorporate innovative methods like the double-flip approach and gamified mathematics. According to Visitedufinn, these techniques actively involve students in the learning process, facilitating a deeper understanding of complex concepts. The double-flip approach, for example, allows students to engage in problem-solving tasks during class sessions and watch video lectures at home.

Many schools have also embraced the Problem-Based Learning (PBL) successfully. Metropolia University of Applied Sciences initiated a significant curriculum reform, emphasizing the adoption of a new PBL curriculum in engineering education. Meanwhile, Griffith University introduced a PBL unit for first year engineering students, receiving favourable feedback from both students and teachers (Vesikivi, 2015). The goal of the unit was to provide a hands-on, interesting learning environment that would encourage the growth of problem-solving and teamwork skills. Finally, Helsinki Metropolia University developed a cooperative project-based learning course specifically designed for engineers (Lavonen, 2021).

One of the teaching theories that has been used in Finland is the student-teacher relationship (Tormey 2021). Tormey's three-dimensional model of student-teacher relationships in higher education highlights the multidimensional nature of emotions in student-teacher relationships and goes beyond simple measurements of emotional valence. In the field of engineering education, paying attention to emotions is valuable because of their significance especially when engineers engage with ethical aspects in their work or solve emotion-provoking, complex, and wicked problems (Roeser 2012).

**Table 2. Comparison between Malaysia, Singapore, and Finland in teaching methods and philosophy**

| Aspect | MALAYSIA | SINGAPORE | FINLAND |
|---|---|---|---|
| **Teaching Methods** | • Discussion<br>• Inquiry<br>• Remembering and imitating | • Singapore Teaching Practice (STP)<br>• STEM education | • Problem Based Learning (PBL)<br>• Collaborative learning |
| **Philosophy and Approach** | Quality enhancement aligning with the Malaysia Education Blueprint | STEM education, student centered, 21st-century skills | Innovative, student centered, emphasis on PBL |
| **21st-century Skills Emphasized** | Introduction of Augmented Reality (AR) | • Critical thinking<br>• Creative thinking | • Critical thinking<br>• Problem solving<br>• Teamwork |

## Challenges in the Engineering Education System

*Malaysia*

The role of the future engineer in this technologically advanced society is becoming more challenging due to the globalization of industry and engineering practices. Current societal challenges, such as international competition, global environmental issues, a growing and diverse population, and rapid population expansion. Consequently, engineers will encounter intensified challenges and competition. In response, he future engineering education system should emphasize comprehensive engineering programs to facilitate easy mobility, flexibility, and adaptability to evolving technologies and environments. Hence, a more dynamic curriculum in engineering education is needed. Recognizing the importance of nurturing highly competent engineers for the future, the Malaysian Ministry of Higher Education (MOHE) has pressured universities to graduate engineers who can effectively compete in the job market (Nor et al., 2020).

Past research has identified various challenges with STEM education, such as the limited application of STEM in rural areas. The discrepancy in competency among teachers in STEM, is not balanced between urban and rural areas (Khairani, 2017). Teachers' inadequate understanding of STEM concepts is also one of the challenges (Idris et al., 2023). Insufficient equipment, and a lack of proper equipment in school laboratories (Belalang et al., 2016). Teacher's attitude towards STEM also contributes to the challenges (Thibaut et al., 2018).

*Singapore*

Singapore's engineering education system faces various issues. One of the most pressing concerns is adjusting to a quickly changing environment, which involves cultivating an entrepreneurial and flexible culture that is also more inquisitive overall (Mun See, 2021). This involves preparing kids for self-directed learning. Another difficulty is the transition to more digital and technology classrooms. This entails developing 21st-century abilities in students and converting instructors from mere recipients of knowledge to co-creators of knowledge (Mun See, 2021).

A fundamental difficulty is a lack of collaboration between industry and academics (Ivanov et al., 2023). The industry needs qualified individuals to be competitive, and academia must keep up with the newest industrial trends and innovations. Engineers are needed to address future issues that Singapore may confront (Lai, 2020). This entails reducing issues to their core causes to create rational, elegant solutions for navigating society through uncertain ground.

Finally, there is a requirement for a clear and successful strategy that incorporates a common vision and commitment to the required restructuring and mentality shifts (Ivanov et al., 2023). These issues necessitate a multifaceted strategy that includes changes in teaching techniques, curriculum design, industry-academic collaboration, and a shift in mentality towards lifelong learning and adaptation.

*Finland*

Even though Finland's engineering courses boast impeccable methods and educational philosophy, they are not exempt from facing significant challenges. First and foremost, the rapid pace of globalization and technological advancements demands adaptation to prepare engineers for the evolving demands of the global workforce (Korhonen et al., 2007). Apart from that, the need for an active and participatory approach in engineering education is one of the main obstacles. Conventional methods and materials are being questioned as global ICT sector initiatives underline the need for an educational framework that is flexible enough to adapt to changing circumstances while also actively involving students in a dynamic learning environment. (Korhonen et al., 2007).

Another important problem that comes up is how appealing teaching is, especially for those in the technical area. For Finland's engineering education to be of a high calibre overall, teaching positions must continue to be attractive (Korhonen, 2011). It may be more difficult to encourage and inspire the upcoming generation of engineers in the absence of a thriving teaching environment.

Finally, tackling these issues requires sufficient cash and resources to be available. The amount of cash and resources that the education system receives strongly affects its ability to develop and satisfy the changing needs of engineering students. Sufficient funding guarantees that academic institutions can make the required adjustments, purchase modern technology, and offer students an excellent education (Korhonen, 2011).

**Table 3. Comparison between Malaysia, Singapore and Finland in challenges in engineering education system.**

| MALAYSIA | SINGAPORE | FINLAND |
|---|---|---|
| • Evolve to adapt with technologically advanced society<br>• A more dynamic curriculum in engineering education is needed<br>• Insufficient equipment and a lack of proper equipment in school laboratories | • Adjusting to a quickly changing environment<br>• Transition to more digital and technology classrooms<br>• A lack of collaboration between industry and academics<br>• A requirement for a clear and successful strategy that incorporates a common vision and commitment to the required restructuring and mentality shifts | • The rapid pace of globalization and technological advancements demands adaptation to prepare engineers for the evolving demands of the global workforce<br>• The need for an active and participatory approach in engineering education<br>• Insufficient cash and resources. |

## Conclusion

In conclusion, this analysis contrasts the approaches in the engineering education system in Malaysia, Singapore, and Finland, examining their distinct methodologies. This research also looks at holistic education approaches in two high-performing school systems: Finland and Singapore. Malaysia's curriculum includes pre-university education and internships that are customized to industrial requirements. Singapore prioritizes STEM education and a student-centred curriculum. Meanwhile, Finland distinguishes itself via creative, student-centred learning that encourages cooperation and problem-solving. Malaysia's teaching methods include conversation, research, and developing technologies such as Augmented Reality. Singapore prioritizes STEM, student-centred instruction, and 21st-century skills. Finland values personalized, problem-based learning and collaborative projects. One of the main challenges faced by Malaysia is insufficient equipment and a lack of proper equipment in school laboratories. Meanwhile, Singapore also faces difficulty in the transition to more digital and technology classrooms. Finland is also not exempt from facing significant challenges such as the need for an active and participatory approach in engineering education. Overall, the study's findings can be used to better understand the learning structure, teaching techniques, and issues of the engineering education systems in Malaysia, Singapore, and Finland.

## Acknowledgment

The authors would also like to thank the Faculty of Engineering and Built Environment, UKM, and the Topik Terkini Kejuruteraan Mekanikal course for their visionary initiatives and for giving us the chance to write an engaging journal.

## References

Anne Kleemola, Samuli Kolari, Janne Roslöf, Carina Savander-Ranne. (2010). Benchmarking Teaching and Learning Practices in Finnish Engineering Education. ResearchGate. https://www.researchgate.net/publication/268197586_Benchmarking_Teaching_and_Learning_Practices_in_Finnish_Engineering_Education

Bahrum, S., Wahid, N., Ibrahim, N. (2017). Integration of STEM Education in Malaysia and Why to STEAM. International Journal of Academic Research in Business and Social Sciences, 7(6). https://doi.org/10.6007/ijarbss/v7-i6/3027

Belalang, W. N. A., & Abd Rahman, M. J. B. (2016). ICT literacy skills among Iban student in rural Sibu, Sarawak. In Proceeding 7th International Seminar on Regional Education (Vol. 1, pp. 606-622).

C. Lek, & C. Kwan. (2017). Mechatronics Education in Singapore | Semantic Scholar. https://www.semanticscholar.org/paper/Mechatronics-Education-in-Singapore-Lek-Kwan/503074e8c5c25da27121f6badd0767e89ebb7806

Ding, L. (2023). Effects of Student-centered Philosophy on Teaching Resources and Teaching Methods in Vocational Education in Singapore. Academic Journal of Humanities & Social Sciences, 6(12), 75-83.

Hamizah, S., A., Ali, M., Abd, M., & Bunyamin, H. (2022). *STEM Education in Malaysia: A Review*. Retrieved from http://www.recsam.edu.my/sub_LSMJournal/images/docs/2022/2022_9_ASPIN_125139.pdf

Hölttä, S. (2000). From ivory towers to regional networks in Finnish higher education. European Journal of Education, 35(4), 465-474.

Idris, R., Priyalatha Govindasamy & Suppiah Nachiappan. (2023). Challenge and Obstacles of STEM Education in Malaysia. *International journal of academic research in business & social sciences* 13(4).

Ivanov, V., Pavlenko, I., Evtuhov, A., & Trojanowska, J. (2023). Major Challenges in Engineering Education. Springer Tracts in Mechanical Engineering, Part F1480, 1–11. https://doi.org/10.1007/978-3-031-44641-2_1/FIGURES/3

Khairani, A. Z. (2017). Assessing Urban and Rural Teachers' Competencies in STEM Integrated Education in Malaysia. MATEC Web of Conferences 87. Universiti Sains Malaysia, Malaysia: EDP Sciences.

King, J. (1999). Engineering Education in Finland. Journal of Engineering Education, 88(2), 159–162. DOI:10.1002/j.2168-9830. 1999.tb00428.x

Korhonen-Yrjänheikki, K. (2011). Future of the Finnish Engineering Education – A Collaborative Stakeholder Approach. https://core.ac.uk/download/pdf/80703928.pdf

Korhonen-Yrjanheikki, K. (2007). New Challenging Approaches to engineering Education: Enhancing University-Industry Co-Operation. Learning & Technology Library (LearnTechLib). https://www.learntechlib.org/p/64090/

Lai, L. (2020). Engineers needed to solve Singapore's future challenges | The Straits Times. https://www.straitstimes.com/singapore/environment/engineers-needed-to-solve-singapores-future-challenges

Lavonen, L., Loukomies, A., Vartiainen, J., & Palojoki, P. (2021). Supporting Pupils' scientific and engineering practices in everyday life contexts at the primary school level during a project-based learning unit in Finland. Education 3-13, 50(7), 918–933. https://doi.org/10.1080/03004279.2021.1921823

Lee, S. G. (2005). Manufacturing Engineering Education in Singapore. In Journal of Mant (fiTcturing Systems (Vol. 24, Issue 3).

Lidé, S., & Cheong, S. K. (2010). National Intellectual Capital: Examining the implications of intellectual capital elements in national and innovation system model context through a comparative study of Finland, Singapore and Malaysia.

Min Chi Low, Chen Kang Lee, Manjit Singh Sidhu, Seng Poh Lim, Hasan, Z., & Seng Chee Lim. (2021). Blended Learning to Enhanced Engineering Education using Flipped Classroom Approach: An Overview. Electronic Journal of Computer Science and Information Technology, 7(1). https://doi.org/10.52650/ejcsit.v7i1.111

Ministry of Education. (2022). Singapore Curriculum Philosophy | MOE. https://www.moe.gov.sg/education-in-sg/our-teachers/singapore-curriculum-philosophy

Ministry of Education. (2023). 21st Century Competencies | MOE. https://www.moe.gov.sg/education-in-sg/21st-century-competencies

Mun See, T. (2021). Tackling Current and Future Challenges of Education | SingTeach | Education Research for Teachers | Research within Reach. https://singteach.nie.edu.sg/2021/07/19/issue77-tackling-current-and-future-challenges-of-education/

Nur, Nahdatul Akma Ahmad, Mohd, Siti Sara Rais, & Mohamed, S. (2021). Development of Augmented Reality (AR) for

Innovative Teaching and Learning in Engineering Education. Asian Journal of University Education, 16(4), 99–99. https://doi.org/10.24191/ajue.v16i4.11954
Nor, N., Rajab, N., & Ismail, K. (2020). Educating the Engineer of 2020: Malaysian Scenario
Rajandiran, D. (2020). Singapore's teacher education model for the 21st century (TE21). Implementing Deeper Learning and 21st Century Education Reforms: Building an Education Renaissance After a Global Pandemic, 59–77. https://doi.org/10.1007/978-3-030-57039-2_3/COVER
Roeser, S. (2012). Emotional engineers: Toward morally responsible design. Science and engineering ethics, 18, 103-115.
Shahali, E. H. M., Ismail, I., & Halim, L. (2017). STEM education in Malaysia: Policy, trajectories and initiatives. Asian Research Policy, 8(2), 122-133.
Teo, T. W., & Choy, B. H. (2021). STEM Education in Singapore. 43–59. https://doi.org/10.1007/978-981-16-1357-9_3
Tormey, R. (2021). Rethinking student-teacher relationships in higher education: a multidimensional approach. Higher Education, 82(5), 993-1011.
Tulkki, P. (1999). The Birth of Engineer Education in Finland. European Journal of Engineering Education, 24:1, 83-94. DOI: 10.1080/03043799908923540.
Vesikivi, P. (2015). Adoption of a new project-based learning (PBL) curriculum in Information Technology. www.academia.edu. https://www.academia.edu/65605693/Adoption_of_a_new_project_based_learning_PBL_curriculum_in_Information_Technology.
Wangel, A. (2021). The MUCED experience: New teaching methods in Malaysia. https://ddrn.dk/7109/