CHOICE - INCREASING YOUNG PEOPLE'S MOTIVATION TO CHOOSE STEM CAREERS THROUGH AN INNOVATIVE CROSS-DISCIPLINARY STE(A)M APPROACH TO EDUCATION

NATIONAL REPORTS ON LOCAL AND REGIONAL INITIATIVES, BEST PRACTICES, STUDENTS' ATTITUDES AND TEACHERS' APPROACHES TO STE(A)M EDUCATION IN CYPRUS

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1 Introduction

The following report gives an overview of the educational system in Cyprus and the types of educational programmes offered by public and private schools and highlights the need to reform STEM-related curricula and integrate good practices in teaching STEM that foster the students' interest in STEM subjects as well as the attractiveness of STEM-related careers.

Moreover, policy trends regarding the integration of STE(A)M in the educational system are described, as well as existing initiatives implemented by schools in Cyprus focusing on the integration of good practices regarding teaching STEM disciplines in high schools,

1 Background information

1.1 Information about Cyprus

Cyprus is an island in the Eastern Mediterranean Sea. It is the third largest and most populated island in the region, which has been inhabited since the 10th millennium BC. The population of Cyprus as of the end of 2018 is estimated to be 875,900 in the southern area controlled by the government of the Republic of Cyprus, where the main spoken language is Modern Greek. The capital, representing the largest city in Cyprus, is Nicosia, the population of which is 200,452.[1,2]

1.2 Statistics

Secondary Education in Cyprus is provided for students aged 12 to 18. For the public schools, it is offered through two three-year cycles – Gymnasium (middle school) and Lyceum (high school). The two cycles include distinct courses, such as Greek and Mathematics, cross-curricular programmes, such as Health and Environmental Education, as well as a variety of extracurricular activities, such as excursions and visits to achieve a global and balanced development of the students' personality. There are currently 64 Gymnasiums (middle schools) and 38 Lyceums (high schools) all over Cyprus. Private schools - depending on the type of school - have their own curriculum, syllabus and tuition fees. Currently, there are 39 Secondary Private Schools all over Cyprus.[3]

In the first year of High School education, students choose one of the four available Subject Orientation Groups, which include a default combination of courses and lead to six corresponding educational directions in the second and third years of High School education. These directions include: a) Classical and Humanity studies; b) Foreign Languages and European Studies; c) Fine Arts; d) Applied Sciences / Biosciences / Informatics & Technology; e) Economics and f) Commerce and Industry. Additionally, the school provides the

[1] https://worldpopulationreview.com/countries/cyprus-population/
[2] https://www.mof.gov.cy/mof/cystat/statistics.nsf/populationcondition_21main_gr/populationcondition_21main_gr?OpenForm&sub=1&sel=4
[3] http://www.moec.gov.cy/dme/en/index.html

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students the basic knowledge in order to be able to continue their studies in tertiary education, but also a more specialised knowledge for accessing the free labour market.[4]

The percentage of young people aged 25-64 years old in Cyprus with very basic digital competences is slightly higher than the average in the EU (34% versus 30%). However, the percentage of individuals in Cyprus having more than basic digital competences is much lower than the average in EU (22% versus 36%). The percentage of schools in Cyprus providing essential equipment to support digital education, such as laptops, computers, cameras and interactive boards, is lower than the average percentage across EU at both primary and secondary levels. Only 40% of middle schools and 59% of high schools offer the necessary equipment to support digital tools as opposed to 54% and 84%, respectively in Europe.[5] Additionally, Cyprus has one of the lowest shares of STEM graduates in the EU and a lower share of ICT specialists in the workforce than the EU average. Approximately, one third of bachelor's students graduate with a degree in business, administration and law, a percentage much higher than any other discipline in Cyprus and the highest in EU. Studies critical for innovation are underrepresented. Only 2.4% of Master's students graduate with a degree in natural sciences, mathematics and statistics and only 1.5% graduate with a degree in ICT. Therefore, there is a great need to enhance students' interest in STEM subjects and increase the attractiveness of STEM-related careers.[6]

The annual Circular of the Cypriot Ministry of Education and Culture (MoEC) in Cyprus stressed for the first time in 2005 the critical role of education in supplying the market with young people with the right employability skills all of which can be taught and learnt at school so that pupils can cope with the challenges of the modern world and labour market later on as citizens. These skills include creativity, critical thinking, problem solving, financial literacy and taking initiative/accountability.[7] Moreover, for the first time in 2010, the Department of Higher and Tertiary Education within the MoEC stressed the need to increase the number of students attending programmes related to STEM and to align the Cypriot educational policy and vision with that of the EU that focuses on boosting research and development that are important for smart economic growth.[8] In response to this necessity, seminars on critical thinking, creativity, innovation, artificial intelligence, lifelong learning skills, new teaching approaches for STEM subjects and the use of ICT tools in teaching STEM, were announced during the years 2007 and 2018 for teachers and school principals to participate on a voluntary basis.[9]

Various initiatives regarding the enhancement of digital education at schools are now underway. Due to unpredictable developments in the labour market and misalignment, the Cypriot MoEC is reinforcing its partnership with the Cyprus Employers & Industrialists Federation (OEB) and the Cyprus Chamber Of Commerce and Industry to identify the needs of today's labour market in order to modernise the school

[4]Annual Report (2018). Ministry of Education and Culture in Cyprus. URL: http://www.moec.gov.cy/etisia-ekthesi/index.html [Accessed on the 7th of April 2020]
[5] Ευρωπαϊκή Ένωση 2019. Έκθεση παρακολούθησης της εκπαίδευσης και κατάρτισης 2019 – Κύπρος.
[6] European Commission. 2018. Education and Training Monitor – Cyprus.
[7] Annual Report (2005). Ministry of Education and Culture in Cyprus: http://www.moec.gov.cy/en/annual_reports/Annual-Report-2005-EN.pdf
[8] Annual Report (2010). Ministry of Education and Culture in Cyprus.
[9] http://enimerosi.moec.gov.cy/d/dme

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curricula by integrating new subjects that will reduce the skill mismatches in the labour market. The subject Design and Technology is delivered to students of all ages and it is based on a problem-solving approach, exploration and implementation of knowledge in other sciences through experiential learning and practical sessions. During the 2017-2018 academic year, the curriculum was revised to integrate the subject or Robotics with an aim to cultivate algorithmic thinking and foster programming skills.[10] In February 2019, a pilot programme was launched, through which approximately 205 robots were provided to secondary schools with an aim to support modules on robots and to implement national robotics competitions.[11] The first National Space and Robotics competition was planned to take place this year.[12]

Future plans for Cyprus include strengthening the Cypriot national qualifications framework, and developing a guidelines handbook that will include guidelines, criteria and procedures for the inclusion of qualifications in the national registry. Additionally, the establishment of a validation agency, development of guidelines on validation of non-formal and informal learning, as well as analysing and implementing learning outcomes in different subsystems are expected to be completed in 2020.[13] Finally, to tackle the low percentage of students choosing STEM careers, the Ministry of Education and Culture is currently developing a STEM programme to be integrated in the curriculum of middle and high schools for the next academic year 2020 – 2021. A pilot STEM programme was implemented for the first time this year (2019 – 2020) in 9 primary schools and was delivered by teachers with a Master's degree in STEM education and teaching approaches.[14]

2 Integration of STE(A)M in schools

2.1 Good practices and ongoing national and international projects, resources, initiatives related to STE(A)M at National level

Here's a list of initiatives fostering STE(A)M activities taking place at a national level:

Research has shown that robotics integration in education contributes to the teaching of STEM subjects and promotes the development of student higher-order thinking skills, like problem-solving, decision-making, creativity and scientific investigation. Integration of Robotics in the teaching and learning practice represents a tool that enhances their learning experience and support the development of 21st century learning skills. **The Robotics Academy at Frederick University Cyprus**, a research and educational unit, conducts and stimulates educational robotics. Recently, they developed the Educational Robotics Curriculum which was tested in a non-formal educational setting in collaboration with a Private Summer School for kids from 8 to 12 years old. The analysis of the data collected through surveys, observations and focus groups, revealed the

[10] Annual Report (2018). Ministry of Education and Culture in Cyprus. URL: http://www.moec.gov.cy/etisia-ekthesi/index.html [Accessed on the 7th of April 2020]
[11] Έκθεση παρακολούθησης της εκπαίδευσης και κατάρτισης 2019 – Κύπρος. Ευρωπαϊκή Ένωση 2019.
[12] http://enimerosi.moec.gov.cy/archeia/1/ypp10452a
[13] Cedefop, 2019. Cyprus – European Inventory on NQF 2018.
[14] http://enimerosi.moec.gov.cy/ypp9188

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positive impact and great potential of this curriculum as a cognitive-learning tool, which increases students' excitement, critical thinking skills, creativity, innovation and collaboration.[15]

STEM programme and Robotics Academy

At Grammar School, the STEM programme has been officially introduced into its curriculum since 2015. Its aim is to educate students in four specific disciplines- Science, Technology, Engineering and Mathematics – in an interdisciplinary and applied approach. Rather than teaching these subjects as separate ones, the programme integrates them into a cohesive learning paradigm. The STEM programme follows a teaching approach relying on applied knowledge, real-world problem-solving, structured inquiry-based learning and students' active and creative contribution. Students learn by doing, designing, making and programming robots or other equipment. The programme aims at enhancing the students' critical thinking, team spirit and creativity. It also provides the knowledge required to emphasise active problem-solving in collaboration with intelligent technology where students are able to create, programme and design applications and real-life scenarios. The programme takes place four times a week and provides students with basic knowledge in various topics, including science and engineering principles, computer programming languages, science experiments and motorized mechanisms, new media design, game development, robotics, research and data analysis, 3D model and design, mobile app development and web technologies. Additionally, students have the opportunity to join the Robotics Academy, an Academy set up as an extracurricular activity that aims at promoting team spirit, leadership and event-organising skills. The goal of the Academy is for students to develop skills and experience for STEM-related careers in fun, creative and innovative ways. Students learn the basics of building and programming miniature robots using LEGO MINDSTORMS. They also have the opportunity to practice team-work, decision making and evaluation of possible solutions and acquire hands-on experience in designing, building and testing. Finally, members of the Academy are selected to take part in Science and Robotics competitions and fairs at a national and an international level and to undergo further intensive training so that they can participate in National Robotics Competitions hosted by the WRO (World Robotics Organisation).[16]

The STEAMers

The STEAMers is a programme organised by the Youth Board of Cyprus that aims to cultivate young people's creative development, entertainment and learning, to enhance their creativity, innovation and communication skills, as well as their personal development and wellbeing. It offers a series of workshops on Robotics, Coding, Film making, Photography, Graphic Design, Creative Writing, Music, Drama and Art delivered by specialised and professional trainers following international STEAM approaches. The workshops address children and young people aged 6-35 years old and consist of 30 sessions that take place throughout the year in the three different districts, Nicosia, Limassol and Paphos. The participants have the opportunity

[15] Eteokleous N & Neophytou R. 2019. The case of the Robotics Academy @ Frederick University: 21st Century Skills Developed through a Non-formal Educational Setting. *10th International Conference in Open & Distance Learning*
[16] http://www.grammarschool.ac.cy/easyconsole.cfm/id/1542

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to meet, experiment and learn new programs, use their imagination, create, gain skills and cultivate their interests.[17]

Youth Makerspace Larnaca

The Youth Makerspace was established by the Youth Board of Cyprus in collaboration with Larnaca Municipality in 2019. The Youth Makerspace follows the Makerspace standards developed by Higher Education Institutes and other communities abroad. Makerspaces represent the democratisation of design, mechanization, construction and education. These spaces are hubs for hands-on, project-based learning, creation and invention supporting the integration of Art in STEM subjects.

The Youth Makerspace in Larnaca aims to foster horizontal and transferable skills, use of new technologies, enhancement of creativity, innovation and entrepreneurial mindset. It provides young people with access to high-quality and state-of-the-art equipment, such as 3D printers, laser cutters, drones, virtual reality, robotics, arduino, raspberry pi and many more. Workshops are taking place at the premises of the Youth Makerspace on how to use the equipment, develop ideas, projects and synergies. The space also hosts the Entrepreneurship Development Programme of the Youth Board of Cyprus.[18]

National Competitions fostering STEAM

The University of Nicosia organises an annual competition entitled "Research by Students" and invites students from Middle, High and Technical schools to submit their team-based innovative projects that can focus on social sciences, applied sciences, economics or healthy.[19]

The Research and Innovation Foundation in Cyprus, a public organisation launched in 1996, organises an annual competition entitled "Students in Research" with an aim to cultivate a research and innovation culture. The aim is to familiarise students of primary and secondary education with scientific research processes and to boost their creativity and innovation. Through the competition students are encouraged to go through various stages of the research and development process, such as formulation of hypothesis, methodology, data collection and analysis, experimentation, interpretation of results and presentation of a research process. The competition improves their ability to communicate, explore and work in a team. It also enhances their critical thinking, creativity and initiative. Research topics include among others Sustainable Development, Information and Communication Technologies, Health and Biological Sciences, Technology, while interdisciplinary approach is encouraged.[20]

Robotics Seminars for STEM teachers and trainers

The TIME Private Institute in Larnaca in collaboration with Eduk8 in Greece started offering Robotics seminars for the first time in Cyprus in 2019, which are delivered by Teacher Trainers certified by the LEGO Education Academy. The trainers provide the tools and resources teachers need to successfully integrate the LEGO

[17] https://onek.org.cy/en/home-page/programs-and-service/creative-activeness/youth-multicentres/#toggle-id-1
[18] https://onek.org.cy/en/home-page/programs-and-service/creative-activeness/makerspace/
[19] https://www.unic.ac.cy/support/research-innovation-office/research-by-students/
[20] http://www.research.org.cy/el/news/mera

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Education Academy's solutions into existing STEM curriculum and daily lesson planning. The seminars provide teachers the opportunity to experience lessons from a student's perspective, master classroom management, and explore best practices in classroom implementation.[21]

On 10th March 2018, the Paedagogical Institute in cooperation with the private company ENGINO co-organised the 1st national seminar on "STEM and Robotics in Education – State-of-the art approaches and applications" under the supervision of the Ministry of Education and Culture. The seminar was targeted at teachers of all educational levels.[22] Since then, there have been annual seminars on reinforcing STEM education, including the use of innovative and interactive technologies in STEM teaching, the use of Go-Lab, an online educational platform containing online workshops and OERs on STEM subjects. **Target group: Young students in elementary school aged 8 to 19 years old**

Aims: The aim of this study was to use Ubiquitous Computing, Mobile Computing and the Internet of Things, collectively referred to as UMI, as both subjects of education and facilitators of the educational process. In order to lay the foundations of their methodologies, a survey was conducted on the use of UMI technologies as educational means and educational subjects in secondary education in Greece, Cyprus and England, which showed that they are mostly used as educational means. .

Resource and activity: The making-&-tinkering approach involved making, tinkering, programming and playing in a group project integrated into the formal mathematics curriculum using a variety of arts, crafts and technological tools, such as a physical robot.

2.2 International level

The Cyprus Pedagogical Institute, Cyprus' main educational institution that was founded in 1972 and undertakes the training of educators of all educational levels, has recently participated in a number of European projects for innovative teaching approaches including:

a) **EDUCATE: Enhancing Differentiated Instruction and Cognitive Activation in Mathematics Lessons by Supporting Teacher Learning.STEAME: Raising STEAM in education[23]**
EDUCATE is a 30-month-long project funded under the Erasmus+ KA2 programme and coordinated by the University of Cyprus, which aims to develop, implement, validate and refine educational materials for educators that integrate cognitive activation through the use of challenging mathematics tasks and differentiation. Prior research has shown that engaging students in challenging tasks is pivotal for advancing their problem solving and reasoning skills that are considered key competencies for lifelong learning.

[21] http://larnakaonline.com.cy/2019/08/02/time-private-institute-prosferoun-seminaria-rompotikis-gia-ekpaideftikous-kai-gia-enilikes-ekpaideftikis-rompotikis-stem/
[22] https://innovativeschools.pi.ac.cy/education-details-2017-2018/kain-sem-2018-engino
[23] http://educate-platform.com/.

The project ran between February 2017 and January 2020 and addressed academics, teachers and educators from Cyprus, Greece, Ireland and Portugal. The materials developed by the Consortium can be found on the project's learning plaftorm: http://educate-platform.com/.

b) M4TM: Mathematics for the million: mathematics for my world[24]

M4TM is an ongoing project funded by the Erasmus+ KA2 programme that aims to provide an innovative approach to teach mathematics that will enhance existing good practices and support teachers' skills confidence and competence to teach. Moreover, it aims to embrace, instill and facilitate 21st century skills for teachers, pupils and parents.

The **STEAME** project aimed at facilitating learning difficult subjects, such as natural Sciences, Technology, Engineering and Maths through Art by taking a more interdisciplinary and holistic approach based on hands-on experience, experiment and learning-by-doing, as well as enabling artistic expression. The project was funded by the European Commission under the Erasmus+ programme Key Action 2. The partnership involved 5 partner schools from 5 different countries, including the I.M.S (Institute of Maths and Science) Private School in Cyprus.[25]

Aims: The aim of the project was to develop an innovative methodology on the implementation of activities and experimental workshops based on the STEAM approach that can be implemented in the classroom.

Resource and Activity: Each transnational meeting of the project explored in depth one STEAM subject in order to develop in a collaborative way workshops, experiments, seminars, tasks, games, flipped classroom and peer teaching, artistic events and academic training material. Topics included Chemistry All Around, Maths and Us, Green Engineering, IT, Robotics, Digital Art and Biodiversity.[23]

STEMitUP

The STEMitUP project was funded by the ERASMUS+ programme 2017 under the key action entitled "Cooperation for innovation and the exchange of good practices" in School Education. The partnership was composed of 7 organisations, including GrantXpert Consulting, from 5 Cyprus, Spain, The Netherlands, Norway and United Kingdom. The duration of the project was 24 months between 01/09/2017 and 31/08/2019.[26]

Target group: Teachers, students aged 11/15, parents, career counsellors and decision-makers

Aims: STEMitUP aimed to develop a state-of-the-art comprehensive educational programme that will provide STEM teachers with innovative pedagogical tools that maintain student engagement. The overall aim of the project was to make STEM-related courses 'fun' and interesting for students of lower secondary schools aged 12-15 in order to boost students' skills, knowledge and competences related to STEM combined

[24] https://sites.marjon.ac.uk/mathematicsforthemillion/contact/
[25] http://steam-erasmus.eu/
[26] https://www.stemitup.eu/

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with an entrepreneurial mindset and strategically plant a 'seed of interest' that could grow into an exciting and rewarding STEM entrepreneurship career.

Resource and activity: The project entailed the identification of the teachers' training needs regarding STEM entrepreneurship education. Partners went on to develop an innovative training programme that offers exciting activities and read-to-use educational resources for teachers to integrate STEM education, Entrepreneruship and Gender Inclusiveness in the classroom. Resources and activities are feely accessible on the project's educational platform https://www.stemitup.eu/platform.[27]

CSRC – Centre for STEAM Education Research, Science Communication and Innovation

The project was co-funded by the European Commission under the HORIZON 2020 programme "Teaming of excellent research institutions and low performing RDI regions". The coordinating organisation was the University of Cyprus and the partnership was composed of 14 organisations, including GrantXpert Consulting LTD, from 7 different countries. The project's aim was to create a unique Centre of Scientific Excellence for Cyprus and the East Mediterranean area, focusing on the development of innovative and top-quality research within STEAM Education, Science Communication and interactive and digital technologies for STEAM.

Aims: The project aimed to establish a Centre of Excellence in Cyprus and the Easter Mediterranean to:

a) undertake competitive interdisciplinary research for the development of innovative tools and exhibits for Science, Technology, Engineering, Art and Mathematics (STEAM) Education and Science Communication.
b) Promote science literacy and capacity building through informal STEAM education using interactive Science Technology and Engineering exhibits, demonstrations and contact with scientists.
c) Contribute towards a Responsible Research and Innovation (RRI) culture
d) Provide teacher professional training for integrating in-house developed ICT tools in formal STEAM education and promote integration of new STEAM approaches in education curricula.
e) Serve as a hub to communicate and disseminate to public and industry innovative technology research outcomes and evidence-based practice to policy makers.

Resource and activity: During Phase 1, the consortium effectively completed the development of a feasibility study and business plan to allow the establishment of an operational and financially viable centre, the formulation of a CSRC research strategy and the implementation of a range of dissemination and communication activities related to the project for key stakeholders.[28]

3 Analysis of students' attitudes and teachers' approaches towards STEM learning and teaching

[27] https://www.stemitup.eu/
[28] https://cordis.europa.eu/project/id/763594

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3.1 Data collected from students' questionnaires

The questionnaire was completed by 100 students of the Grammar School in Nicosia. The majority of students were 14 years old (55%), followed by 15-year-olds (14%) and 17-year-olds (11%). aged 13-18 years old. In this group of students, 51% were males and 49% were females.

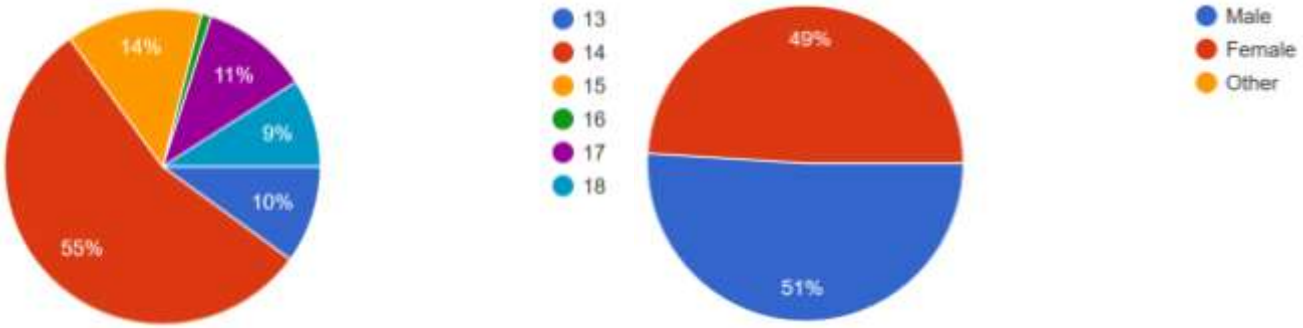
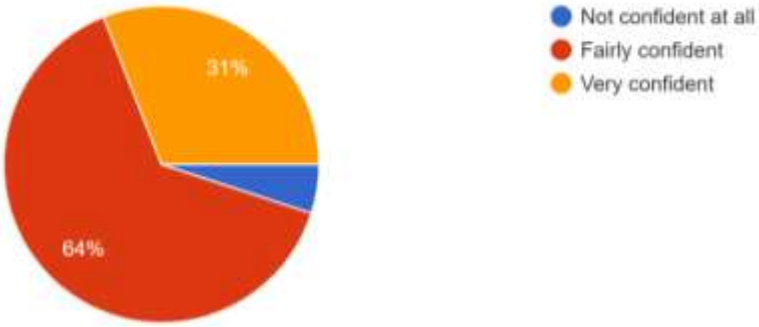
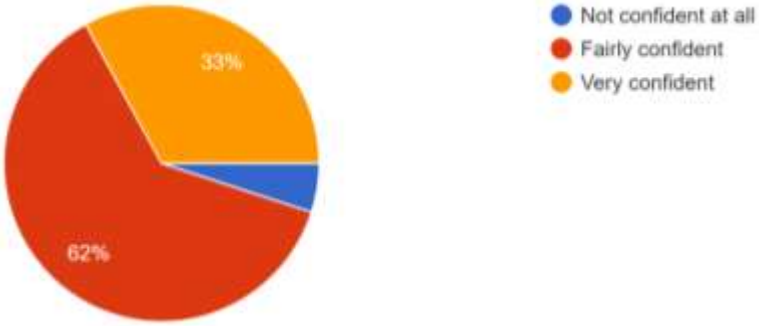


Figure 1 | Age distribution (left panel) and gender distribution (right panel) among students who completed the questionnaire.

Regarding student's confidence to ask questions about a phenomenon or define a problem that needs to be solved (Q5), the majority reported fairly confident (64%), 31% reported very confident and the remaining 5% reported not confident at all.



Regarding students' confidence to plan and carry out investigations (Q6), 33% reported that they feel very confident, 62% reported that they feel fairly confident and 5% reported not confident at all.



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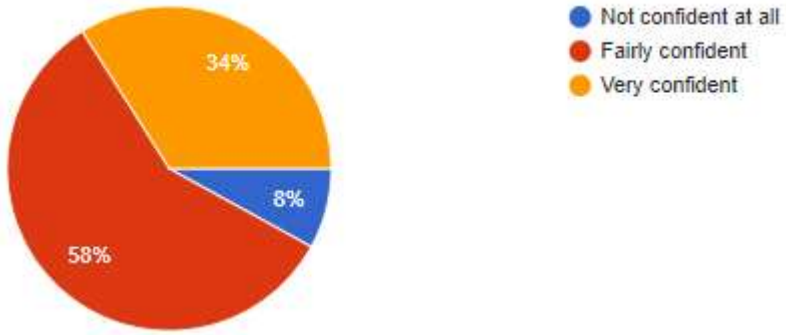
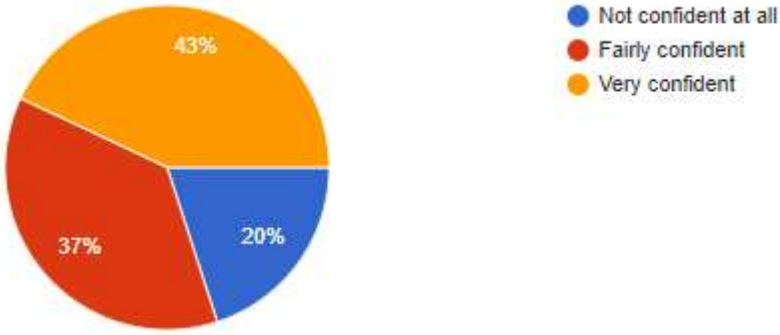
Regarding students' confident to analyse and interpret data (Q7), the majority of students (58%) reported that they feel fairly confident that they are able to analyse and interpret data, 34% reported very confident and 8% reported not confident at all.



The majority of students (43%) reported very confident regarding the use of mathematics and computational thinking (Q8). About 37% of students reported that they feel fairly confident and 20% not confident at all.



The majority of students are fairly confident (more than 50%) that they are able to build explanations about a phenomenon or design solutions for a problem (Q9), find evidence that helps them reason and argument when finding the best explanation to a phenomenon or the best solution to a problem (Q10) and obtain, evaluate and communicate information (Q11).

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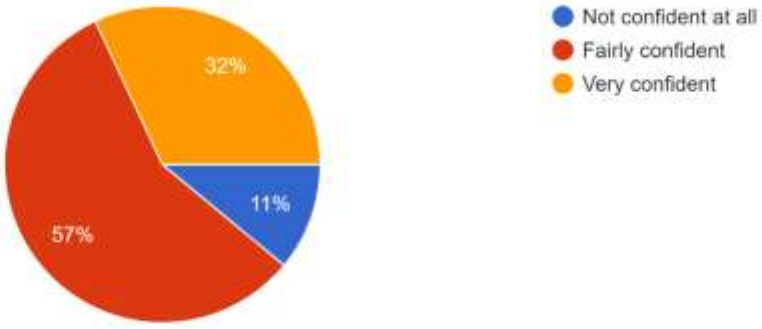
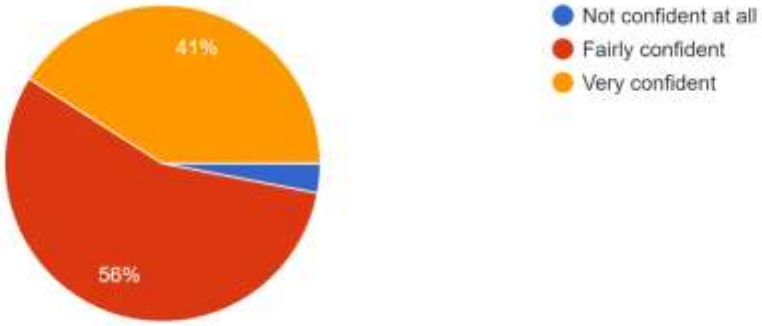
9. How confident are you that you are able to build explanations about a phenomenon or design solutions for a problem?

100 responses



10. How confident are you that you are able to find evidences that helps you to reason and argument when finding the best explanation to a phenomenon or the best solution to a problem?

100 responses



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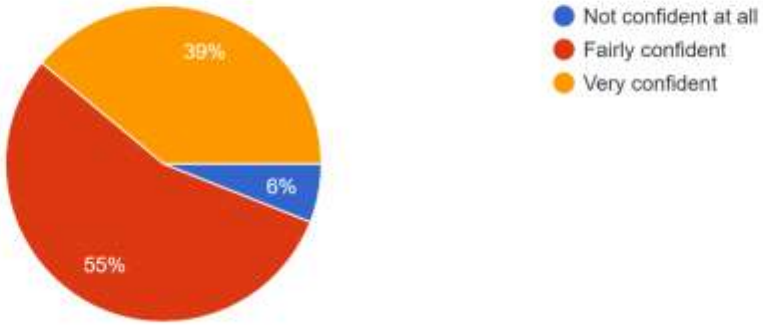
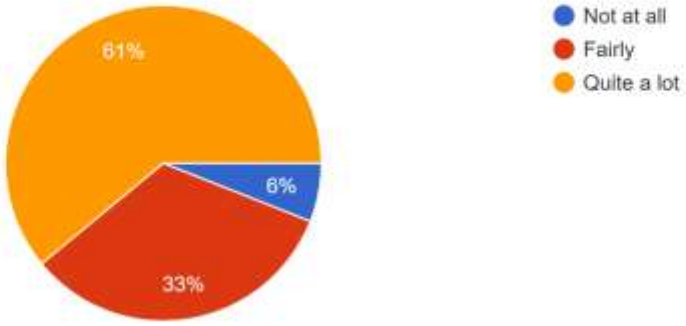
11. How confident are you that you are able to obtain, evaluate, and communicate information?
100 responses



Most students get good grades at science, technology and/or mathematics (61%), while 33% get fairly good grades and 6% do not get good grades at all.

12. I get good grades at science, technology and/or mathematics.
100 responses



Most students understand quite a lot in their science, technology and/or mathematics lessons (54%), while 40% understand a fair amount (Q13). When they were asked whether they find these subjects easier than theoretical subjects (Q14), 38% answered quite a lot, 37% answered fairly and 25% answered not at all. When they were asked whether they look forward to these lessons (Q15), 44% answered quite a lot, 40% answered fairly and 16% answered not at all.

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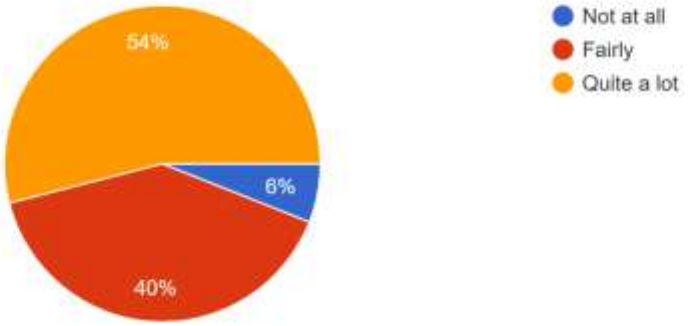
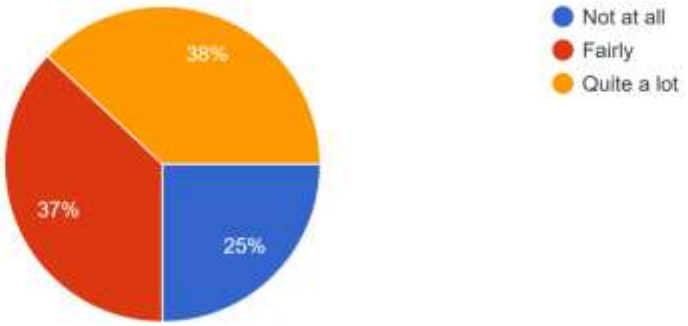
13. I understand everything in my science, technology and/or mathematics lessons.

100 responses



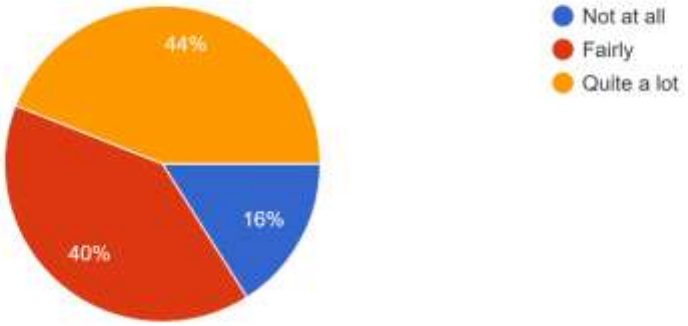
14. I find science, technology and/or mathematics easier than theoretical subjects.

100 responses



15. I look forward to my science, technology and/or mathematics lessons.

100 responses



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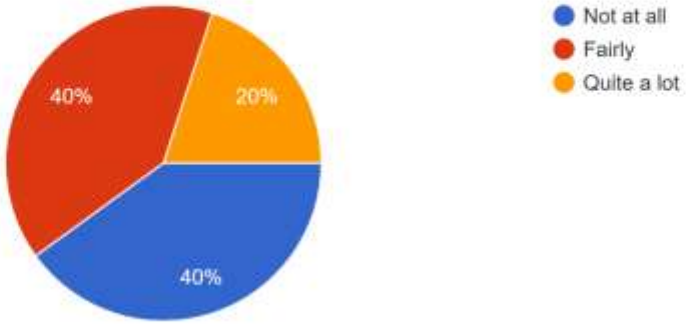
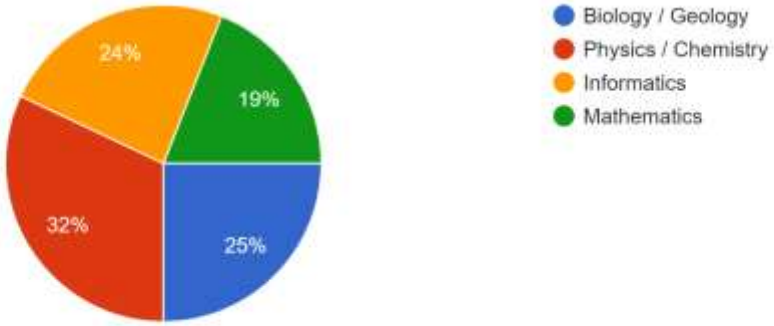
When students were asked whether it is important for them to work with mathematics rather than people for their future job (Q16), 40% answered not at all, 40% answered fairly and 20% only answered quite a lot. When they were asked to think about science and technology subjects and select which of them they feel more capable and willing to study in the future (Q17), most chose Physics/Chemistry (32%), 25% chose Biology/Geology, 24% chose Informatics and 19% chose Mathematics.

16. For my future job it is important to me to work with mathematics rather than people.
100 responses



17. Think about science and technology subjects. Which of them do you feel you are capable and willing of studying in the future?
100 responses



Most students believe that their teachers consider them good candidates for a career related with science, technology, engineering and mathematics (56%), followed by a career related with humanities and/or social sciences (30%) and then a career related with any other type of studies. Similarly, most students believe that

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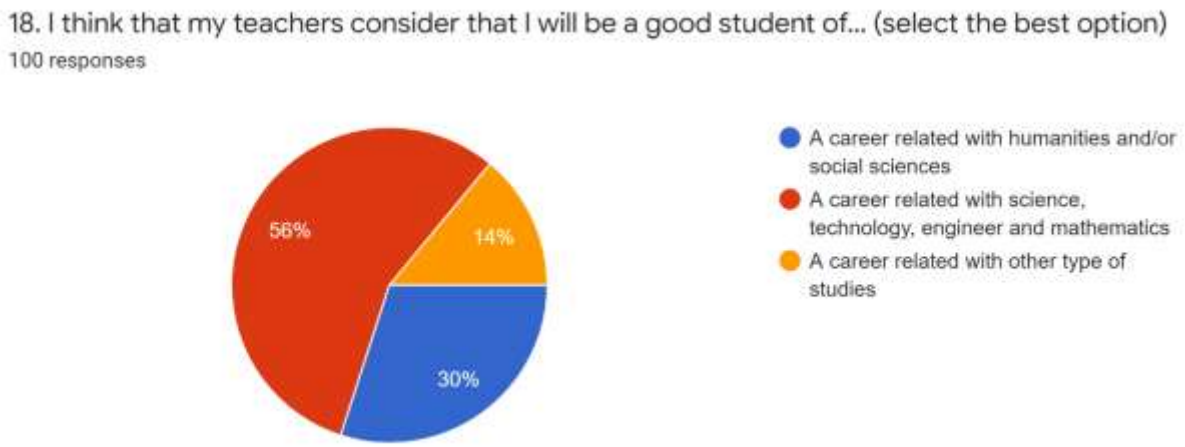
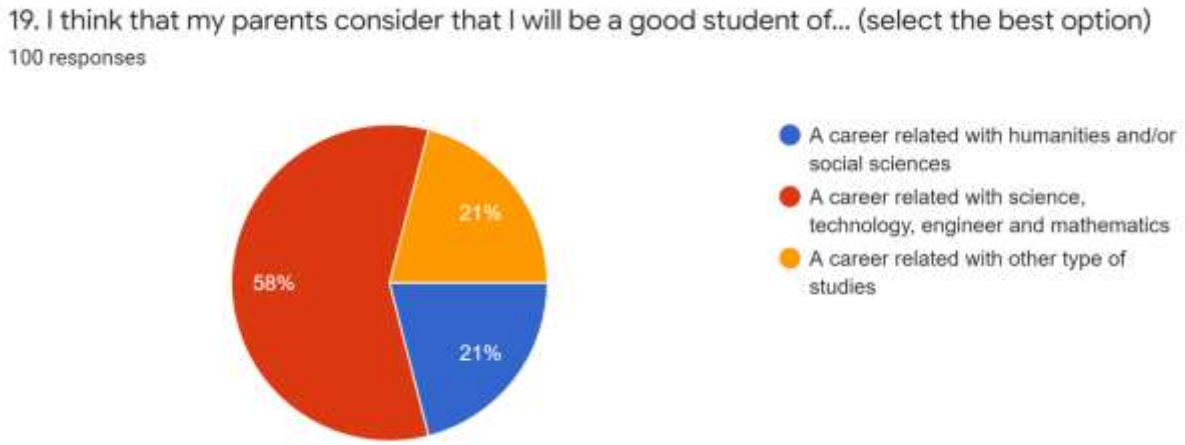
their parents consider them good candidates for a career related with science, technology, engineering and mathematics (58%), followed by either a career related with humanities and/or social sciences (21%) or a career related with any other type of studies.





3.2 Data collected from teachers' questionnaires

The questionnaire was completed by 41 teachers, most of which are teaching at Grammar School in Nicosia. The majority of teachers are between 30 and 39 years old (43.9%), followed by teachers between 40 and 49 years old (31.7%). Nearly half of the teachers who completed the questionnaire were females.

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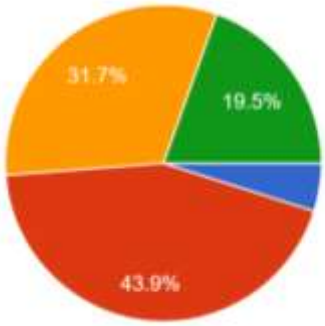
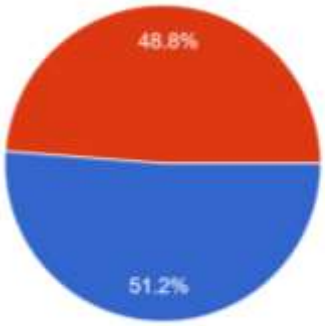
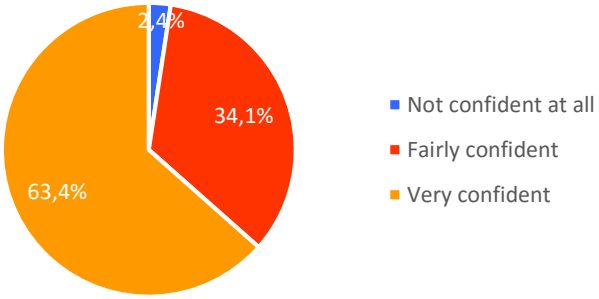
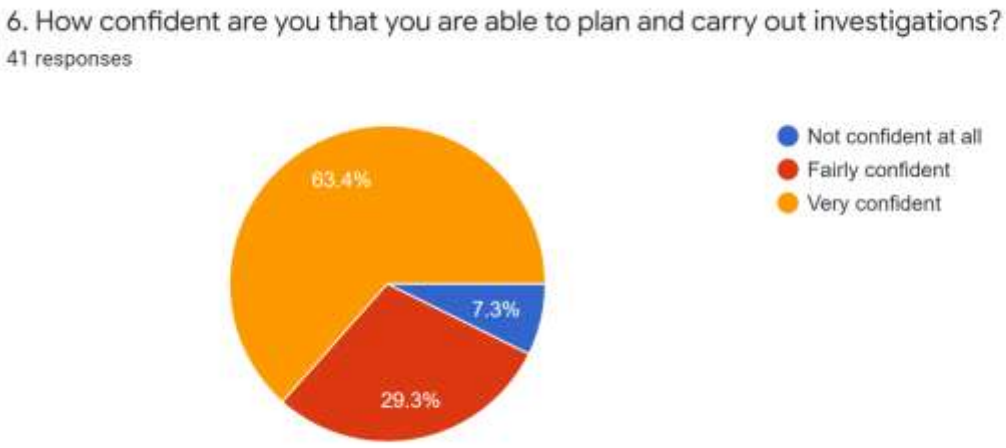




Regarding teachers' confidence to ask questions about a phenomenon or define a problem that needs to be solved (Q5), the majority reported vert confident (63.4%), 34.1% reported fairly confident and the remaining 2.4% reported not confident at all.



Most teachers (63.4%) feel very confident that they are able to plan and carry out investigations (Q6), 29.3% feel fairly confident and 7.3% do not feel confident at all. Similarly, 68.3% of teachers feel very confident with the analysis and interpretation of data, 26.8% feel fairly confident and 4.9% do not feel confident at all.



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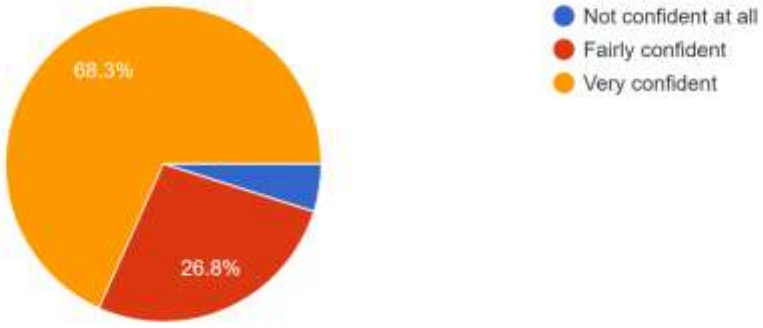
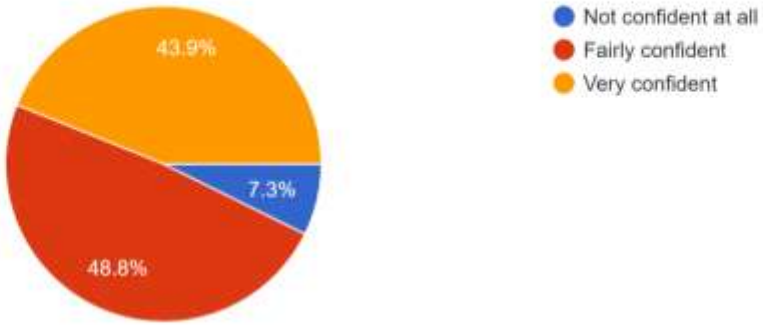
7. How confident are you that you are able to analyse and interpret data?
41 responses



Out of 41 teachers, only 3 (7.7%) do not feel confident using mathematics and computation thinking (Q8). The number of teachers feeling very or fairly confident was 43.9% and 48.8%, respectively.

8. How confident are you that you are able to use mathematics and computational thinking?
41 responses



The majority of teachers (61%) also feel very confident building explanations about a phenomenon or designing solutions for a problem (Q9). About 7.3% of teachers do not feel confident at all. An equal number of teachers (61%) feel confident at finding evidence that helps them reason and argument when finding the best explanation to a phenomenon or the best solution to a problem (Q10).

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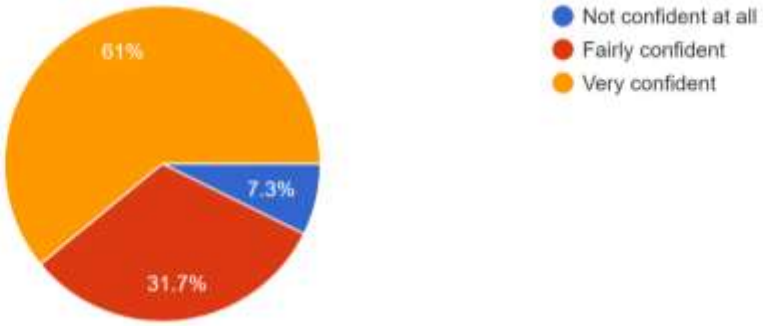
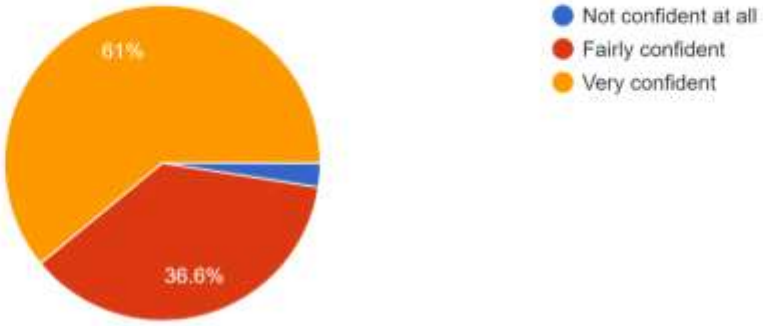
9. How confident are you that you are able to build explanations about a phenomenon or design solutions for a problem?

41 responses



10. How confident are you that you are able to find evidences that helps you to reason and argument when finding the best explanation to a phenomenon or the best solution to a problem?

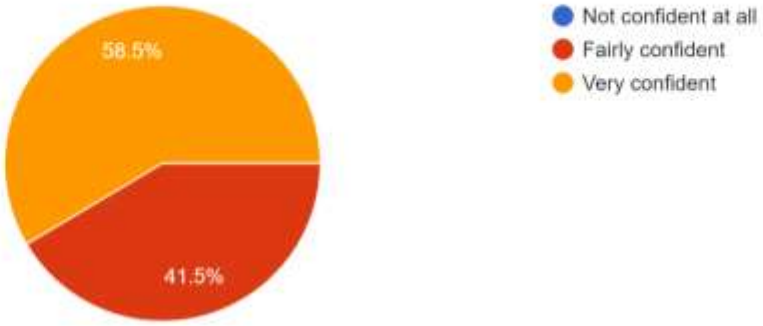
41 responses



More than half of the teachers (58.5%) feel very confident with obtaining, evaluating and communicating information and the remaining 41.5% feel fairly confident with this. Nearly half of the teachers (48.8%) also feel very confident that they are able to explain the STEM content of the subject/project/workshop to participant teens.

11. How confident are you that you are able to obtain, evaluate, and communicate information?

41 responses



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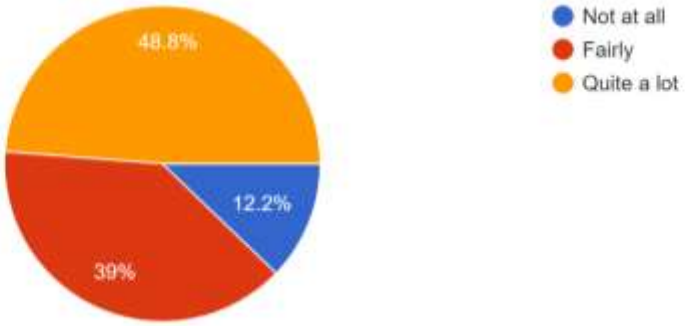
12. How confident are you that you are able to explain the STEM content of the subject/ project/ workshop to participant teens?

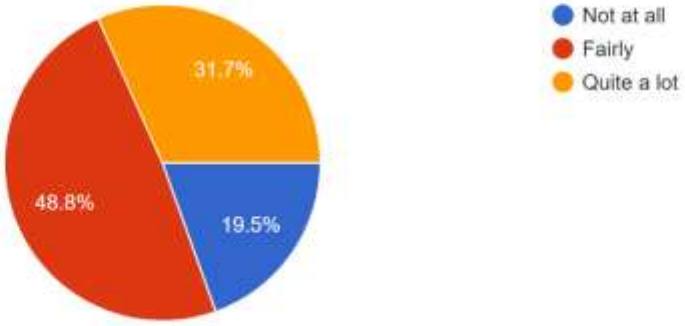
41 responses



Nearly half of the teachers (48.8%) feel only fairly confident that they have sufficient knowledge of STEM subjects to answer participant teens' questions during their lesson/workshop. About 31.7% feel that they have quite a lot of confidence regarding this subject, whereas 19.5% feel that they do not have the confidence at all.

13. How confident are you that you have sufficient knowledge of STEM subjects to answer participant teens' questions during your lesson/workshop?

41 responses



Nearly half of the teachers (48.8%) feel that they have a fair amount of confidence regarding the use of a variety of teaching approaches or strategies to develop their cognition of mathematics/science/technology concepts and 39% of them feel that they have quite a lot of confidence.

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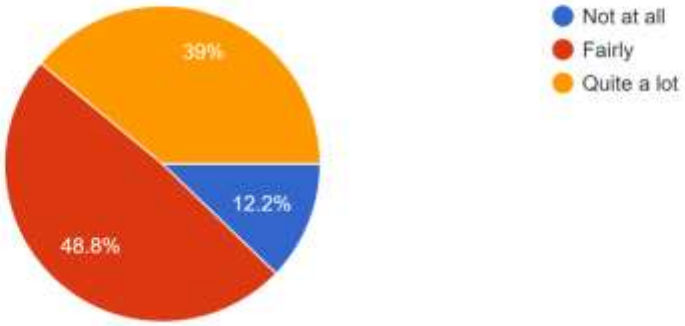
14. How confident are you that you are able to use a variety of teaching approaches or strategies to develop your cognition of mathematics/ science/ technology concepts?

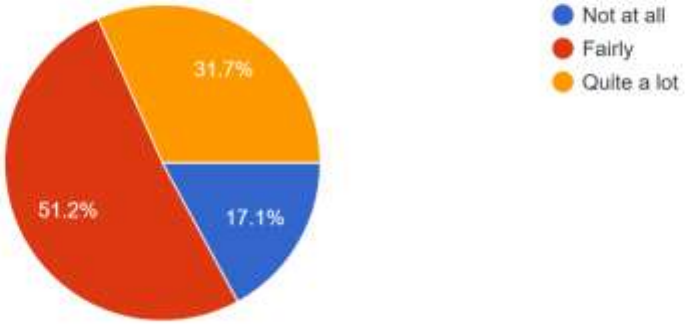
41 responses



More than half of the teachers (51.2%) are very familiar with the whole structure and directions of their lesson/project/workshop, 31.7% of them are only fairly familiar and 17.1% are not familiar at all.

15. I am familiar with the whole structure and directions of the lesson/ project/ workshop.

41 responses



Regarding selecting effective teaching approaches to guide student/teens thinking and learning in mathematics/science/technology, 46.3% feel very capable, 35.6% feel fairly capable and 17.1% do not feel capable at all. Furthermore, less than half of the teachers (29.3%) use teaching approaches or strategies to raise teens' confidence in their capacities to perform successfully STEAM activities quite a lot. More than half (56.1%) fairly use such approaches, whereas 14.6% do not use them at all. More than half though (56.1%) believe that they know very well how to choose effective teaching approaches to guide student's learning and thinking, while the remaining teachers believe that they know fairly well how to choose such approaches.

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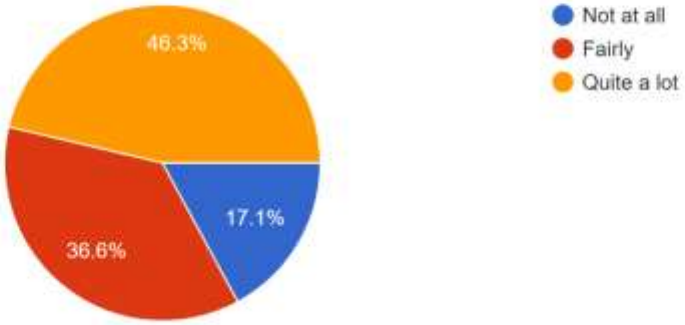
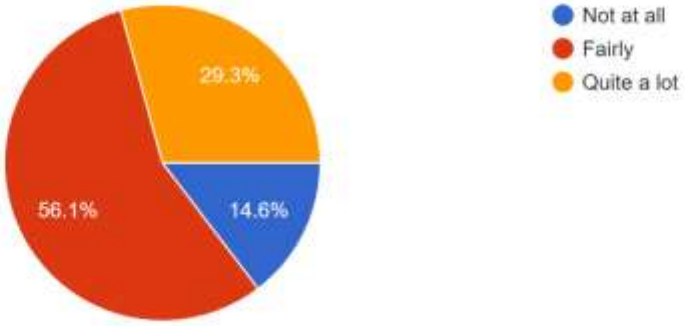
16. I can select effective teaching approaches to guide student/teens thinking and learning in mathematics/ science/technology.

41 responses



17. I use a variety of teaching approaches or strategies to raise teens' confidence in their capacities to perform successfully STEAM activities.

41 responses



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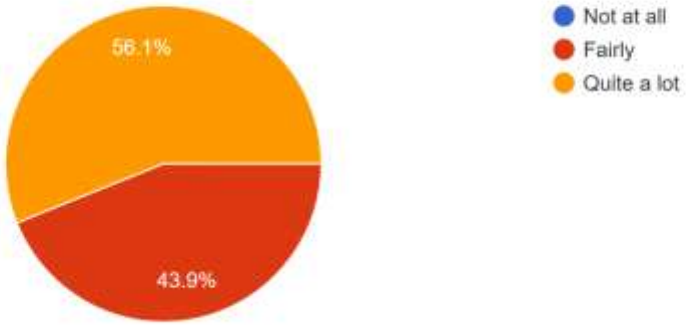
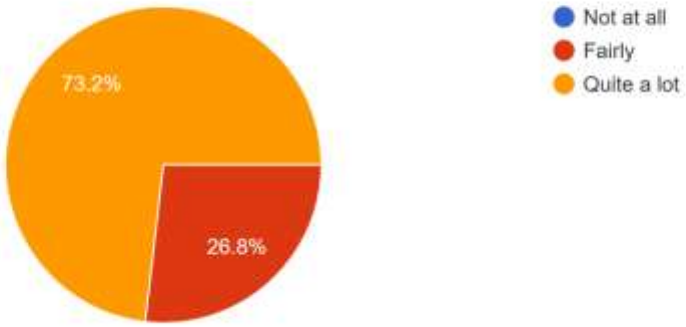
18. I know how to choose effective teaching approaches to guide students' learning and thinking.
41 responses



A significant number of teachers (73.2%) believes that they can adapt their teaching style to different learners, while the remaining believe that they are fairly capable to adapt it.

19. I can adapt my teaching style to different learners.
41 responses



The majority of teachers (46.3%) believe that they are fairly familiar with common student understandings and misconceptions of the STEM content that they are teaching, while 34.1% believe that they are very familiar with these and 19.5% believe that they are not familiar at all.

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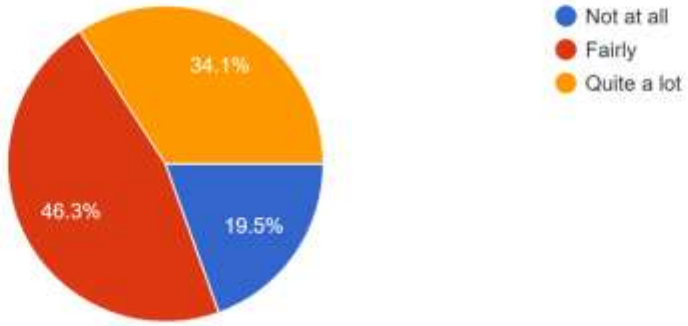
20. I am familiar with common student understandings and misconceptions of the STEM content I am teaching.

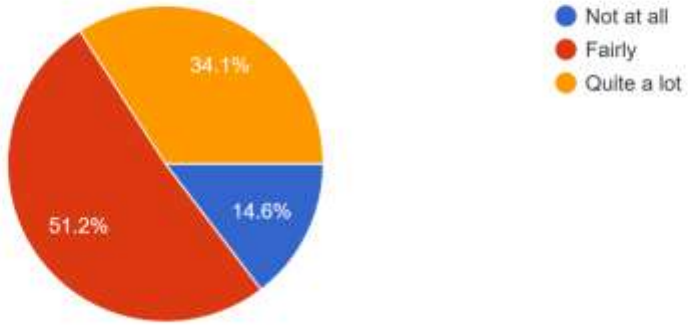
41 responses



More than half of the teachers (51.2%) believe that they are fairly capable in creating a classroom setting to promote students' interest for learning STEM concepts. About 34.1% believe that they are very capable and 14.6% believe they are not capable at all. Additionally, 19.5% have quite a lot of knowledge in the necessary steps to teach STEM concepts effectively, 58.5% have a fair amount of knowledge and 22% do not know the steps at all.

21. I can create a classroom setting to promote students' interest for learning STEM concepts.

41 responses



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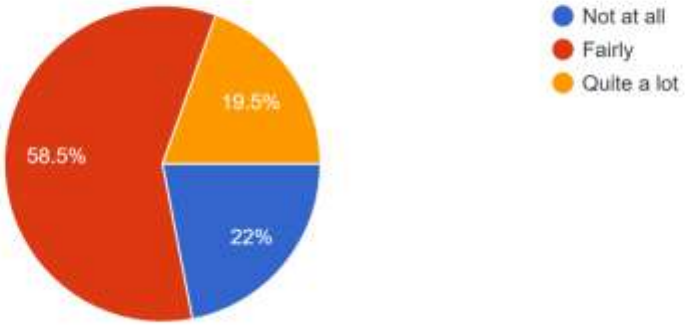
22. I know the steps necessary to teach STEM concepts effectively.

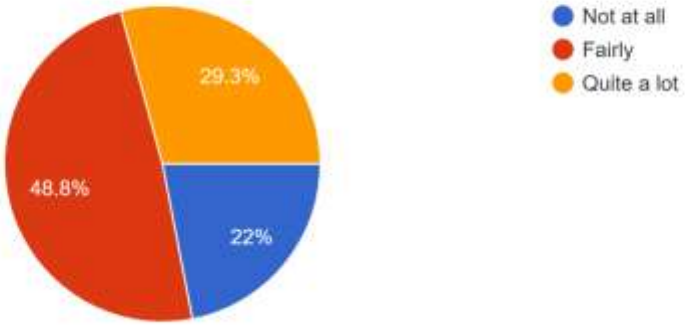
41 responses



Approximately 29.3% of teachers find it very easy to explain why STEM experiments work to students, while 48.8% find it fairly easy and 22% do not find easy at all. When teaching STEM, 51.2% of teachers encourage students/teens to ask questions quite a lot, while 34.1% only fairly encourage them and 14.6% do not encourage them at all.

23. I find it easy to explain to students why STEM experiments work.

41 responses



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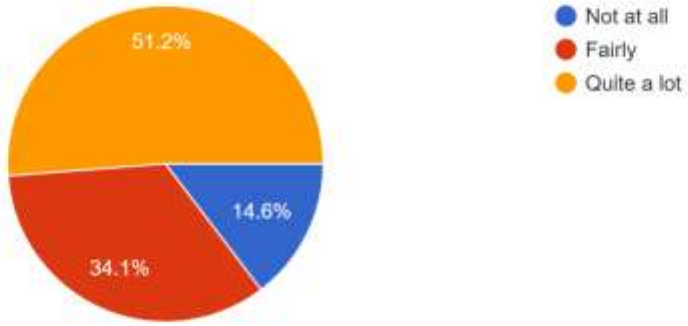
24. When teaching STEM, I usually welcome students/teens questions.

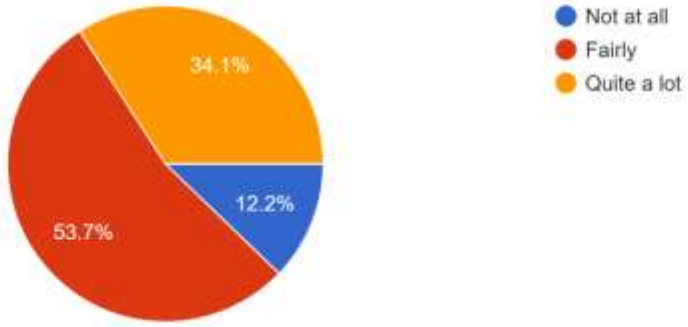
41 responses



Less than half of the teachers (34.1%) are very capable in effectively teaching STEM content to teens/students whose first language is not English. Approximately 53.7% feel fairly capable and 12.2% do not feel confident at all.

25. I am able to effectively teach STEM content to teens/students whose first language is not English.

41 responses



As teachers, 39% can do quite a lot to increase the achievement of STEM subjects of children who do not speak the national language as their first language, 46.3% can do a fair amount and 14.6% cannot do much. Additionally, 41.5% of teachers feel they have quite a lot of ability to help teens from low socioeconomic backgrounds to be successful in STEM subjects.

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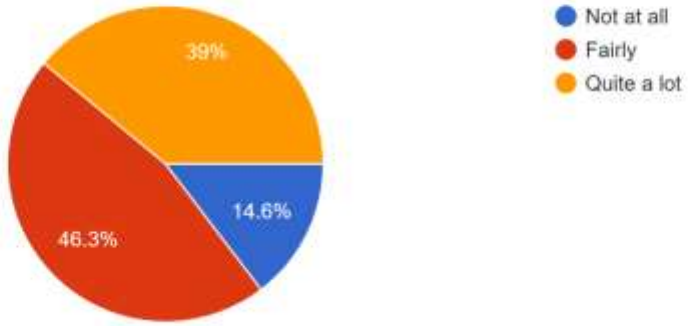
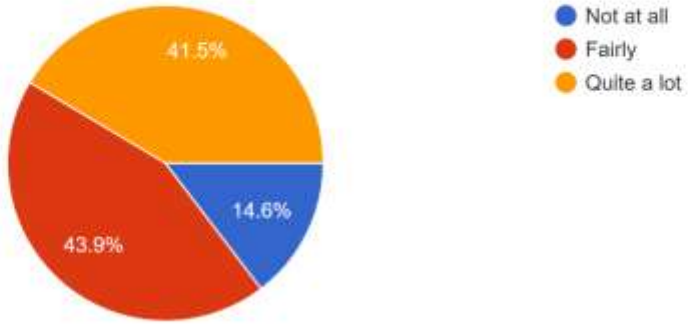
26. I can do a great deal as a teacher to increase the achievement of STEM subjects of children who do not speak the national language as their first language.

41 responses



27. I have the ability to help teens from low socioeconomic backgrounds be successful in STEM.

41 responses



Conclusions

Overall, approximately 40% of students feel very confident with STEM subjects and approaches, such as asking questions, designing and carrying out investigations, analysing and interpreting data, using mathematics and computational thinking, building explanations or finding solutions to problems, finding evidence and communication information. However, 61% of students get good grades in STEM subjects and 54% of them understand everything in their STEM lessons. More than 50% of the students think that both their teachers and their parents believe that they would be good candidates for STEM-related careers, although students themselves do not seem to be more attracted to STEM-related careers than careers involving human people, since only 20% find it very important to choose a job that is related to STEM. Approximately 40% of the teachers feel very confident with the use of a variety of STEM teaching approaches,

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but only 29.3% of them exploit such approaches a lot to raise their students' confidence related to STEAM activities. Furthermore, 34.1% of teachers are very capable in creating a setting in the classroom that promotes students' interest towards STEM subjects and 51.2% of teachers are fairly capable. Therefore, even though teachers have sufficient knowledge to effectively teach STEM subjects, the incorporate of innovative STEAM approaches in the classroom may reinforce the students' interest in STEM-related careers.

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