



**EY-STEAM**

Empowering Youths in STEM through the Arts

*Methodology & Results*

# Empowering Youths in STEM through the Arts



Co-funded by  
the European Union





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# EMPOWERING YOUTH IN STEM THROUGH THE ARTS – METHODOLOGY & RESULTS

## Research Methodology

An online questionnaire was carried out to gain a clearer and more detailed view of youths' engagement with non-formal science learning at interactive science centres, particularly Esplora. This methodological approach has several beneficial outcomes when compared to paper-based questionnaires (Regmi, et al., 2016). These include the fact that respondents can answer at a time that is most convenient to them; online questionnaires are rich in question diversity, that is a good combination of open and close-ended questions; and that a graphical representation of the data results is automatically generated with the completion of the questionnaire, such as through the Google Forms software.

In addition, from the twenty questions selected, the majority were highly structured and close-ended. Whilst the nature of such questions makes the reproduction of biased data results more likely (Foddy, 1993; Reja, Manfreda, Hlebec, and Vehovar, 2003) they have the potential of allowing patterns to be observed across groups, which in this case are youths with varied gender and age groups (Cohen, Manion and Morrison, 2011; Dewaele, 2018). Open-ended questions were used sparingly, and these provided a good representation of youth's spontaneous responses which, in turn, makes responses far more impartial (Manfreda, Hlebec, and Vehovar, 2003).

Considering that the target audience was youths it was decided that the access link for the questionnaires be posted on Esplora's Facebook page and on Esplora's official website with the aim of reaching a wider audience. The timeframe for collecting responses was from the second week of August to the first week of September 2021, and there was an overall response rate of 78. However, this numerical value fluctuated depending on the nature of the question, in that high response rates were recorded for more close-ended questions as opposed to open-ended questions.

Alongside this, eight focus groups were carried out throughout June 2021, with around 70 youths who attend the National Youth Agency participating actively in such a study.

# RESEARCH ANALYSIS

## Introduction

This section focuses on the presentation of the data gathered for the project from online questionnaires. Names of respondents have kept anonymous for ethical reasons and to safeguard the identity of the participating youth.

## Level of Engagement with Science in non-formal Learning Settings

The majority of participants were aged between 18 and 24, mostly female, whilst there were no responses from participants aged 16. This might imply that youths in the later stages of their adolescents are more likely to engage with science in science centres when compared to early adolescents. This notion is worth considering for future research since adolescents aged between 15 and 19 years of age are a crucial audience for the development of informal education strategies in science and technology (NRC, 2009) and one which is studied very little in terms of both interest in science and informal experience with science (Prokop, Prokop, & Tunnicliffe, 2007; Lavonen et al., 2008; NRC, 2009; Dabney et al., 2012; Massarani, et al. 2019).

This is especially true when nearly half the respondents (42.3%) claim that they are not familiar with the science centre, followed by 22.2% who are not interested in visiting science centres and museums, and 30.8% arguing that the location is out of their way, whilst 15.4% claimed that the entrance fee is very costly. Ironically, however, when asked whether they have visited a local science centre or museum in the past 3 years, 66.7% of the youths answered in the affirmative. The latter reflects one of the main limitations of close-ended questions: the possibility of biased responses. In fact, whilst 78 youths responded to the latter question (close-ended), only 26 youths responded to the former question (open-ended).

In the case of the Esplora Interactive Science Centre, whilst the majority of respondents have visited the science centre (80.8%), those who never visited claimed that this has been mainly because of their lack of interest in visiting the centre (22.2%). Related to this, half of the respondents seemed indecisive whether they would re-visit Esplora Interactive Science Centre, with 72.7% of youths arguing that they do not like to receive further information about future events/activity at the Esplora Interactive Science Centre but were willing to recommend the experience to others. Conversely, those interested in receiving further information suggested that social media platforms such as Facebook, followed by email and Instagram, would be the most adept at such.

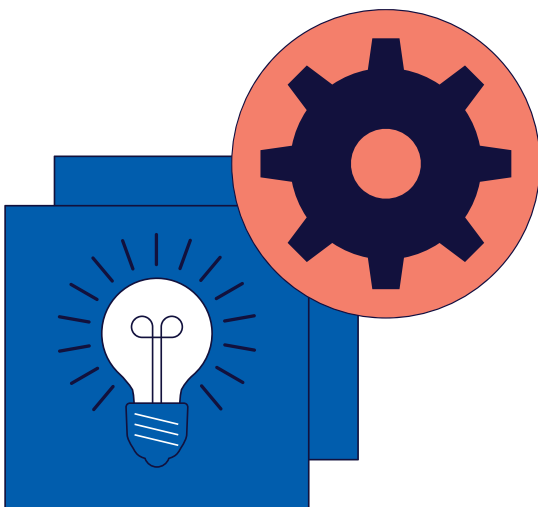
On a more positive note, however, many of the youths who completed the questionnaire stated that they had visited Esplora Interactive Science Centre and that they recalled positive experiences from their visit. For instance, one youth remarked:

*“Enjoyable experiences all around that better explain certain scientific concepts that may have only been explained in theory at school.”*

This comment, highlights the importance of there being better developed and stronger ties between the formal and non-formal science learning sectors since, by working together, they would allow a rather more engaging and authentic learning experience amongst youths (Hofstein and Rosenfeld, 1999).

Multiple youths commented on the fun element of informal learning environments by arguing that their visit to the Explora Interactive Science Centre has been “amazing...” “positive!”, and “enjoyable”. These claims are important since they debunk the stereotypical views of science as being “geeky” and “boring” (Pedretti, 2002).

When asked what they remember most from their visit to the Explora Interactive Science Centre, many youths mentioned the planetarium followed by the exhibits related to sound, optical illusions, and engineering and mechanics. The latter could be due to the fact that many youths like “hands-on experiences”, “...working with numbers”, “mechanics... are very interesting”, “creating games”, and “engineering because it creates”. Less frequently mentioned were exhibits related to motion, the human body, and eco-life. The fact that the planetarium is one of the most preferred attractions for youths can be supported by literature arguing that the planetarium dome can act as a potential tool for exciting and inspiring youth and communities into learning and reclaiming their astronomical knowledge (Harris, 2017).



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# ATTITUDES AND PERCEPTIONS TOWARDS SCIENCE SUBJECTS AND CAREERS

The online questionnaire also sought to gain an understanding of youth attitudes and perceptions towards science and their level of interest in studying or pursuing science-related careers. It is unfortunate that, when youths were asked what they understand by the acronym 'STEM', many youths responded that they do not have an idea what it means or what it stands for. This is quite a worrisome outcome that reflects that more work and research need to be done to explore Malta's current education systems, particularly when it comes to science teaching and learning since there seems to be a correlation between a lack of interest in science and the way science is taught in schools (Polino, 2011).

Such responses could also be linked to the fact that most respondents form part of the unrepresented groups in Maltese society and who have far less opportunities to engage in STEM at compulsory schooling when compared to more privileged youths (Bevan, Ryoo, and Shea, 2017). Moreover, since the majority of youths did not know what STEM stands for, they were not able to indicate whether they are studying or following a STEM-related course even though they might be doing so. This echoes the lack of awareness related to which subjects fall under the realm of science, with most youths holding the wrong perception that science is exclusively the core sciences, that is biology, chemistry, and physics.

In fact, those who did respond that they are studying STEM subjects, stated that are following studies in the core sciences, with minimal reference to the 'technology', 'engineering', and 'mathematics' dimensions of STEM. Furthermore, when asked to determine whether they find STEM-related subjects interesting, the majority replied in the affirmative; however, there is a high probability that this result is biased considering that most youths did not have a good understanding of what STEM is.

The latter can be substantiated by the responses given by youths to the question asking why they are not interested in STEM subjects, with many youths stating that they had never heard of STEM but that they are sure that it is boring and too complex for them to be competent in.

This is reflected by responses like, "mathematics and science were never favourites to study at school"; "I am not driven towards mathematically

based questions and subjects. I find them it difficult to learn STEM subjects”; “Interesting but difficult”. This can be further supported by a research study exploring high school students’ aspirations in STEM arguing that, generally, students believe that science is a complex subject or career and entails more effort than they expected and this in turn results in them perceiving science careers as far less appealing (Aschbacher, Li, and Roth, 2010).

Additionally, the question related to whether participants are following a STEM-related course or studying any STEM subjects at school also seemed to be misunderstood since, whilst the majority of respondents did not know what STEM is, 55.6% responded in favour. This observation reflects the limitations imposed by close-ended questions on resultant outcomes and the interpretation of collected data.

**Analysis of data gathered from focus groups**

Eight focus groups had been conducted as another form of evaluation alongside questionnaires. As such, it can be argued that the triangulation method adopted further enhanced the validity, reliability, and legitimation of the data, which encompasses credibility, dependability, confirmability, and transferability, of data findings (Renz, Carrington and Badger, 2018; Moon, 2019; Noble and Heale, 2019; Gundumogula, 2020). The images below showcase the workshops conducted during the focus group sessions.



**Figure 1:** One of the Focus Groups conducted with youths attending Aġenzija Żgħażaġh in June 2021.



**Figure 2:** Focus Group participants engaging in dialogue with an Aġenzija Żgħażaġh youth worker.

Considering that many youths do not visit Esplora on a regular basis, it was decided that these focus groups be conducted with one of the project’s main partners the National Youth Agency. For each focus group, there was an attendance of around 70 youth participants. During these sessions, youths engage in dialogue with their respective youth workers and provided feedback about the online questionnaire that they completed and elaborated further on the main reasons why they enjoy visiting Esplora or not, and, if the latter applies, what they would like to see changed to entice them to visit Esplora.



Based on their response regarding the process of completing the questionnaire, it was found that some youths managed to complete it autonomously whilst others sought assistance from youth workers to ensure that they understood the question well.

An issue of concern worth noting is that some youths did not know what the acronym STEM stands for and what it signifies. As such, many youth expressed their desire to have further explanations regarding this acronym in the questionnaire. In turn, this unfavourable response further reinforces the notion that there is a need for more promotion of STEM and education in STEM fields as being desirable for future scholars and students, so as to create highly educated experts who will, in the future, be innovation holders, new technology solution experts, and initiators of economic growth (Roncovic, Androlic and Druzinic, 2019).

Furthermore, even though it was surprising to find out that the majority of youths did visit Esplora, most of them stated that they visited during a school outing when they attended compulsory schooling. Few young people said that they attended Esplora alone, with friends, or with family. This concurs with literature findings arguing that the majority of youths are hesitant to visit science centres (Fors, 2006), with one of the major reasons being that related to admission fees (Falk and Katz-Gerro, 2016; Lattarulo, Mariani, and Razzolini, 2017).

Another potential reason drawn out by participating youths is that the science centre houses a large number of interactive exhibits that could potentially be overwhelming and exhausting. In fact, research shows that having a lot of interactive exhibits at a given space tends to alienate rather than engage potential visitors (Govenar, 2019), even more so if they are diagnosed with Autism Spectrum Disorder or other forms of disability that makes a person oversensitive to high-pitched sounds and other sensorial manipulatives.

In line with this, participants also expressed what would draw them more to Esplora Interactive Science Centre and the most common identified ideas included having a more varied selection of workshops, experiments, and shows that bring science and art together and which are more targeted to their age group, having a youth club or hub where they can be actively part of and act as ambassadors for Esplora, activities that link science and sports, and activities related to marine biology and the science of the sea given that Esplora is right on the seafront.

### **Youth – Dealing with such an unfulfilled demographic segment**

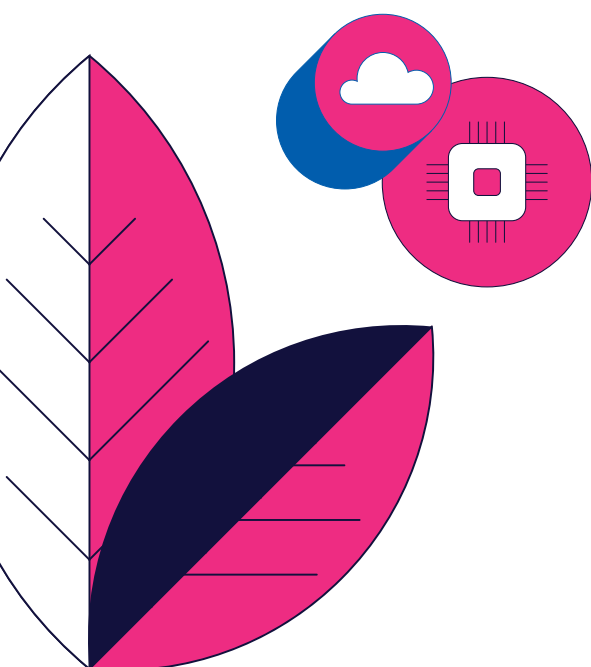
Interestingly, participants had a number of innovative ideas of how Esplora Interactive Science Centre could engage more youths and enhance their visit experience. Some of the responses that are worth considering for future research include youths' desire for Esplora to place more emphasis on underrepresentation of women in STEM and minorities in STEM develop more science shows related to STEM careers and more outputs that specifically targets youths rather than children. The latter suggestion, whilst challenging, can be realised especially when one looks at what international science centres have been doing to engage more youths in informal science learning. Some of the most concurrent activities organised by international science centres to reach more youths include science youth cafés and youth programmes organised in science

centres. For instance, the North Carolina Museum of Natural Sciences organises a number of events aimed at engaging more youths in STEM, including teen science cafés, summer camps, and summer ed-ventures targeting girls in science (North Carolina Museum of Natural Sciences, 2022).

The last two questions provided an explicit indication regarding what youths expect to find when they visit an interactive science centre and what they would like to see should Explora Interactive Science Centre start organising activities targeting youths, including establishing a youth club where teenagers are given the opportunity to experience science outside the formal setting of a school and engage in activities that potentially enhance their engagement with science, scientific literacy, and their attitudes and perceptions towards science.

Based on the responses obtained, participants suggested more health, environment, and nutrition-based activities to increase interest amongst youth to go to interactive science centres and extended use of the creative arts in science. The implication here is that teenagers find topics that are more directly related to their daily lives and relevant to their careers (Sheldrake, Mujtaba and Reiss, 2017) far more intriguing than abstract topics (Harackiewicz, Rozek, Hulleman and Hyde, 2012; Rozek, et al., 2015) and that the use of arts in science has the potential to enhance students' engagement with science (Spiegel, et al., 2013).

Participants, however, did provide several innovative topics that could potentially be explored in youth clubs including “exciting experiments, engaging talks with professionals and learning activities that instil a love for science amongst youths”; “interactive projects, outings, fun experiments, information sessions about STEM careers”; and activities related to robotics, computing, and artificial intelligence.



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# CONCLUSION

In conclusion, the major results obtained through such methodological research further reinforces the notion that science centres need to widen their audience base, as indicated in the two surveys conducted by MISCO (2015; 2019) exploring Maltese citizens' attitudes and perceptions towards science by developing new resources and outputs targeting youths.

This would offer youths the opportunity to be inspired by science outside of the formality and stagnant curricula imposed upon them whilst learning science at school and would also bring change to the manner in which youths are perceived in science communication and public engagement studies, that is, as 'underserved' audiences (Humm, Schrögel and Leßmöllmann, 2020).

As opposed to what is commonly believed, youths are an indispensable resource for non-formal learning institutions such as museums and science centres since they are the new energy that such learning institutions need to remain alive, to grow, to achieve their mission in building a new generation literate in STEM, and to ensure their long-term success. On the other hand, youths also benefit through their active participation in science centres. This is because, as highlighted in the literature, youths' active involvement in science centres mediates their developmental process, enhances their social and communication skills, and helps them become more critical of the decisions that they take later on in life (Fors, 2006).

In conclusion, then, further efforts should be made to provide youths with new opportunities during such a period of turbulence in their life by reaching out to them, catering for their individual needs, and giving them a voice in the process of bringing changes in current STEM practices, attitudes, and perceptions towards science amongst society as a whole.

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