WP 3: EXAMINE: Mapping Science Learning at Individual Level

Deliverable 3.2:

Report on survey results in 19 locations during two testing phases, including content of questionnaire with all adaptions and translations

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Glossary of Terms

Acronym	Definition
H2020	Horizon 2020
DoA	Description of the Action
STEAM	Science, Technology, Engineering, Arts and Mathematics
WP	Work Package
D	Deliverable
PCA	principal component analysis
p-value	indicating the statistical significance
r	Cohen's r indicating effect size
OR	Odds ratio
AME	average marginal effect
long	longitudinal, in relation to samples: the longitudinally surveyed sample
w1	Wave 1 of the Survey, in relation to samples: the sample only reached in wave 1 but not again for wave 2
w2	Wave 2 of the Survey, in relation to samples: new respondents only reached in wave 2

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1 Introduction

Learning can potentially take place anywhere and anytime – so how do the learners the SySTEM 2020 project targets, connect with science, if at all? Work Package 3 – EXAMINE investigates individual STEAM learning ecologies of young learners between age 9 and 20. The core of this endeavour is formed by a longitudinal survey specifically developed by the ZSI-team leading on the WP 3. The development of the instrument, testing and data collection was an ongoing collaboration process with all involved 19 SySTEM 2020 practice partners; 8 main partners and 11 third parties. The longitudinal data provides insights on the development of STEAM learning ecologies over the period of one year and provides significant insights into persisting structural inequalities that shape the science learning ecologies of the investigated children, teenagers and young adults.

The SySTEM 2020 questionnaire investigates the learning ecologies of young learners across all educational levels in 17 different countries distributed all over Europe and Israel/Palestine.

In investigating learning ecologies, the SySTEM 2020 projects strongly builds on the efforts of two already finished projects:

(1) The ASPIRES project was a five-year study conducted by Louise Archer and colleagues and funded by the UK's Economic and Social Research Council to explore science aspirations and engagement in sciences among 10 to 14 year olds based on a quantitative online survey and longitudinal interviews with a sub-sample of students and parents (Archer Ker et al. 2013).

(2) The Synergies project was conducted by John Falk, Lynn Dierking, Nancy Staus, Jennifer Wyld, Deborah Bailey, and William Penuel in the context of funding by Noyce and Lemelson Foundations as well as the National Science Foundation. The project investigates STEM learning of a single cohort in Parkrose, an under-resourced community in Portland, Oregon, US, with the goal to measurably improve STEM learning, interest and participation of these learners in early adolescence. Amongst agent based modelling, mapping activities and in-depth family interviews a longitudinal paper-based survey was conducted (Falk, Staus, et al. 2016).

In total, this deliverable of the SySTEM 2020 project reports on 2204 collected unique surveys, whereas 736 participants have answered longitudinally, i.e. two surveys, 732 participants only answered one survey either in wave 1 or in wave 2.

1.1 Objectives of this deliverable

Deliverable 3.2 reports on the whole data collection and analysis process happening in the framework of WP3 EXAMINE and Task 6.2 of WP6 EVALUATE.

Doing so, first the analytical framework of the research is presented, summarising the state of the art of researching in- and non-formal science learning and the findings of previous studies in and outside of Europe. As a next step the research design of the SySTEM2020 specific questionnaire is described in a detailed manner starting with the target group, the survey has been developed for, i.e. the sampling strategy. The usability testing of the survey is elaborated to then delve into the specific way the survey is organised, the longitudinal survey design and

the operationalisation of concepts. Afterwards, the results of the descriptive and exploratory analyses of the surveys are reported with a specific focus on science equity.

Ethical considerations underlying the research process were already introduced in detail in D3.1 and are – as an updated version - included of the Annex of the deliverable at hand (see chapter 9.1). All survey versions are further, as well as a detailed table of results are further included in the Annex (sections 10.2f).

1.2 Objectives and research questions of the survey

The main interest of this survey is to investigate individual learning ecologies in all the spaces they extend to, whereas a focus is put on in and non-formal learning outside of the classroom. Together with all 19 partner locations, local strengths and specific audiences are included to come up with a heterogeneous sample which allows for cross-national multivariate statistical analyses over time.

The longitudinal questionnaires hence provide for:

(1) A cross-sectional, interpersonal analysis investigating the individual responses of the learners posing the following questions:

* Who are the learners that participated in our survey?
* How do the learners' learning ecologies look like?
* How do socio-demographics influence the way learners connect with STEAM?

(2) A longitudinal intrapersonal analysis, connecting the data of wave 1 and wave 2 enabling to answer the following research questions:

* Do learning ecologies change over time?
* How does the learners' relationship with science change over time?
* Is the influence of socio-demographic variables declining, exacerbating or stable over time at the level of the respondents?

2 Analytical Framework

In line with the project's overall focus on equitable STEAM learning, the analytical framework is guided by considerations of equity and hence questions of accessibility, inclusion, and diversity in science learning (see D6.3 and D4.1).

The approach taken by the SySTEM 2020 project is based on the conception of **learning ecologies** as a network of connected "physical settings, social interactions, value systems, and histories" (Bevan 2016, 3) in which learning takes place over time. In the framework of this socio-cultural and spatial settings, learners construct their own stable, yet also changing STEAM learning ecologies through educational experiences in and across formal and non-formal settings.

The following section introduces the different components of the analytical framework behind the SySTEM 2020 survey. First, the specific focus on learning, interest development and science interest development are elaborated. Second, the socio-cultural embedding of science learning is looked at and lastly findings from earlier studies on science learning with a focus on specific socio-demographic variables are summarised.

2.1 Learning, the development of interest, and empirical evidence of science learning

Learning is potentially ubiquitous, happening anywhere anytime, including specific experiences made over the course of one's lifetime (Bell, Shouse, and Feder 2009). A multi-facetted process requires versatile approaches for investigation. In general, learning can be examined using perspectives focussing on the individual (related cognitive, emotional and behavioural processes), the places of learning (physical spaces as well as the institutionalisation of settings) and the socio-cultural embedding of learning (D2.1; Bell, Shouse, and Feder 2009; Stecher 2005).

The theoretical lens chosen in the SySTEM 2020 project perceives learning as cognitive, behavioural and emotional process that is socio-culturally embedded (D2.1, D3.1)(Brown, Kapros, and Roche 2019; Seebacher 2019)(Brown, Kapros, and Roche 2019; Seebacher 2019). It is constructed by individuals through the lens of their prior knowledge and experience as well as through their interactions with others over time (Anderson, De Cosson, and McIntosh 2015), including educational experiences in and across formal and non-formal settings. All of these settings, where learning takes place over time, can also be addressed as important part of young learners' STEAM learning ecologies (Bevan 2016).

The SySTEM 2020 project further focusses on **science learning outside of the classroom**, putting a particular emphasis on non-formal learning, i.e. learning happening intentionally in pre-structured educational settings similar to schools, and informal learning, i.e. learning resulting from daily activities happening in a contingent unstructured and unintentional form (D2.1; Bell, Shouse, and Feder 2009; Stecher 2005). Nevertheless, experiences made in the formal education system must not be excluded from the analysis, since informal, nonformal and formal education are strongly interconnected (Jordan 2010). In short, the SySTEM 2020

project conceives science learning as an ongoing and cumulative process (Bell, Shouse, and Feder 2009; Falk, Staus, et al. 2016).

Studies find that learners with a developed interest are more likely to be attentive and motivated learners (Hidi and Renninger 2006; O'Keefe, Horberg, and Plante 2017; Renninger, Bachrach, and Hidi 2019). Each individual can potentially be interested in anything. How is it that interest in science forms? Based on empirical findings, Suzanne Hidi and Ann K. Renninger (Hidi and Renninger 2006) have developed a **four phase model of interest development**, which is also used in the SYNERGIES project (Falk, Staus, et al. 2016). They define interest as a "psychological state of engaging or the predisposition to reengage with particular classes of objects, events, or ideas over time (Hidi and Renninger 2006, 112)". The first phase of interest development starts with a situational interest that is potentially triggered by an event in the person's environment and causing positive emotions and a specific form of engagement with the area of interest. The second phase is reached once this initial sparkling is a maintained situational interest, with focused attention for the topic, and the engagement in interest-related tasks. It is only in the third phase that an individual interest emerges, leading to the generation of questions out of curiosity about the content of interest which is consolidated in the last phase as the result of already build knowledge and the developed understanding, leading to a long-term constructive and creative pursuance of this interest even when entering frustration (Hidi and Renninger 2006). When looking at the way interest in STE(A)M evolves and persists, we hence need to look at the involved cognitive, behavioural and emotional processes (Falk, Staus, et al. 2016; Carlone and Johnson 2007).

Empirical studies emphasise the importance of the social environment, be it family, teachers or peers, on the formation of science interest (Archer et al. 2012; Aschbacher, Li, and Roth 2009; Falk, Staus, et al. 2016). Learners participating in science-related activities at a young age are also more likely to have positive science attitudes and perceive their own agency on doing science differently (Falk, Staus, et al. 2016).

Up to date research, especially for the European context, investigating STE(A)M interest development going beyond one single topic or subject in school or linking the attitude and the take-up of science further, is rare (Falk, Staus, et al. 2016; Gorard and See 2009).

The strongest predictor for STEM interest in the SYNERGIES project was self-reported STEM knowledge followed by the science attitudes of parents and the science enjoyment of the learner (Falk, Staus, et al. 2016). Science interest did not, however, significantly vary with the science self-concept, young learners who found science difficult were equally interested in science as those who found science easier (Falk, Staus, et al. 2016). The results of the ASPIRE project further emphasize the role of the formal education system – attitudes to school science, and additionally parental attitudes to science as well as the learner's self-reported performance have the strongest positive relationship with the learner's science aspirations (Archer Ker et al. 2013).

2.2 Socio-cultural embedding of science learning

The approach of learning ecologies is chosen as a theoretical framework of the SySTEM 2020 project to examine the way learners develop, pursue, and sustain an interest in STE(A)M. This

theoretical lens further entails that learning cannot simply be understood as isolated process of knowledge-creation, but needs to be investigated as inherently intertwined with the learner's social identity (Bell, Shouse, and Feder 2009). In this sense, science and the broader field of STE(A)M can be seen as a **community of practice**; not everyone automatically is a member of this community, instead membership - access and inclusion - is based on a process of learning itself, where learners are socialised into the norms and the practices of this science community and on the same time a specific science identity, i.e. an understanding of who they are and who they want to become (Carlone and Johnson 2007). In order to learn science, one needs to develop identities that are compatible with scientific identities (Brickhouse, Lowery, and Schultz 2000).

The theory of cultural reproduction as framed by Bourdieu, argues that the educational system is shaped by the "dominant cultural conventions of thought and action of a particular society (Grenfell 2004, 50)", including socialized norms or tendencies that guide behaviour and thinking, commonly referred to as habitus. The educational system as community of practice is strongly framed by the habitus of the powerful class(es) in society, i.e. middle and bourgeois classes. It is their norms and conventions that are prescribed in curricula, educational principles assessment criteria and grades that define transitions and pathways within the educational system and hence act as gatekeepers for those not sharing the same habitus. Reconnecting the concept of science identity with the theory of cultural reproduction Archer and colleagues put forward the concept of a "**family habitus**" (Archer et al. 2012, 886) referring to the familial science capital in the form of "resources, practices, values, cultural discourses and 'identifications' ('who we are') (ibid)" at the level of the learner's family setting. The family is the first and most important place of primary socialization where knowledge, skills, norms, values and traditions are learned (Anastasiu 2011). Families of dominant classes raise their children in a way that allows them to adapt easily to the educational system as they share the same habitus (i.e. values, norms, behavioural patterns and interpretative standards). (Goldthorpe 2007).

The theory of cultural reproduction suggests that those children, familiar with the dominant conventions of a society, are advantaged in gaining educational credentials and will benefit more from the educational system. In this sense, the formal education system does not "create spaces where multiple perspectives in knowing and showing in science can emerge" (Calabrese Barton and Osborne 2001, 21) and hence does not foster diversity. These narrowly defined and acknowledged science identities in turn do not appeal to a broad range of diverse students coming from diverse living situations, entering the formal education system equipped with their own set of knowledge, cognitive skills and beliefs of how the world works (Jordan 2010; Bell, Shouse, and Feder 2009).

Ideas of science and those who do science, do equally not exist in a vacuum, but are framed by the values of the dominant classes. Popularly, science is connected to cleverness, intelligence and academic success (Archer, DeWitt, and Willis 2014; Archer et al. 2013). In this sense, **science is not seen as being for everyone**, those, who fail in school are likely to see learning after school life as irrelevant and unnecessary for their capacities and needs (Gorard and See 2009). Additionally, as persons working with the mind, which, historically has been framed as masculine, in contrast to the feminine-constructed body, scientists are predominantly linked to masculinity and imagined as male, an image re-creatable by children as young as the age of 6 (Carlone and Johnson 2007; Archer et al. 2013). As a consequence, also science learning is gendered and contributes to this process of self-identification (Brickhouse 2001; Sadler et al. 2012; Hughes 2018). While at a young age, science interests do

not vary with gender, statistically significant gender differences manifest themselves as children grow older (Archer et al. 2012; DeWitt et al. 2013). This mind-body-division further exacerbates class-based differences with mind-based work linked to middle and upper-class learners instead of bodily work linked to working class (Archer et al. 2013; Altreiter 2017). Adding further intersections, ethnicity, migration experiences and ability can yet establish further layers of dis-/identifying with science (Brickhouse, Lowery, and Schultz 2000; Hazari, Sadler, and Sonnert 2013; Bell, Shouse, and Feder 2009).

2.3 Findings from earlier studies

A focus on the diversity of the learners themselves as well as their different learning contexts has only emerged recently (Brody, Bangert, and Dillon 2007). In accordance with the outlined goals, the SySTEM 2020 project does not perceive learners as homogeneous individuals but puts a particular focus on science learning of non-dominant groups and the intersection of socio-demographics, which structure individual learning ecologies. In doing so, the **'culture' of non-dominant groups** is put at the centre of the undertaken research. Culture in this sense is hence not to be misunderstood as exclusively used with regard to ethnicity or religious affiliation. Rather, it is used in a much broader sense alongside Philip Bell, Andrew W. Shouse and Michael A. Feder (2009, p. 211) who employ the term culture for every "group with some shared affiliation" based on shared socialised norms, access, resources, opportunities and cultural values.

The individual STEAM learning culture is shaped by socio-demographic variables. The way learner identities form, as well as the way the educational system responds to these identities is further shaped by a complex interaction of class relations, gender, ethnicity, ability and other socially established yet powerful norms of discrimination (Brickhouse, Lowery, and Schultz 2000). Socio-demographics are not to be misunderstood as deterministic interventions. Rather, they *inform* tendencies, but do not lead to straightforward science ecologies. (Archer et al. 2012; Brickhouse, Lowery, and Schultz 2000) A learner's identity and agency are hence socially situated, supporting specific competences, performances and social recognition thereof, which again shape the learner's identity.

With regard to science learning non-dominant groups might for example be represented by female-identified learners with migration experiences or male-identified learners from low educational strata.

The following section condenses findings on social class, gender identity, ethnicity and age as selected socio-demographics. Like other underrepresented groups, also people with disabilities may tend to dis-identify with science, face language and other barriers, and experience political and ideological tension between the norms of science or host institutions and those of their cultural group (Bell, Shouse, and Feder 2009). Also, the family setting as well as the place of living can play role in shaping individual learning cultures.

All of these dimensions intersect at the level of individual learning ecologies (Hazari, Sadler, and Sonnert 2013).

2.3.1 Class, family habitus and science capital

In relation to the theory of cultural reproduction, the family's educational, financial and occupational background and hence the social class and the socio-economic status were

identified as stratifying factors of participation and attainment in the formal education system in general and found by several studies across different contexts (Bell, Shouse, and Feder 2009; Gorard and See 2009; Archer et al. 2012).

Well-off middle class families tend to condense science-specific cultural and social capital with a sense of a science-related image of who they are and what they do or at least provide a supportive context for their children's science interests (Archer et al. 2012). Children from middle and upper classes are advantaged in gaining educational credentials, benefitting more from the formal education system, getting positive recognition of their learning behaviour from their teachers and significant others (Fredricks, Blumenfeld, and Paris 2004). In line with this finding, the discourse practices of traditional classroom settings were found to favour those students with similar discourse patterns, who mostly stem from middle and upper-middle class families, acting as gate-keeper for individuals from non-dominant groups (Bell, Shouse, and Feder 2009; Kurth, Anderson, and Palincsar 2002).

Working class families with a lower socio-economic status and less cultural capital did not perceive science as part of their being. Instead, science was a non-part of their daily practices and hence also something rather 'unthinkable' for their children (Archer et al. 2012). Children from economically poorer families are not necessarily found to be less interested in science in the first place, however, less likely to choose science as subject, based on its perceived difficulty, which is again linked to social class and the influence of their family (Gorard and See 2009). In the context of Austrian working-class families, Carina Altreiter (2017) indicated the habitual rooting of career aspirations related to the idea of using one's own hands and body instead of working predominantly with the mind, an idea closely related to popular images of scientists.

The SYNERGIES project identified a strong connection of parental attitudes to science and a learner's STEM interest (Falk, Staus, et al. 2016). The ASPIRES project referred to the broader role of science capital of the family, emphasising science-related qualifications, knowledge and understanding, interest and social network as key-factors influencing a learner's aspirations of science-related careers (Archer Ker et al. 2013). While not strictly related to social class, families with higher science capital tend to be middle-class (Archer Ker et al. 2013). In particular the mother's educational level was identified to be an important variable influencing a learner's performance across several subjects (Gorard and See 2009). Across all social classes, parental support was shown to have a positive impact on academic achievement of the learners (Gorard and See 2009). However, available resources for supporting the learners, such as parental time again vary with socio-economic status (Jordan 2010).

2.3.2 Gender identity

Learning makes part of developing a gender(ed) identity. Science learning is equally gendered and contributes to this process of self-identification (Brickhouse 2001). While at a young age, science interests do not vary with gender, statistically significant gender differences manifest themselves as children grow older (Archer et al. 2012; DeWitt et al. 2013). Studies investigating these gender differences do so by reproducing a binarily defined gender, i.e. discussing differences between female and male learners, excluding the experiences of learners not conforming to binarily defined gender relations.

The SYNERGIES project did not find any gender-related differences among 11 and 12 year olds as far as their perspective on science, self-identification with science, knowledge of science, engagement in scientific activities or the support social environment is concerned (Falk, Staus, et al. 2016).

The ASPIRES project, however, stated that despite more girls having rated science as their favourite subject, boys are more likely to aspire science-related careers (Archer Ker et al. 2013). Sciences and in particular the profession of being a scientist are male-connoted themselves (Carlone and Johnson 2007). Relational gender stereotypes and conceptions of femininity and masculinity can make science "incompatible with girls' performances of popular/desirable hetero-femininity" (Archer et al. 2013, 181). The sexual orientation of learners is imminently connected with ideas of ideal masculinity and femininity. Disciplinary stereotypes that physical sciences are more appropriate for boys and life sciences for girls exacerbate early on, teenage girls tend to be more interested in life sciences than boys (Falk, Staus, et al. 2016) and are less likely to engage in technology related activities such as programming (Barron 2004). Gender disparity in STEAM retention was found to be reversed with students not identifying as heterosexual (Hughes 2018). Those not conforming to gender stereotypes were found to be unpopular in high school (Hazari, Sadler, and Sonnert 2013). As a consequence, also career aspirations in STEM are gendered (Archer Ker et al. 2013; Sadler et al. 2012).

The way gender identity forms and performs and its impact on science is further mediated by the family context - Gender stereotypes of parents were found to be persistently at work (Bell, Shouse, and Feder 2009): in older studies, mothers overestimated mathematical skills of sons and underestimated those of daughters (Frome and Eccles 1998), and tended to talk about science more with boys than girls. In more recent studies, fathers' increasing gender stereotypes were observed to be negatively related to girls' interests in mathematics, while positively related to boys' enthusiasm (Jacobs et al. 2005). Further, fathers tended to employ more cognitively demanding speech with boys than girls (Tenenbaum and Leaper 2003). In short, parents and other adults were found to support and encourage boys and girls differently (Falk, Staus, et al. 2016). The underlying idea of masculinity and femininity differ by social class. Boys from working-class context are less likely to see how science relates to their lives than boys from middle- and upper classes (Archer, DeWitt, and Willis 2014). The class-gender intersection, however, exacerbates more strongly with regards to working-class girls, resulting in the exclusion of both, being an ideal student and having science-related future aspirations (Archer et al. 2013, 185).

2.3.3 Ethnicity

With science being an important part of a dominant culture, it also bears a – yet often unfulfilled – promise of upwards social mobility. The learners' experiences with science were further found to vary with learners' ethnicities. The ASPIRE project operationalised ethnicity in the context of the UK and found that in their sample Asian students expressed stronger science aspirations than Black students, who in turn expressed stronger science aspirations than White students (Archer Ker et al. 2013). Ethnicity is mediated through the larger social setting of a learner, i.e. their gender, their social background and their specific situation (Gorard and See 2009). Within the context of racist societies, strong correlations between ethnicity and economic poverty can be found. The resulting economic deprivation provides for an important

explanation of the US educational gap of Black and Latinxs[1] students on the one and White students on the other hand (Jordan 2010).

Nancy Brickhouse, Patricia Lowery and Katherine Schultz emphasise the way class, gender and ethnicity interact, shaping the strategies available to students to perform scientific identities, as well as the way these learners are seen by others (Brickhouse, Lowery, and Schultz 2000). As Louise Archer and colleagues (Archer Ker et al. 2013) highlight, barriers for developing science aspirations are amplified in the case of Black student. In the context of racist societies, Black working class learners are stereotypically constructed as "problem students" rather than recognised as "clever science students" (Archer, DeWitt, and Willis 2014, 2; Carlone, Haun-Frank, and Webb 2011).

Hazari and colleagues (2013) looked at a combined analysis of gender and ethnicity for the US and found that not all trends hold along one gender or one ethnic group. For example, Hispanic females identified themselves the least with science across all scientific disciplines, while white males had the highest likelihood to pursue STEM related careers. Similarly, in the context of the UK the intersection of gender ideals, ethnicity and science capital facilitates the potential identification with science, resulting in White and South Asian middle-class boys to experience an easier fit (Archer, DeWitt, and Willis 2014).

2.3.4 Age

Since learning ecologies evolve over time, age is a formative factor shaping science attitudes. Several studies indicate that learners take over a higher level of ownership of their own learning as they grow older and gain more experiences (Bevan 2016, 3). 'Being into science' and the way this interest is acted upon can well change as learners get older, for instance, gender ideals and their influence on science-identities exacerbate with adolescence (Archer Ker et al. 2013). STEM interest between ages 10 and 14 was identified a key variable as far as the likelihood of further science education and careers are concerned(Falk, Staus, et al. 2016). John Falk and colleagues (Falk, Staus, et al. 2016) found that while science interest increased for young learners between 10 and 11 to 11 and 12, activities related to STEM decreased. Other studies suggest a general decline of science interest between the age of 10 and 14 (DeWitt et al. 2013). Students not expressing STEM interest at the age of 10 are unlikely to develop this interest by age 14. Most people's science attitudes are rather fixed at the age of 14 (Archer Ker et al. 2013; Hazari, Sadler, and Sonnert 2013).

[1] The term 'Latinx' refers to students of all genders with roots in Latin America (See for example Vidal-Ortiz and Martínez 2018).

3 Research Design

The goal of WP3 is to examine the STEAM learning ecologies of young learners. The chosen instrument for a thorough investigation is a **longitudinal self-administered survey**, specifically designed for the SySTEM 2020 project. The focus of the data collection with the surveys lies on self-reported data – the learners are asked about their own attitudes, practices and learning experiences to examine their STEAM learning ecologies (Bell, Shouse, and Feder 2009; Falk, Dierking, et al. 2016)

Being longitudinal in nature, the survey was designed to reach the same participants within the timeframe of one year twice. **Survey wave 1** happened in the period February – April 2019, and **survey wave 2** from February – April 2020. Based on the Covid-19 pandemic coinciding with wave 2, this data collection period was extended until the end of June 2020.

Figure 1 depicts the process of the longitudinal survey design, testing, roll out and analysis.

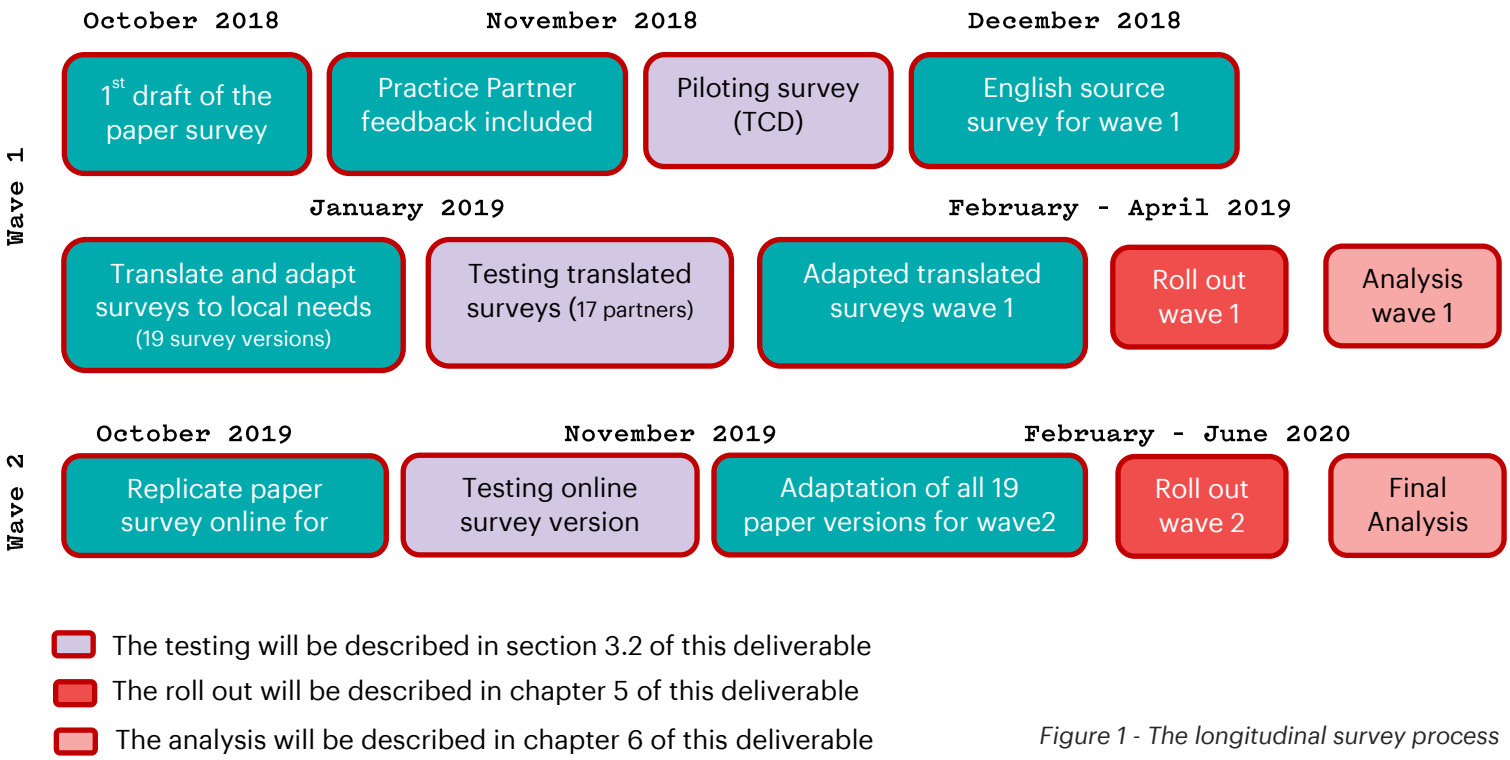


Figure 1 - The longitudinal survey process

The following section elaborates on the sampling strategy developed for the longitudinal study and hence the target population of the undertaken research. The second part elaborates on the usability testing procedures and then, in a third part, guides through the survey creation and the concepts operationalised in the survey.

3.1 Sampling Strategy (see D3.1 for more detail)

The chosen sampling strategy to engage learners in the longitudinal study is called **convenience sampling**. This strategy is a form of a deliberate and hence a non-probability sampling, which involves a purposive selection of participants (D3.1; Kothari 2004). In the frame of SySTEM 2020 project practice partners and third parties were asked to engage visitors of their existing formats for wave 1, which were then to be invited again to participate in wave 2.

The convenience sampling method offered the advantage that the workload for practice partners was minimised, however it bore the danger that the chosen sample was inherently different from the target population: the participants of non-formal learning programmes in general. While the SySTEM 2020 project did not aim at reaching statistical representative results at national levels, analyses were drawn across socio-demographic variables as they were linked to critical areas of accessibility, diversity and inclusion (Durall, Bauters, and Hietala 2019) requiring a broad range of individual data across partners and third parties. Therefore, all practice partners were asked to keep an eye on covering the heterogeneity of their different visitors and participants.

In each of the 19 practice partner and third party locations, partners were asked to engage at least 60 survey participants for survey wave 1, based on the following criteria:

* They were visitors/participants of informal science events/workshops
* They were aged between 9-20
* They were heterogeneous regarding gender-identities and migration experiences

In total, 1140 participants were thus sampled in all 19 practice partner and third party locations.

3.2 Testing and Piloting the Survey

Testing the survey instrument with users was a crucial building block of its design. This chapter gives a short overview of usability testing in the framework of the SySTEM 2020 project to then refer to the specific methodology applied in the context of the longitudinal surveys in WP3.

3.2.1 Usability testing and testing for Usability

The involvement of end-users in the design process has gained increasing attention since its initial usage in the US in the 1960s. Engaging users in this way primarily evolved in the context of social responsibility, urban development and citizen participation before it moved to the realms of product development (Sanoff 2006). More engineers, scientists and designers started to scrutinise predominant assumptions of modern design and product development enabling discussions and attempts towards a socially responsive and responsible approach to

design. The change of mindset is reflected in a refocus of the design process itself and increasing attention given to design approaches such as 'inclusive and accessible design' over the last decade (Cassim 2007; Durall, Bauters, and Hietala 2019).

The participation of users in the design of tools, instruments or processes is crucial to usability testing, which, according to Jeffrey Rubin and Dana Chisnell (2008, 19), observes participants performing a realistic task with the product to collect empirical data. Only items, products or services that do have a usable component can be tested for usability (Dicks 2002). With its roots stemming from experimental methodologies, usability testing works with representative samples of end users in the actual work environment, and includes a set of qualitative and quantitative methods to collect data from the participants to iteratively improve the tested product or tool (Koivuniemi 2013; Rubin and Chisnell 2008). Using this definition, *testing the usability* of a tool or a product, by asking for feedback after a product has been used, *does not equal usability testing* in a strict sense. Many empirical tools, including quantitative surveys, can be used in both usability studies as well as other forms of testing procedures. The use of a specific method hence does not automatically turn a test into usability testing (Dicks 2002).

In the frame of the SySTEM 2020 project, a toolkit of different evaluation instruments specifically developed during the project has employed usability testing methods (T6.4). Every instrument has undergone mechanisms that explore usability from various users; namely the facilitators, as well as respondents to the evaluation instruments. Each user group comes with specific needs that should be considered in an authentic setting. Due to the project structure which separates the tool developers from the facilitators of the evaluation, usability testing by future test respondents was mostly settled in the realm of piloting the whole instrument process.

Instrument	Deliverable reporting on Usability Testing	Lead	Due Date
Longitudinal Survey	D3.2	ZSI	M30
Experience Sampling Method	D6.2	ZSI	M30
Self-evaluation Tool	D5.4	TCD	M33
Learning Portfolio	D3.3	TCD	M34
Engagement Tracker	D5.3	ZSI	M34

Table 1- Overview of Usability Testing Reports organised in the frame of T6.4

The methodology used in the realm of the longitudinal survey is elaborated in more detail in the following section, before then reporting on the tool specific adaptions and applications in the following section of this deliverable.

3.2.2 Cognitive Probing Interviews

Cognitive interviewing is an umbrella term referring to specific qualitative interviewing techniques investigating the cognitive processes used by a respondent to answer a question as well as the way questions are interpreted in specific linguistic and socio-cultural settings (Willis 1999; Miller 2014). The approach is used in order to test, evaluate, improve and enrich survey questions and other measurement materials (Willis 1999).

This methodology is based on cognitive aspects of survey methodology (Tourangeau 1984) as well as the approach of intensive interviewing (Willis 2015). While stemming from the intersection of various disciplines such as psychology, sociology, anthropology and linguistics, cognitive interviewing is rooted in the qualitative paradigm (Miller 2014; Willis 2015). As such it is applied from various paradigmatic perspectives such as phenomenology or ethnography and grounded theory. The latter is particularly present when it comes to interpretivism; a theoretical frame that conceives all interpretations of the phenomenon at hand as valid and important parts of the way meaning is attributed to the survey questions at hand (Chepp and Gray 2014; Willis 2015).

As a specific form of interviews the process of cognitive interviewing varies with the scope of the testing, be it more an interest on weaknesses of the measurement instrument to improve them – this is what Gordon B. Willis (Willis 2015, 18) calls "inspect-and-repair model" – be it a general interest in the interpretation of the questions posed in order to make use of this additional information when interpreting the results of the later rolled-out and quantitatively answered survey (Willis 2015).

The two most popular techniques present in cognitive interviewing are the use of think-aloud techniques and verbal probing. *Think-aloud interviews* stem from psychological procedures and intend to unveil the "'window into the mind'"(Willis 2015, 27). In think-aloud interviews, respondents are instructed and trained to spontaneously voice their thoughts when reading and answering a question. One disadvantage of this technique is that it significantly increases the burden of the test-respondent (Willis 1999; Prüfer and Rexroth 2005).

Verbal probing represents an alternative approach which attributes a more active role to the researcher involved in the cognitive interview. Verbal probes can either be scripted prepared and standardised to be used during all cognitive interviews conducted or might spontaneously come up during the interview situation (Willis 2015). Depending on the scope of probing, different techniques can be used in the frame of cognitive interviews. Peter Prüfer and Margit Rexroth (2005, 5–11) list different types of verbal probing techniques depending on the scope of the item or the tested survey:

- Comprehension probes elicit how the answered question has been understood
- Category selection probes investigate why specific answers have been selected
- Probes investigating the information needed to answer the question as intended by the researchers
- Information retrieval probing elicits the process of remembering in the context of retrospective questions
- General probing investigates the ease or difficulty to answer a question and the underlying reasoning patterns

In addition to think aloud techniques and probes, confidence ratings of answers can be used in the context of retrospective questions to judge the precision of the answer given. Also the technique of asking the test-respondent to rephrase the answer in their own words is a possible technique to elicit interpretation and comprehension. Further, card sorting techniques can be used in the frame of cognitive interviews to investigate the respondent's definition of used wordings (Prüfer and Rexroth 2005).

With the exception of the think-aloud technique all of the named techniques can be used right after a specific item has been answered, subsequent to an answered question or once the full questionnaire has been administered by the respondent on their own. Answering on the spot

might guide response behaviour to a stronger degree, however, also yields the benefit of the respondent being able to recall immediate thoughts while answering to an item. Probes asked after the instrument has been answered completely instead run the risk of the respondent not recalling neither the answers given nor the reflections on the answer in question. However, they might be more suitable for testing self-administered surveys (Willis 1999; 2015).

In addition, cognitive interviews can be used to not only test the general survey instrument, but also to test its translation in different languages and/or cultural contexts (Schoua-Glusberg and Villar 2014). In this specific setting differences in social desirability, levels of diction, naturalness of language as well as different behaviour of how scales and response options are used can be evaluated (Miller et al. 2014; Schoua-Glusberg and Villar 2014). Using cognitive interviews for testing the survey in different languages and/or cultural contexts while the source questionnaire is still under development or at least open for modification is suggested to be beneficial to both, the source survey which becomes more translatable as well as the translated surveys which are adapted to the specific needs of the targeted group (Schoua-Glusberg and Villar 2014).

The number of interviews to be aimed for again depends on the theoretical frame of the testing. Being a qualitative approach, statistical representativeness is not an acclaimed goal of cognitive interviews. Instead the richness of the information potentially gathered from a small, but diverse number of interviews with test-users similar to the survey population makes it practically sufficient to conduct between 12 and 15 interviews for testing a survey (Willis 1999). The documentation of the gathered material is crucially important for its further consideration. Therefore, most cognitive interview techniques operate with full interview recordings that are transcribed partly or fully according to the research in context (Willis 2015).

The analysis of responses focusses on summarising the gathered information to condense the findings and to move from the level of individual cognitive interviews towards comparisons across respondents and subgroups potentially identifying common patterns according to socio-cultural backgrounds, as well as issues arising in specific cases (Miller et al. 2014; Willis 2015). For doing so text summary, deductive or inductive coding can be used. For a detailed description of these coding schemata see for example Willis (2015). The results need to be carefully scrutinised in relation to the item they are specifically related to as well as to the context of the whole survey (Miller et al. 2014).

3.2.3 Survey Testing Wave 1 - Usability Testing applied

The first English survey version was shared with all practice partners for feedback in October 2018. Feedback given was documented in incorporated in the English survey. The testing procedure then carried on in two phases.

Phase 1 of the testing was facilitated by TCD SG testing the English source survey. In order to thoroughly test the source questionnaire, we decided to use cognitive probing interviews. The foreseen focus group interviews (T3.4) were deemed disadvantageous since they would not allow to discuss the whole questionnaire at the level of every item and only offer limited insights in the specific cognitive processes of the involved testers (Schoua-Glusberg and Villar 2014). Instead, it was decided to use individual cognitive interviews as described in section 3.2.2. More specifically, **15 individual cognitive interviews were conducted by the TCD SG team**, (as suggested by Willis 1999) which were specifically coached for conducting the

interviews and equipped with an annotated survey including probing questions as well as a fitted table to transcribe the voice-recorded test-results.

The sampling strategy aimed at involving testers having the same characteristics as the respondents in the main survey, i.e. being aged between 9 and 20 years, involving male as well as female identified learners and potentially also reach out to non-dominant groups reached by TCD SG.

The testing happened in a quiet and closed room in a one-on-one setting. The test-respondents were handed over the original survey, the interviewer used the annotated survey which included pre-scripted probes for specific questions which were asked once the respective items were answered by the test-respondents. In addition, interviewers were urged to be attentive towards spontaneously voiced reactions of the test users in order to formulate also spontaneous probes.

The specifically annotated survey contains 4 probing techniques lined out in *table 2*.

1. "Please, tell me what you are thinking when answering the following set of questions!"
This question belongs to the "think-aloud" technique. You ask the respondent before answering the question to verbalise all the thought processes that lead to their response and thus any problems that participants may have understanding a question or answering it.
2. "How do you understand the item/question?" "How do you understand the word "X"?"
This is a specific probing technique. It enables additional information to be gained about the way in which participants understand the questions. These probes can be administered concurrently (after the participant has answered the question).
3. "How did you come up with your answer "X"?"
This probing technique provides more detail about the reasons for picking one of the provided answer options and informs about them being exhaustive and clear.
4. "Can you repeat this question in your own words?" "What have you just read? Can you repeat this information in your own words?"
This question belongs to the paraphrasing technique. This verbalisation yields information about whether or how the respondent understood the question and whether this understanding corresponds to the one of the researchers. This question is asked once the participant has answered the survey question.

Table 2 - Four types of cognitive probes used when testing the longitudinal survey

The results were partly transcribed in a prepared excel sheet informing about the given answers to the survey item in question, spontaneous reactions to the item, responses, and reactions to cognitive probes as well as comments and remarks by the interviewer.

Since the longitudinal survey represents a self-administered instrument, respondents should be able to fill in the questionnaire without additional support. Therefore, **another 30 surveys were handed out by TCD SG to additional test-users to be filled autonomously.** These paper-based versions were scanned and sent to ZSI.

The cognitive interviews as well as the answers given in the self-administered surveys were scrutinised and the source-survey was adjusted. For clarity questions were rephrased, answer options were extended including examples. Also, the order of individual questions or question blocks was changed to intervene in discovered sequencing effects. For instance, the section asking questions about science was prepended to be answered prior to the block asking questions about science in school, to prevent general questions about science being answered with a school science focus only. Questions which lent themselves to many different understandings where either specified or removed. The latter was for instance the case for a question matrix investigating science importance at the learner's home, school, village/town and society - respondents tended to either think of a specific person in this realm or about the issue of science being important for these areas to work properly, e.g. for electricity to work.

The English source survey (see Annex) was now ready for translation processes which were led by each practice partner and third-party institution using professional translation services.

Phase 2 of piloting focussed on testing the translated survey versions and potentially necessary local adaptions with practice partners. Again, cognitive interviews were used to test for translation issues and needed changes (Schoua-Glusberg and Villar 2014). **Each practice partner organisation that needed translation** (17 out of 19) **tested its translated survey with 3 to 6 test-respondents**, whereas again a variety of age groups, gender balance and the inclusion of non-dominant groups were recommended. In case a partner needed translation into more than one language, testing all language versions was compulsory. A specific guideline was produced for all practice partners and third parties involved in testing. The source survey was once again annotated using the same techniques already outlined in *table 2* and the interviews were conducted in the same way as the cognitive interviews in phase 1. The results were analysed at a partner-level and necessary translation checks were communicated at an individual level.

For most partners, the survey worked very well, nevertheless the translation check led to some adjustments. Specific keywords caused some difficulties in the translation process, most prominently this was the case with the concept of ‘science’. Literal translations into the language needed often resulted being too theoretical or abstract, particularly in the context of young learners. In order to solve this challenge, some partners translated ‘science’ using word pairs to open up its meaning. For instance, WAAG used the translation "wetenshap en technie" (literal English translation: science and technology).

The same translation difficulties arose with ‘gender’ with many languages not having a translation of the English concept. Partners therefore suggested using the English word and additionally adding a translation of ‘sex’. Partner organisations working with young learners further included possible gender identities in brackets to give respondents an idea about possible answers. Traces for instance included "fille, garçon, un peu des deux, aucun des deux, autre, ... ?" (literal English translation: girl, boy, a bit of both, none of both, other, ...) as examples.

The testing also resulted in general changes of the source survey and hence all survey versions. A question operating with a 5-point Likert scale (strongly agree – agree – undecided

– disagree – strongly disagree), additionally offered a 'not applicable' category. 'Not applicable' was included in the first place to offer learners with diverse living realities the possibility of indicating once an item is not applicable to their situation. When disagreeing to the item in question, test-respondents tended to use the 'not applicable' category instead of 'strongly disagree'. Consequently, 'not applicable' was removed to clarify the possibility of indicating disagreement.

The cognitive interviews of the translated surveys enabled to adapt examples and categories to the diverse living realities of the respondents being based in 18 different countries. Furthermore, the testing led **to specifically adapted surveys for LATRA and Bloomfield Science Museum Jerusalem**, designed to be specifically inclusive for the target groups at hand. Based on the experiences in the piloting process the following two specified survey versions were created by the ZSI team with the support of the practice partner concerned:

LATRA, who is operating in a refugee camp for unaccompanied minors in Lesvos, obtained a substantially changed survey. 12 items related to activities that are broadly related to informal science learning, were not applicable to the specific setting of the camp. For example, caring for a pet, or gardening are prohibited in the camp area. Therefore, these items have been removed from the survey. In addition, the question asking about the respondent's self-identified gender was perceived as potentially sensitive making the test users suspicions. In order to prevent from distractive answer behaviour, the position of this question was changed to the very end of the survey.

Bloomfield Science Museum Jerusalem (BSMJ) approached ZSI to ask for an additional survey version that can be completed by a major non-dominant group of their visitors: ultra-orthodox Jews. Based on the input of a cultural expert in Jerusalem, for instance survey items related to IT, mobile devices or social media were removed to eliminate potentially insensitive items that might hinder the learners from participating in the survey in general. In total 10 items as well as some examples given in brackets were removed from this survey version to include ultra-orthodox Jews as respondents.

3.2.4 Survey Testing Wave 2

Based on the minor adaptions happening between wave 1 and wave 2 (outlined in section 3.3.5) the survey was tested anew on a large-scale setting. Rather, testing procedures were limited at a partner level. Those partners using the online survey handed their adapted and translated survey in. The survey was then included in the online survey and simultaneously checked for needed adaptions, which were communicated to the practice partner in charge and adapted. In addition, all online survey versions were tested and reviewed by the practice partners in their respective languages.

Also, the partners not using the online survey in their data collection of wave 2 were asked to hand their translated survey version in, which was in turn reviewed by ZSI and adapted by the practice partner in charge.

3.3 Survey Design

The longitudinal survey used in the SySTEM 2020 project has been specifically designed for the project. As repeated-measures design, a longitudinal survey has more statistical power to identify effects than cross-sectional surveys (Field, Miles, and Field 2012). In doing so, the

longitudinal surveys used in the *Synergies* project (Falk, Staus, et al. 2016) as well as in the *ASPIRES* project (DeWitt et al. 2013) were used as a baseline for item selection that was subsequently enriched with items operationalised elsewhere.

The survey design was exclusively made for paper-based surveys, directly filled by the respondents in a supervised setting (D3.1). This paper-based version was selected based on the model survey of the Synergies project (Falk, Dierking, et al. 2016). Methodological advantages of a paper and pencil survey lie in the more detailed manner, papers are read in contrast to screens, the instrument further does not include any technology effects (Nielsen 2000; Fuchs 2003; Smith and Jibum 2015). Lastly, not all involved practice-partners do have the possibilities to provide for enough electric devices to fill in the survey in a simultaneous and supervised setting. Paper-based surveys hence provided for the most accessible survey option.

Initially, the paper-based version was supposed to be the only valid survey version for data collection in wave 1 and wave 2. Based on the SySTEM 2020 practice partners' strong concerns of not being able to reach all participants from wave 1 again for wave 2, the paper-based survey was additionally replicated as online survey using Lime Survey, which is directly hosted on ZSI-servers.

This additional online survey enabled partners to send the survey to participants who were not able to get at their location a second time. While, from a methodological point of view, introducing a potential bias in the data collection (Nulty 2008) the decision was taken based on the following four reasons:

(1) The target group of wave 2 has already participated in wave 1 hence had already made the experiences of filling the survey in a paper-based format in a supervised setting, having the possibility to ask questions of understanding and receiving support for answering the survey. Since the survey of wave 2 is nearly identical to the survey of wave 1 the familiarity with the instrument might limit the introduced bias.

(2) The age group of the SySTEM 2020 project is enormous – 8-12-year-olds might find it difficult to answer online surveys without additional support. Partners reaching this target-group were hence urged not to send the online-survey out, but rather facilitate a supervised data collection setting for wave 2.

(3) The drop-out rates for longitudinal studies are usually quite high (Laurie and Lynn 2008). Online-surveys reduce the burden of participation in the survey and are hence a means to limit the number of dropping out respondents. Aiming for re-recruiting the maximum number of respondents is necessary to meet project-aims as well as for making meaningful comparisons between wave 1 and wave 2.

(4) The Covid-19 pandemic created the need for questionnaires which can be filled in autonomously keeping physically distanced.

The final survey version is organised in four consecutive parts:

Guiding Theme	Elaborated in D3.2
The everyday engagement in science learning and the connected social environment	Section 3.2.1
Attitudes towards STEAM in general	Section 3.2.2
Attitudes towards science in school	Section 3.2.3
Socio-demographic information about the learner	Section 3.2.4

Table 3 - Building Blocks of the Survey

The following section elaborates on the operationalised concepts of the SySTEM 2020 survey, which were present in all survey versions – the paper version of wave 1 as well as the paper and online versions of wave 2. The last section of this chapter elaborates on minor adjustments happening to the wave 2 surveys based on experiences made in wave 1 and necessary changes resulting from the online replication of the survey.

3.3.1 Engagement in scientific practices

The **engagement in scientific practices** was operationalised asking the learners about the frequency of participating in 19 activities potentially offering possibilities for informal science learning e.g. by using a library, reading a book not for school, learning a music instrument or doing sports. The frequency scale was implemented offering 5 options ranging from '**every day** or **almost** everyday' (coded as 4) to '**hardly ever** or **never'** (coded as 0). An additive index combining the number of activities done with the frequency of this engagement was created.

Participation in groups, as a setting of institutionalised out-of-school science learning, was operationalised offering three answers: "I am already a part (or have been part) of such a group" (coded as 2), "I would like to join such a group" (coded as 1), and "I am **not interested** in joining such a group" (coded as 0) tapping 6 group settings. Mean based indices of the participation in groups and the interest in groups were built.

Each question set taps partly similar activities that potentially foster the same forms of science-learning. To investigate the underlying, latent and multidimensional elements of science-learning an exploratory principal component analysis (PCA) was conducted with the data collected in wave 1. This method enables to identify the minimum amount of factors to consistently summarise the interrelated items into a single, yet multidimensional variable (Field, Miles, and Field 2012).

The initial PCA was conducted on all 25 items measuring the frequency of engagement in broadly defined science activities as well as the participation in institutionalized groups. The PCA was rotated, based on the assumption that different forms of science-learning correlate, since they all make part of science-learning. The obliquely rotated factor analysis identified 6 latent factors: self-directed science learning, art science-learning, science learning by the means of using technology and social media, science learning through sports and science learning by engaging in various other activities such as cooking and spending times outdoors. Factor loadings >0.50 are considered large enough to summarise the respective item among this factor.

Item in Survey	Oblimin rotated factor loadings >.40					
	Art-science learning	Self directed science-learning	Science learning by use of technology and social media	Sport science learning	Biology related science learning	Broad science related activities
A choir, music or dance class	**0.75**					
Play a musical instrument or sing or hum	**0.71**					
Drama or acting class	**0.62**					
Participate in an after-school activity (e.g. music or dance classes)	0.46					
Cooking or sewing class						
Scout troop						
Read a book or magazine not for school						
Watch a video about science, maths, or tech-nology in out of school hours		**0.77**				
Visit websites to learn about things you're interested in out-of-school-hours		**0.66**				
Build or take things apart or repair things		**0.62**				
Do science experiment at home		**0.55**				
Visit a science gallery, exhibition or museum		0.41				
Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter			**0.72**			
Use a computer, game console, pad or mobile phone to play games at home			**0.53**			
Actively listen to music			0.49			
Use a library			-0.41			
Do sport in a team (e.g. Soccer)				**0.79**		
A sports club (such as soccer, tennis)				**0.77**		
Do sport by yourself (e.g. Dancing, running)				0.43		0.41
Take care of pets					**0.69**	
Visit a farm, a zoo or an aquarium					**0.59**	
Garden or grow plants at home					**0.51**	
Cook or bake						**0.58**
Spend time outdoors						**0.53**
Religious youth group						-0.47
Eigenvalues	2.47	2.34	1.72	1.70	1.64	1.44
% of variance explained	.22	.21	.15	.15	.15	.13
α	**0.64**	**0.65**	0.34	**0.52**	0.42	0.27

Table 4 - Pattern matrix of 24 STEAM learning activities PCA, incl. factor loadings >0.40, factor loadings >0.50 in bold print

However, only 3 of these 6 identified factors were internally consistent (Cronbach α > 0.5 for the set of variables loading highly on the same factor, see *table 4*). As a consequence, variables with a poor fit (r.drop values <0.30) were excluded from the analysis, and the PCA was re-run with 10 variables only. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis KMO=0.67, with all individual KMO values >0.50. Bartlett's test of sphericity, $\chi^2(45) = 1833.105$, $p<0.001$ indicated that the correlations between the individual items were sufficiently large for a PCA. A non-rotated PCA was run to identify the number of components with eigenvalues over Kaiser's criterion of 1. Three factors were identified. Based on the correlation between the analysed items, an obliquely rotated PCA was run extracting three factors: **Art science learning, self-directed science learning** and **sport science learning**. Together, they explain 100% of the identified variance amongst the 10 activities: Based on the large sample size, the scree plot and the Kaiser's criterion, these three components were retained for further analysis of a specific type of science learning.

To summarise these types of learnings into single variables, the variables asking about the membership in specific institutionalized settings were recoded to fit the scale of activities. Being part of a group was interpreted as regular engagement in these activities and re-coded as 3, which equals doing this activity about once or twice a week at the 5-point scale used for activities with 0 signifying hardly ever or never engaging in this activity and 4 doing this activity 'everyday or almost everyday'. Based on this point-based index, a mean-based index was constructed calculating the average intensity of engagement for self-directed science learning activities, art-centred science learning and sport-based science learning.

Item in Survey	Oblimin rotated factor loadings >.40		
	Art-science learning	Self directed science-learning	Sport science learning
A choir, music or dance class	**0.81**		
Play a musical instrument or sing or hum	**0.76**		
Drama or acting class	**0.64**		
Participate in an after-school activity (e.g. music or dance classes)	**0.52**		
Build or take things apart or repair things		**0.74**	
Do science experiments at home		**0.71**	
Watch a video about science, maths, or technology in out-of-school-hours		**0.69**	
Visit websites to learn about things you're interested in out-of-school-hours		**0.60**	
Do sport in a team (e.g. soccer)			**0.84**
A sports club (such as soccer, tennis)			**0.80**
Eigenvalues	1.95	1.92	1.51
% of variance explained	0.36	0.36	0.28
α	0.65	0.63	0.59

Table 5- Pattern matrix of STEAM learning activities PCA, incl. factor loadings >0.40, factor loadings >0.50 in bold print

Item in Survey	Art-science learning	Self directed science-learning	Sport science learning
A choir, music or dance class	**0.80**	0.08	-0.02
Play a musical instrument or sing or hum	**0.76**	0.19	-0.02
Drama or acting class	**0.63**	0.10	0.01
Participate in an after-school activity (e.g. music or dance classes)	**0.55**	0.23	0.39
Build or take things apart or repair things	0.19	**0.72**	0.06
Do science experiments at home	0.19	**0.71**	-0.08
Watch a video about science, maths, or technology in out-of-school-hours	0.19	0.60	-0.08
Visit websites to learn about things you're interested in out-of-school-hours	0.02	**0.73**	0.18
Do sport in a team (e.g. soccer)	-0.01	0.14	**0.84**
A sports club (such as soccer, tennis)	0.02	0.03	**0.79**

Table 6 - Structure matrix of STEAM learning activities PCA, factor loadings >0.50 in bold print

The next section of the survey investigates the social **support structures** learners experience encouragement of to engage in the science-related activities just mentioned (Falk, Staus, et al. 2016). The learners were asked about the encouragement of parents, siblings, grandparents or other relatives, teachers, and friends as well as their self-motivation to engage in a set of 13 selected science activities. Based on indicated encouragement six mean-based support indices were built for all these forms of encouragement as well as an overarching support index counting all encouragement received.

3.3.2 Attitudes towards science in general

The following sections of the survey tap attitudes to science (DeWitt et al. 2013; Falk, Staus, et al. 2016), positive and negative science self-identification (DeWitt et al. 2013; Falk, Staus, et al. 2016), emotions connected to science (Bell, Shouse, and Feder 2009; Falk, Staus, et al. 2016), science relevance (Falk, Staus, et al. 2016) and science interest (Archer Ker et al. 2013; Falk, Staus, et al. 2016). Further, parental science attitudes (Bell, Shouse, and Feder 2009; Falk, Staus, et al. 2016; Jacobs et al. 2005; Tenenbaum and Leaper 2003) and peer science attitudes (Falk, Staus, et al. 2016) are investigated. Most of these items were operationalised as 5-point Likert scales. In order to confirm the underlying and cross-cutting components in science attitudes as derived by earlier studies another principal component analysis (PCA) was run using all Likert-based items of wave 1 data.

The PCA was conducted on 18 items with oblique rotation, again assuming correlation between underlying components. The Kaiser-Meyer-Olkin measure verified the sampling adequacy for the analysis KMO=0.89 ('good' according to Kaiser 1974), with all individual KMO values >0.77. Bartlett's test of sphericity, $\chi^2(153) = 8808{,}28$, $p<0.001$, indicated that the correlations between the individual items were sufficiently large for PCA[2]. An initial analysis was run to identify the number of components with eigenvalues over Kaiser's criterion of 1. Hence, four components that commonly explain 58% of the variance were identified. Based on the large sample size, the convergence of the scree plot and Kaiser's criterion, four components were retained in the final analysis.

[2] For more information on the tested assumptions you might refer e.g. to Kaiser 1974 and Field et. al (2012).

Whereas parental and peer science relevance resemble the findings by Falk and colleagues (2016), the component 'positive science attitude' is more comprehensive and blurs the distinction between the *Synergies* concepts of 'Science Enjoyment' and 'Science Relevance', which is why we have named it 'Positive Science Attitude'. This component is related to a 'Negative Science Self-Concept' whereas a low score at the latter implies a high score at the former. The internal reliability was tested with Cronbach α. The internal reliability of the ‚Negative Science Self-Concept,' as indicated by the rotated PCA has been improved by including ‚Science is not for me' and removing ‚I have no idea what my family thinks of science' based on a low correlation with the overall scale (r.drop = 0.26), which improved the internal consistency (Cronbach α from 0.46 to 0.59).

Table 7 - Pattern Matrix of science attitudes PCA, incl. factor loadings >0.40, factor loadings >0.50 in bold print

Item in Survey	Oblimin rotated factor loadings >.40			
	Positive Science Attitude	Parental Science Relevance	Peer Science Relevance	Negative Science Self-concept
I find science to be really interesting	**0.81**			
I enjoy learning science	**0.73**			
How do you feel when you think of 'SCIENCE'? Bored – Neutral - Fascinated	**0.73**			
How do you feel when you think of 'SCIENCE'? Means nothing – Neutral – Means a lot	**0.69**			
Science is helpful in understanding today's world	**0.68**			
I see how science relates to my life	**0.62**			
How do you feel when you think of 'SCIENCE'? Afraid – Neutral – Excited	**0.58**			
I think I would make a good scientist	**0.52**			
Science is not for me	**0.50**			0.45
Are there science topics that you find particularly interesting? Which ones? (counts number)	0.43			
My parents are interested in science		**0.82**		
My father talks to me about science		**0.79**		
My mother talks to me about science		**0.78**		
My close friends like science			**0.90**	
My close friends enjoy science			**0.87**	
My way of thinking and learning makes it hard to understand science				**0.75**
Other people of my age find it easier to learn science topics than I do				**0.60**
I have no idea what my family thinks of science		0.42		**0.55**
Eigenvalues	4.47	2.31	1.88	1.73
% of variance explained	0.43	0.22	0.18	0.17
α	0.86	0.79	0.84	0.59

Item in Survey	Positive Science Attitude	Parental Science Relevance	Peer Science Relevance	Negative Science Self-Concept
I find science to be really interesting	**0.82**	0.28	0.34	0.14
I enjoy learning science	**0.79**	0.32	0.37	0.20
How do you feel when you think of 'SCIENCE'? Bored – Neutral - Fascinated	**0.79**	0.22	0.35	0.32
How do you feel when you think of 'SCIENCE'? Means nothing – Neutral – Means a lot	**0.74**	0.15	0.34	0.21
Science is helpful in understanding today's world	**0.60**	0.27	0.11	-0.10
I see how science relates to my life	**0.64**	0.36	0.22	0.05
How do you feel when you think of 'SCIENCE'? Afraid – Neutral – Excited	**.64**	0.15	0.32	0.31
I think I would make a good scientist	**0.63**	0.35	0.34	0.25
Science is not for me	**0.64**	0.25	0.28	**0.56**
Are there science topics that you find particularly interesting? Which ones? (counts number)	0.47	0.21	0.12	0.29
My parents are interested in science	0.34	**0.85**	0.30	0.06
My father talks to me about science	0.30	**0.81**	0.23	0.16
My mother talks to me about science	0.29	**0.80**	0.26	0.03
My close friends like science	0.35	0.26	**0.91**	-0.01
My close friends enjoy science	0.36	0.32	**0.90**	-0.03
My way of thinking and learning makes it hard to understand science	0.27	0.04	0.00	**0.77**
Other people of my age find it easier to learn science topics than I do	0.14	0.01	-0.25	**0.62**
I have no idea what my family thinks of science	0.03	0.41	0.08	**0.54**

Table 8 - Structure Matrix of Science Attitudes PCA, factor loadings >0.50 in bold print

Each of the four components is comprised of individual items which can be scored for each respondent to create a latent variable that corresponds to the underlying dimension or component. Each identified component was remodelled as an index ranging from 1 to 5 independently from the number of items included in the index, with 1 implying the highest possible opposition towards the concept and 5 the highest agreement.

3.3.3 Attitudes towards school science

Diverging STEAM learning ecologies must not only be understood as an 'achievement gap' resulting from a 'student deficit' perspective (Carlone, Haun-Frank, and Webb 2011). Good achievements in school science are not necessarily linked to personal science interests or identification with science (Carlone, Haun-Frank, and Webb 2011; Gorard and See 2009; Jordan 2010).

Based on the efforts made in the *Synergies* and *ASPIRES* projects, STEAM learning ecologies were operationalised explicitly in both, the informal and the formal context.

As far as attitudes towards science taught in formal settings are concerned, the learners were asked about their favourite school subject, their perspective on their school performance according to their teachers as well as their attitudes towards school science, based on two items – "Science lessons are exciting" and "I look forward to my science lessons" (DeWitt et al. 2013). A mean-based index was created summarising school science attitudes with wave 1 data (Cronbach α= 0.85).

3.3.4 Socio-Demographics

The following section introduces the socio-demographic variables operated in the survey. Socio-demographics are included in the last part of the survey in order to prevent primacy effects or breakoffs possibly provoked by demographic, potentially 'too personal' or just 'boring' questions (Stoutenbourgh 2008).

Socio-economic status for youth usually refers to parental and family background, assessed by occupational status, educational qualification and income (Gorard and See 2009). Since the economic situatedness of the learner is undisputedly linked to the educational capital, the survey only operationalised the latter. In order to collect information about the **educational capital** from younger and older learners alike, not overburdening the respondents, questions were not directly included in the self-administered survey, but in the consent sheet filled directly by parents/guardians in case of minor participants, or the participants themselves in case of majority[3].

An index was created informing about the educational capital of the learner by using information of their parent's highest level of education completed, their current profession (collected according to ISCO-08 major groups (International Labour Organisation 2008) and the number of physical reading materials that are available in the household (DeWitt et al. 2013) (α=0.57). In case that both parents' educational and professional status had been collected, data of the higher-ranking parent was included in the index (International Labour Organisation 2008). On the condition that information on the parents' occupational and professional status was lacking completely, the mean value of persons with the same educational level was imputed based on the amount of reading materials available at home and vice versa (19.4% of occupational and professional status were imputed, 0.02% of book counts were imputed for wave 1). In case of the unaccompanied minors, who participated in the study, no educational capital could have been computed, since educational and professional status of their guardians were not available, and the number of reading materials could – in their specific situation – not be used as a proxy.

The added results ranged from 2 (indicating the lowest score in all three categories) to 10 (indicating the highest score in all three categories). The scale was then summarized into three categories:

* low cultural capital, ranging from 2 – 4.5, representing the lowest educational strata
* medium cultural capital, ranging from 4.6 – 7.5, representing the medium educational strata

[3] For further information regarding the consent sheet and the consenting process see Annex section 9.1.2

* high cultural capital, ranging from 7.6 – 10, representing the highest educational strata

Additionally, participants were asked who they live with at home, to inform **about the family setting** of the respondents.

The survey asked for the current **place of living** providing for three options: countryside, outskirts of a city/close to a city and in the city.

In order to avoid possible pitfalls of operationalising **gender** as closed end variable (Döring 2013), gender-identity was operationalised as an open-end question and coded in three categories afterwards, namely "female", "non-binary" and "male".

While not being able to cover the diverse field of **disabilities** fully, the survey asks, whether the respondents experience serious difficulties with hearing, seeing, speaking, or moving.

The international context of the SySTEM 2020 project makes it difficult to operationalize ethnicity at a country-specific but comparable level. An additional complication is added by GDPR regulations, which prevents questions about ethnicity except for specific justifications. Therefore, the SySTEM 2020 survey operationalized the concept of migration experiences only, while knowing that they do not fully cover the issues at hand and hence need to be interpreted with care.

Additionally, the languages spoken by the parents when talking to each other were collected. In case that both, the parents as well as the surveyed learners use more than one language a multilingualism dummy-variable was inferred.

Migration experiences have been operationalized as dummy variable asking for the respondent's country of birth, their first language (Cronbachα = 0.78). Both respondents born outside of the country of the partner institution as well as respondents having a first language deviating from the main languages spoken in the partner country have been coded as 1, counting those having made migration experiences themselves as well as potential second generation migrants. Since learners might also grow up learning two languages at once, additionally the language spoken by the parents/adults at the learners' home were taken in consideration in case parents used languages deviating from the countries' official languages when talking to each other, the learner's migration experiences were equally coded as one.[4]

The survey investigates learners between **age** 9 and 20 throughout the period of one year. The yet-to be 9-year olds are hence 8 years old in wave 1, the still-20-years old of wave 1 are 21 at the second wave. The survey operates with 4 age groups: 8-11-year olds[5], 12-14-year olds, 15-17-year olds and 18-21-year olds.

In addition, learners are asked about their current **school and job situation**, **the highest level of education completed** as well as already made **job experiences**. Learners are further asked who they share a **home**, their material living conditions were investigated asking for the number of computers, televisions, smart phones (in use), cars and music instruments at home.

[4] In case of survey data for longitudinal respondents, only the languages spoken by parents indicated in wave 1 were used to infer migration experiences.
[5] Since 8 year old learners in wave 1 are 9 year old in wave 2, this age group only covers 9 to 11 year olds in the wave 2 group of the longitudinal sample.

3.3.5 Survey adaptations between wave 1 and 2

Based on the experiences and the data collected in wave 1 as well as the requirements of the online survey version 9 minor adaptions are made in the survey for wave 2.

(1) In order to emphasise the importance of participating again in the survey, the introduction sentence from wave 1 has been changed into: “Thank you for your help with this survey!” with “THANK YOU FOR PARTICIPATING AGAIN IN THIS SURVEY!”. Partners engaging new participants were urged not to make this change.

(2) Question Matrix 1 lacked an ‘in’ in the English version only. This error was only discovered after roll-out of wave 1. For wave 2 the item was corrected to ‘Visit websites during out-of-school-hours to learn about things you’re interested in’

(3) Question 6 operates with three consecutive Likert scales, all of them only being labelled in the middle position as well as on the outermost poles while offering 5 circles to tick (Mellor and Moore 2014). Practice partners reported that some respondents found it difficult to answer the questions. In addition, the online-implementation and the restricted graphical elements in the Lime Survey display made it necessary to change the labels for all three Likert scales for the wave 2 survey version. For demonstration question 6.1 ("How do you feel, when you think of 'SCIENCE'") is displayed in *figure 2*: Whilst wave 1 operationalised this question labelled on three points, namely Bored – Neutral – Fascinated, wave 2 options needed to reformulate the labels to demarcate the distinction between the different answer options.

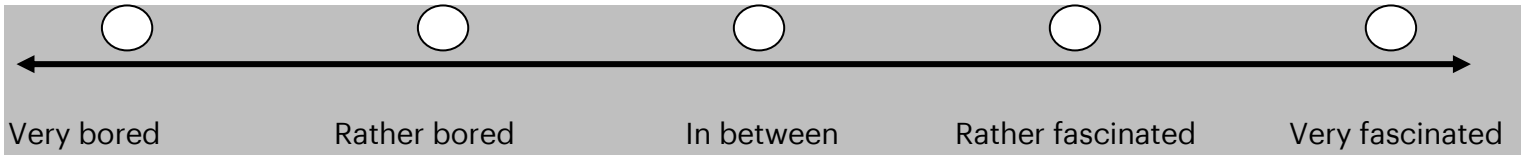


Figure 2 - Question 6.1 - How do you feel, when you think of 'SCIENCE'? as modified for wave 2

(4) Practice partners reported that some respondents complained about the repetitive character of the survey. Since Item 9.3 (“My close friends like science”) is rather similar to 9.8 (“My close friends enjoy science”) item 9.3 was deleted for wave 2.

(5) The answers obtained form question 10 ("Please choose your circumstances") hinted at potential issues of understanding. Hence, the categories offered were reduced in their level of detail, removing unpopular answers from the options given as well as dividing the first option into two separate items to be chosen.

(6) Coding the answers given to question 11 led to the introduction of a new favourite subject often named using the provided ‘Other’-category: Informatics (Coding, Multimedia), which is now provided as choose-able option.

(7) In parallel to question set 6, question 12 required additional labelling for all 5 answer options.

(8) Question 19 required a double check among all partners. This question asks whether the survey language corresponds to the first language of the respondent. The English

survey version, that was translated by the practice partners, was not adapted to the local survey version by all partners. Answers to the question were corrected before analysis. In order to avoid this error for wave 2 special attention was drawn to this question.

(9) Question 22 asked for the number of persons living in the learner's home, however, did not differentiate between children and adults. Contrary to the expected possibility to use this information in the context of question 28 investigating the possession of typical consumer goods, the analysis of wave 1 showed that this link cannot be established. Hence, for the sake of shortening the survey, this question was dropped for wave 2.

(10) The online survey additionally includes a question asking about "In which country do you live". This question was included in the online version only to ensure proper classification of potentially new respondents not having token-based access to the survey.

The online survey version additionally omitted asking participants for their names – participant IDs were instead used as tokens for linking survey wave 1 and wave 2 data (see Annex Chapter 9.1.3 for more details on the underlying pseudonymisation process).

In addition, an open online survey was created to enable the engagement of new participants in the study. This link-based online survey was an exact replication of the wave 2 online survey, however, additionally included the four questions of the paper consent sheet tapping the mother's and father's highest level of education and current occupation.

4. Data Collection Process

While the survey was designed by the ZSI team, the data was collected by the 19 practice partners and third-party members of the SySTEM 2020 project consortium. The following chapter elaborates on the roll out of the longitudinal survey in both wave 1 and wave 2.

4.1 Roll out of Survey Wave 1

Wave 1 of the data collection was exclusively using paper-based surveys, directly filled by the respondents in a supervised setting (see D3.1).

The first survey wave was planned to happen between February - April 2019. Due to delays in an amendment-process, KCL SG was not able to start working on the SySTEM 2020 project until April 2019 resulting in survey data being collected until June 2019.

While the specific effects of incentives is dependent from the survey mode and the timing of incentives being offered, studies across several survey modes and strategies suggest a general effect of incentives on increasing response-rates (Collins et al. 2000; Galea and Tracy 2007; Laurie and Lynn 2008). Therefore, the common decision was taken with the partners to use incentives in the roll-out. Whilst the choice of incentives remained with the partner institutions, it was commonly agreed to not overspend the price of a T-shirt per participant. Every survey participant was supposed to receive an incentive individually upon completion.

For instance, TCD handed out vouchers for their own Science Gallery museum shop, CPN used the SySTEM 2020 visual identity to print bags and pens handed out to survey respondents.

In order to guide practice partners through the survey process, the ZSI team set up a handbook explaining all decisions taken and directing the sampling procedure, the preparation of data collection and survey roll out, as well as coding the responses. In addition, partners were asked to document the sampling and roll-out process, writing down the way participants were selected, invited, and supported during the roll-out.

Not all partners were able to recruit the non-dominant respondents they were aiming for. Three partners reported the consent-sheet requiring the authorization and additional information of the parents represented a barrier for some potential participants from non-dominant groups otherwise reached by the practice partner institutions. This experience coincides with findings from earlier studies suggesting that those participants not responding to a survey might differ demographically from those answering the questionnaire (Nulty 2008).

Most partners achieved rather high response rates – more than every second invited respondent filled the survey in with 11 partners. Only two partners, achieved a response rate of 25% and below. Most partners included the survey-roll out in one of their workshops and events. Support was offered for young learners and learners who needed assistance. Two thirds of the practice partners and third parties (13 out of 19) collaborated with formal education structures, such as existing collaborations with teachers or schools to recruit survey participants. Collaboration with schools was perceived as easing the process. This was even more the case when supportive teachers prepared their classes for the survey situation and helped organizing the consent procedures.

In total, 1322 valid response sets have been collected by the 19 practice partners involved. Based on the size and frequency of their workshops, four practice partners were not able to reach the target of 60 respondents for wave 1. Nevertheless, the overall target of surveying 1140 learners for survey wave 1 was met.

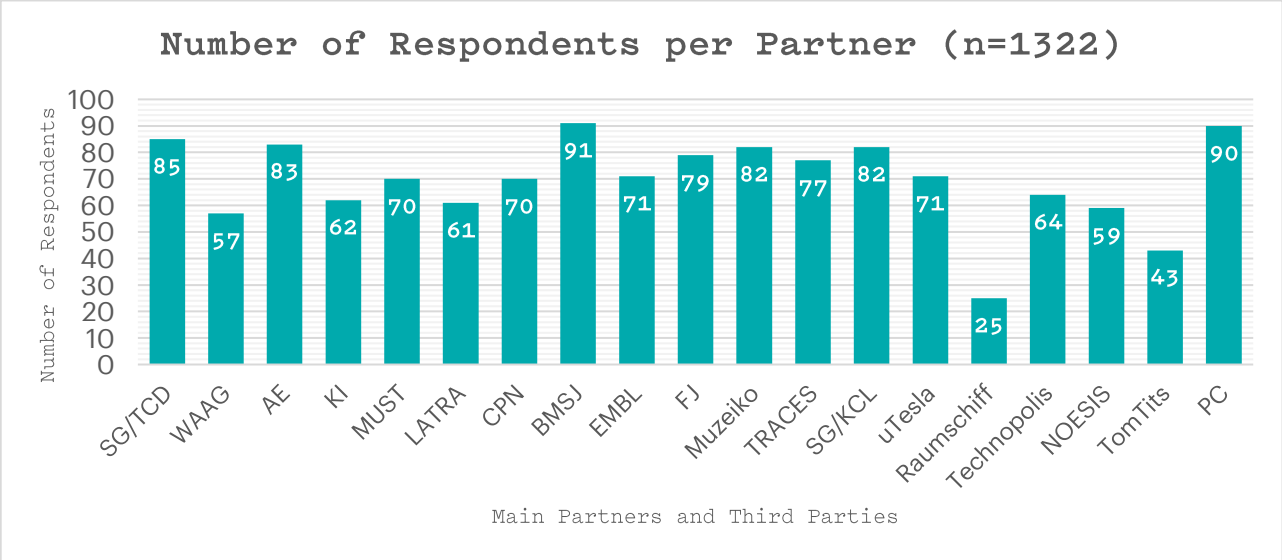


Figure 3 - Number or respondents per partner of wave 1

4.2 Roll out of Survey Wave 2

In line with the preparation of wave 1 also the roll out of wave 2 was guided by a specifically produced checklist set up by the ZSI team. Early calls were organised by ZSI in M17 (November 2020) to talk with practice partners and third-party members about best practices in wave 1 and the upcoming steps and processes.

At this point PC informed the ZSI team that they will not be able to reach the same participants of wave 1 for wave 2. Due to their specific collaboration with schools during wave 1, consent sheets were kept by the collaborating schools making a re-identification of participants impossible. Therefore, it was agreed that PC will only include new participants for wave 2. In addition, it was agreed that all partners were allowed to include new respondents in the data collection to be more inclusive, enabling partners to engage not just wave 1 participants, but all participants of an organised workshop in the survey. Involving new participants was also a last resort for partners to be implemented in case that their reached response rate to survey wave 2 was extremely low.

Partners were free to choose, whether they would like to use the online survey or the already known paper-based survey version for wave 2. Upon notification, the translated online survey was included in the Lime Survey version. In total, the SySTEM 2020 online survey version worked in 13 different languages (see section 3.3). An additional open survey was created for involving new participants. Partners were hence enabled to collect data in three different ways – using the paper survey, the online survey for wave 1 participants or the online survey for new participants. As can be seen in *table 9*, most partners worked with only using online survey versions.

Only using paper survey	Using paper & online survey for wave 1 participants	Only using online survey for wave 1 respondents	Using online survey for wave 1 + new respondents	Using online survey for new respondents
FJ	AE	BSMJ	CPN	PC
LATRA	EMBL	KI		
Noesis	SG/KCL	MUST		
uTesla	Muzeiko	Raumschiff		
	Tom Tits	SG/TCD		
	TRACES	Technopolis		
		Waag		

Table 9 - Survey versions used by partners in wave 2

Initially, many partners planned to exclusively use paper surveys for wave 2, with its planned duration from February 2020 (M20) to April 2020 (M24). With the COVID-pandemic hitting Israel/Palestine and Europe right when wave 2 had taken off and planned face to face workshops were cancelled, additional translations were included in the online survey to mitigate the situation and enable data collection in times of physical distancing and lock-down.

A call was organised with all partners in April 2020, to talk about best practices for reaching wave 1 participants in these special times. The common decision was taken to extend the phase of data collection until June 2020 (M26) to enable partners to also seize post-lock-down phase for data collection. This was, for example, pertinent in case of LATRA, operating in a refugee camp in Lesvos, Greece. An online survey version would not have been accessible for their respondents, which is why paper surveys have been used in small groups once the organisation was allowed to re-open.

In order to raise response rates, incentives were also to be organized for wave 2, independently of the survey mode used. The kind of incentive could be chosen by the partner organisation in charge. *Table 10* lists the incentives used by the partners.

No Incentive	Material Incentive	Free Entry or Activity
CPN	AE	AE
MUST	EMBL	BSMJ
PC	SG/KCL	EMBL
	KI	FJ
	Raumschiff	KI
	SG/TCD	LATRA
	WAAG	Muzeiko
		NOESIS
		Technopolis
		TomTits
		TRACES
		uTesla

Table 10 - Incentives handed out by partners (multiple references included)

Some partners decided to offer vouchers to visit their institution to the participant (sometimes including plus 1) such as TRACES or Technopolis. Since the museum was still closed, LATRA took the respondents to a picknick on the beach. Other partner organisations handed out material incentives – WAAG for example decided to distribute Do it yourself Virtual Reality glasses with a list of links to find instructions, AE handed out branded light bulbs, TCD SG organised a prize-draw to win 15 times €5.

Due to the Covid-19 pandemic and the use of the online survey instead of face to face workshops, CPN, MUST and PC have – contrary to common guidelines - not used any incentives.

In total, 18 partner organisations reached 736 wave 1 participants a second time for wave 2. Additionally, 146 new participants were engaged by PC, AE, CPN and TomTits. *Figure 4* indicates the number of collected answers in wave 2 as well as the number of collected answers in wave 1.

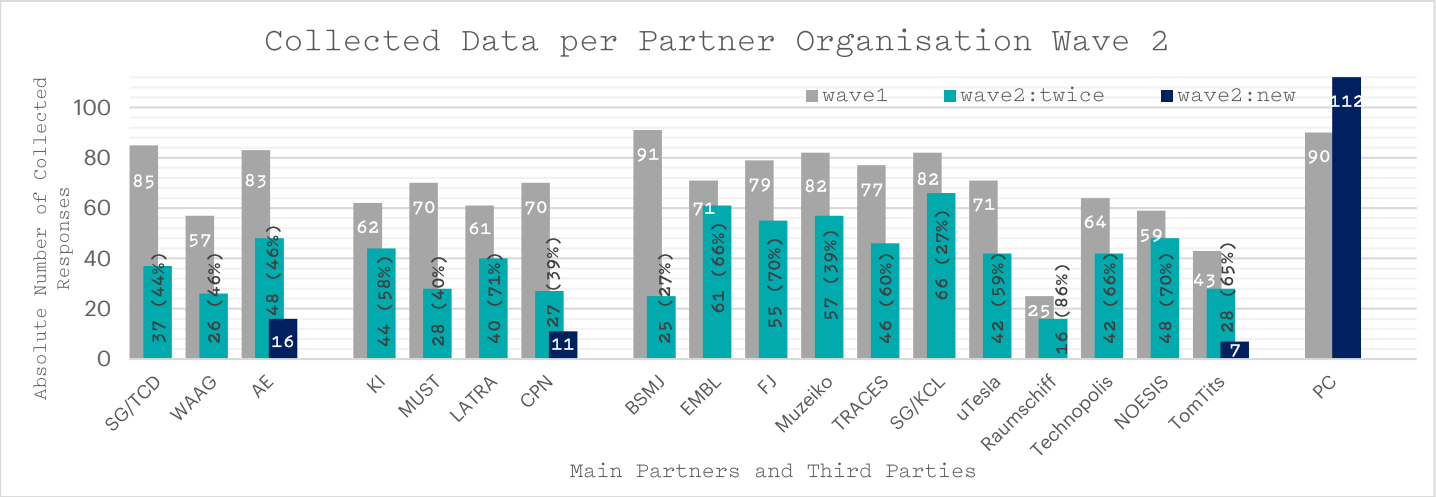


Figure 4 - Collected data per partner organisation wave 2

Altogether, partner organisations were able to reach **56% of wave 1 participants a second time** for wave 2. This share, however, notably varies with the data collection method employed – those nine organisations, who were able to use face to face settings for data collection achieved an average response rate of 69%, the ten organisations fully working online, on average hardly reached every second participant again (49%). The use of incentives was equally linked to higher response rates (62% on average with incentives vs. 39% without). The collaboration with schools in wave 2 did not impact the average response rates this time (53% with school collaborations, 59% without).

At a partner level, EMBL, NOESIS and SG/KCL reached the highest shares of 80% and more participants a second time. Notably, these three partners were able to collect data in face to face settings and all of them used incentives for re-engaging participants. In total, eight practice partner organisations and third parties could reach at least a two thirds of their wave 1 participants in wave 2, all of them were using incentives, three of them were able to achieve these response rates using online surveys as sole tool for data collection. 17 of 19 partner organisations were able to motivate at least a third of their wave 1 learners to participate in the wave 2 survey. Despite significant efforts to continue data collection during the lock-down, BSMJ was only able to reach 27% of their wave 1 participants a second time. As already introduced earlier, PC was not able to re-engage wave 1 participants for survey wave 2 and only reached out to new participants.

The exceptional circumstances of Covid-19 with children and teenagers learning from home and parents or guardians facing economic insecurities and overburdening based on childcare and labour set the scene for many of the learners who answered the survey online. Perhaps, these circumstances were even more pressing for those wave-1-participants not reached a second time.

The requirement to do the survey online due to Covid-19 did not fit everyone's situation equally well. From an equity perspective, the online survey was not accessible for every respondent, e.g. those respondents not having access to individual smart phones or computers living in remote areas (e.g. reported by CPN and BSMJ). In the context of young children, partners were particularly dependent from parental support to collect data on wave 2, which in turn bore aspects of inclusiveness as overburdened parents might not have the additional resources to do so (e.g. reported by Raumschiff). Despite Covid-19, ten partners were collaborating with

teachers and schools to re-engage participants in the longitudinal survey (similarly to wave 1, where 13 organisations collaborated with schools).

In contempt of the difficulties caused by Covid-19, the roll-out of wave 2 worked well at a general level. In face to face settings, partners reported that learners took less time to answer the survey (e.g. reported by EMBL) and young learners found it easier to answer the paper survey as they were already familiar (e.g. reported by AE). Many partners also found that the online survey option eased the process of reaching participants.

The responses collected in wave 2 were again coded by the partner organisations, either using a pre-coded excel-sheet and a codebook guiding through the code attribution or by using a specifically created LimeSurvey version, where partners could replicate the answers given on paper online.

Based on participant IDs, datasets of participants reached in wave 1 and wave 2 were merged. Merged datasets were checked for consistency. Ten datasets collected in wave 2 needed to be excluded, since their linked dataset from wave 1 significantly deviated in terms of age, gender identity as well as country of birth and languages spoken and could not be uniquely linked to another wave 1 participant ID of the same partner organisation.

Inconsistent answers of relatively stable socio-demographics of the same respondents between wave 1 and wave 2 were scrutinised at an individual level and adjusted where the given information allowed for clear decisions. The participants' age, gender-identity, country of birth, highest level of education and job experiences were thus adapted for a small number of inconsistent answers. In case items for age, gender, highest level of education and migration experiences were answered in one wave but left blank in the other, data was imported from the given answer, whereas age was adjusted for plus/minus one year when imported.

The reason for data inconsistencies might be manifold. At the level of the data collection instrument, changes in question formats – on the basis of the newly created online version for wave 2, impact the way questions are answered. Inconsistencies with regard to the country of birth – a timely stable variable that does not change over time, unless rare geo-political changes occur – can be related to the different question format used (open-end in paper, list with other option at the very end online). For instance, one participant indicated being born in Northern Ireland in wave 1 and simply picked Ireland, which was part of the pre-defined list in the online survey, in wave 2.

Further, respondents might not remember the answer given, and e.g. consider their current level of education as already completed in wave 1, whereas re-reading the question in wave 2 made them realise that only completed levels are eligible and hence answer differently, resulting in decreasing levels of education, which are technically not possible.

Since partners were curating the data fully in wave 1, also coding errors are possible – this was particularly the case with gender-identities. While gender identities might change over time, several switched gender identities within the time frame of one year only related to coding errors happening in wave 1.

Lastly, coding errors might also occur at the level of indicator construction and analysis.

5. Survey Analysis and Results

The research design of WP3 aimed at a repeated measures design and respondents surveyed twice within the period of one year. Due to dropouts and the engagement of new participants in wave 2 the data collected resulted in **three different groups of respondents ($n_{overall}$=1468):**

(1) The **longitudinal group** of respondents reached in wave 1 and wave 2 – henceforth abbreviated with *long* (n=736). Respondents of all partners, but Parque de las Ciencias are part of this sample.

(2) The group of respondents only reached in **wave 1**, who **dropped-out** afterwards and were not reached again – henceforth abbreviated with *w1* (n=586). No partner was able to re-engage every respondent a second time, the sample hence covers all practice partner institutions.

(3) The group of respondents **newly included** in **wave 2** – henceforth abbreviated with *w2* (n=146). As described in section 4.2, few partners engaged new participants for wave 2 only. Notably, this was the case for Parque de las Ciencias (PC), being unable to re-identify respondents of wave 1, exclusively engaged new participants in wave 2. PC contributed more than three quarters (77%, n=146) of new wave 2 respondents to this sample. In addition, Ars Electronica (AE), the Centre for the Promotion of Science (CPN) and Tom Tits engaged new respondents for survey wave 2.

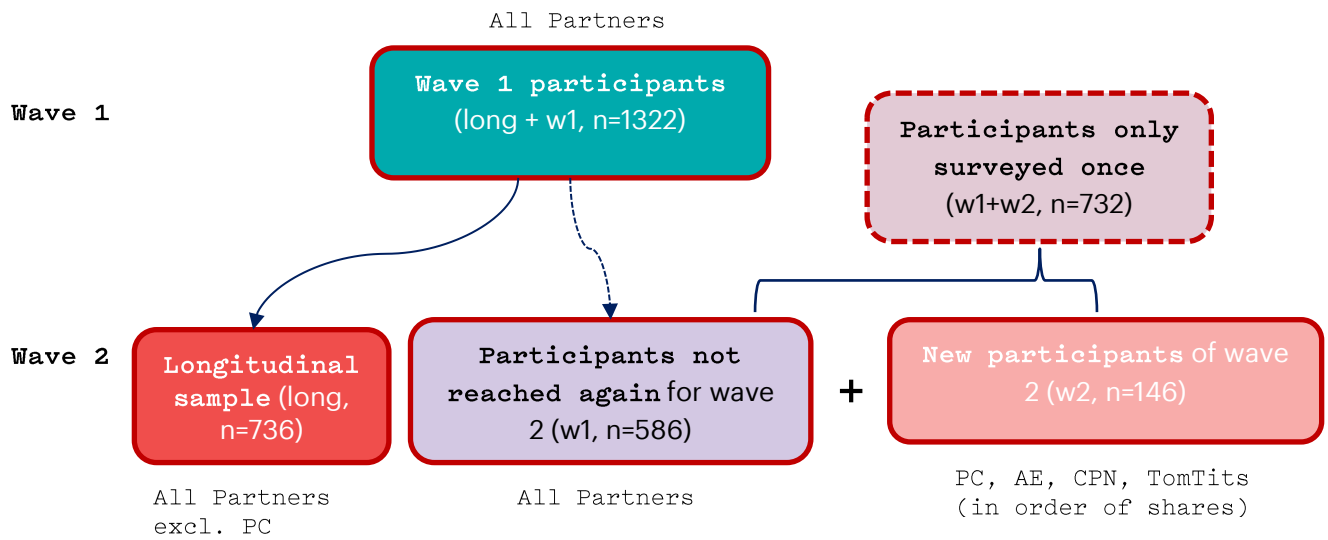


Figure 5- Description of samples across wave 1 and wave 2

The longitudinal group has been the clear focus of the SySTEM 2020 survey design and data collection efforts. Nevertheless, also the answers of those learners, who were only reached once in the period of one year, be it wave 1 or wave 2, is investigated in more detail, enabling a reflection on discrepancies between these three data sets, shedding light on potential biases with some groups being overrepresented in one data set, but not the other.

At the level of descriptive analysis, respondents of one survey wave only (wave 1 or wave 2) will be demarcated accordingly. Since both samples share the property of having been engaged only once in the SySTEM 2020 survey, they are further pooled in a common data set called '**pooled sample'** and abbreviated as **'w1+w2'** (see *figure 5*). This pooled sample encompasses 732 learners and is hence nearly equally as large as the longitudinal sample (n_{long}=736). This pooled group will mainly be used in the analysis section, but also helps the visual representation of w1 and w2 data. Based on the overrepresentation in wave 2, PC is still overrepresented in the pooled w1+w2 sample, making up for more than a quarter (28%, n=732) of the respondents.

Who are the learners engaged in the SySTEM 2020 project and how do their STEAM learning ecologies look like? The following section introduces the surveyed population(s) from a socio-demographic perspective. Once, the profile of the respondents is more familiarized the methodology for further analyses is presented. The last part of this chapter elaborates on the learning ecologies of the surveyed learners; the way activities related to science learning are pursued, the learners' connection with science as well as the social context their formal and informal science learning takes place in.

5.1 Surveyed Population

As elaborated in this section, learners only surveyed once (be it in wave 1 or wave 2) differ to some extend from the longitudinally surveyed learners (answered wave 1 and wave 2).

Longitudinal participants of the 1st wave who could be motivated to participate also in the 2nd wave:

* tend to be older (after wave 2), and therefore also tend to have a higher level of education
* tend to have more working experience than newly included wave 2 respondents
* tend to live in families possessing a higher educational capital than the ones, who only participated in wave 1
* tend to report less frequently having migration experiences than those only participating in wave 1 but more frequently than newly included wave 2 respondents
* tend to speak more often multiple languages at home
* tend to indicate comparatively less frequently facing serious difficulties with regard to hearing, speaking or moving than wave 1 only respondents
* tend to live in cities more often

Differing in size, programmes and target-group, the practice partners reach different **age groups**. As a consequence, age groups are not balanced at a partner level. No partner reaches all age groups at an equal level. More than a third of the longitudinal respondents of WAAG, KI, TRACES, SG/KCL and Raumschiff belong to the youngest age group of 9 to 11-year olds. The oldest age group of 18 to 21-year olds is highest represented in the samples provided by MUST, FJ and uTESLA. The variance of age groups reached is also visible at an aggregated

level: As can be seen in *figure 6*, most of our longitudinal respondents are between 12 and 17 years old (mean age of 14.66, sd=2.91)

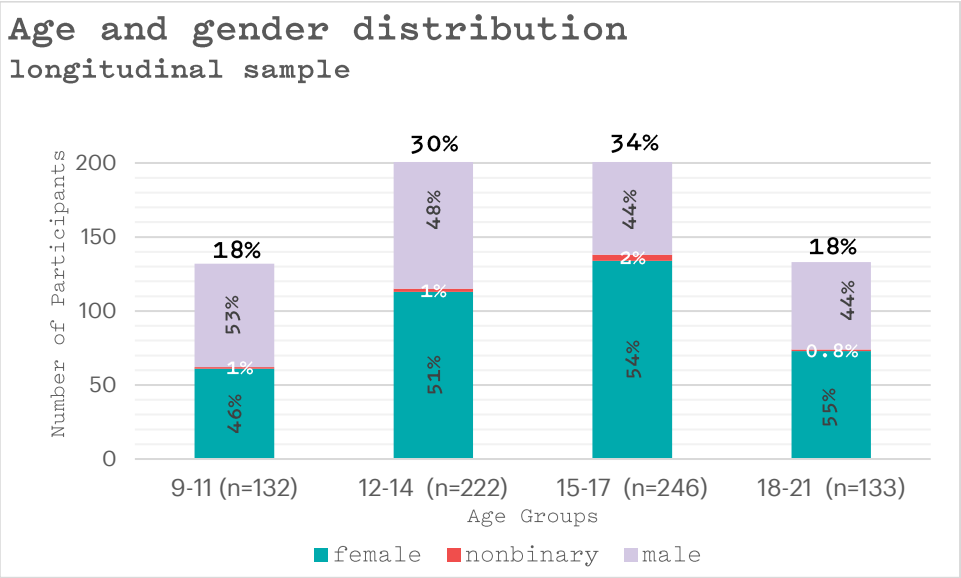


Figure 6 - Distribution by age and gender, longitudinal sample, n=733

This distribution shifted notably from wave 1 (w1+long) where the youngest group made up for 28% (367 of 1313) of the surveyed population. Along these lines, the participants, who only were part in wave 1, but dropped out in wave 2 are younger (mean age=13.64, sd=2.84) than the longitudinal group, but also the newly included participants in wave 2 are younger (mean age=13.53, sd=2.92) than the group surveyed twice. The sample of participants only surveyed once is hence younger than the longitudinal sample after wave 2[6].

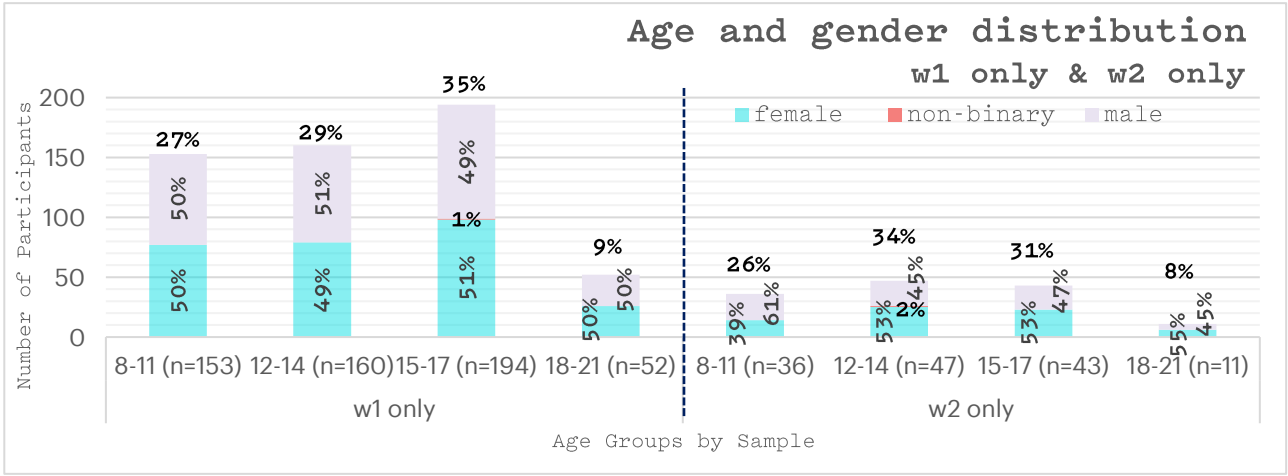


Figure 7 - Distribution by age and gender, wave 1 (n=559, on the left-hand side) and wave 2 (n=137, on the right hand side)

[6] Looking at wave 1 data of the longitudinal participants, with a mean age of 13.66 (sd=2.89), the age-profile is similar to those participants equally participating in wave 1 but dropping out afterwards.

In the longitudinal sample **gender** is about evenly distributed at an aggregate level, with 52% (n_{long}=733) of the respondents identifying themselves as female, 1% (8 out of 733) as non-binary and 47% as male. Female and male identified respondents are equally distributed among all age-groups, based on the scarce presence of non-binary respondents, they are henceforth excluded from gender-based analyses. Comparing the longitudinal sample with wave 1 only and wave 2 only respondents, **all samples are about gender balanced**, with most non-binary respondents being part of the longitudinal sample.

Only a small fraction of all learners included in the SySTEM 2020 survey indicated **facing serious difficulties with regard to hearing, speaking or moving**. Whereas 9% (n_{w1}=574) of those respondents only participating in wave 1 expressed facing these difficulties, this was the case for a smaller share of 4% (n_{long}=643) of the learners surveyed longitudinally and 3% (n_{w2}=143) of learners newly involved in wave 2. From the way this question was posed, no inference about specific physical disabilities is made. The respondents' self-categorisation, however, provides the basis for further analysis, whether this perceived impairment is a differing factor for learning ecologies in line with the literature cited above.

In total about a third (35%, n_{long}=734) of our longitudinally surveyed respondents have **migration experiences**. Without the survey respondents from LATRA, who do live in a refugee camp and therefore make up for 15% of young learners with migration experiences in the whole sample, still 32% of our surveyed learners have made migration experiences or live in homes with histories of migration. From a gender perspective, female-identified learners and male-identified learners with migration experiences or family histories of migration are about equally represented (50% vs. 48%), whereas 2% of the learners with migration background identify as non-binary. Comparing the longitudinal sample with learners, who dropped out after wave 1, 40% (n_{w1}=574) have made migration experiences. In contrast, more than three quarters of the newly involved learners in wave 2 have not reported any histories of migration (77%, n_{w2}=143).

Additionally, we have asked respondents about the languages they use themselves as well as their parents when talking to each other at home. More than a third of the learners surveyed twice (38%, n_{long}=736) is multilingual and speaks more than one language in everyday life. Most of these learners (82%) live in homes, where also the adults speak multiple languages (representing 32% of the total longitudinal sample, n_{long}=717). Not all children living in multilingual homes share migration experiences or histories, as speaking several languages is also related to countries knowing more than one official language or acknowledged minority languages. Comparing the longitudinal sample with wave 1 and wave 2 indicates the largest share of learners living in multilingual homes are part of the longitudinal survey and less represented in the other groups, with the lowest share of 13% (n_{w2}=143) being part of the newly involved participants in wave 2.

Which is the **highest level of formally obtained education** of our surveyed respondents? After wave 2, three quarters (75%, n_{long}= 733) of our longitudinal sample has at least completed primary school, 28% have just finished lower secondary education, one eighth of our respondents (13%) have already finished upper secondary education levels such as high schools. A fraction of 1% indicated to already have a tertiary degree. In relation to the younger age profile, the highest level of education completed by one third and hence the largest fraction (34%, n_{w1}=558) of learners only included in wave 1 is pre-school education. While – on average – also being younger than the longitudinal sample, nearly every second learner newly included in wave 2 (48%, n_{w2}=137) has already finished primary school. Once, the group of learners only surveyed once – independently from the wave – is pooled together, a similar distribution of highest education levels obtained by gender and is reached.

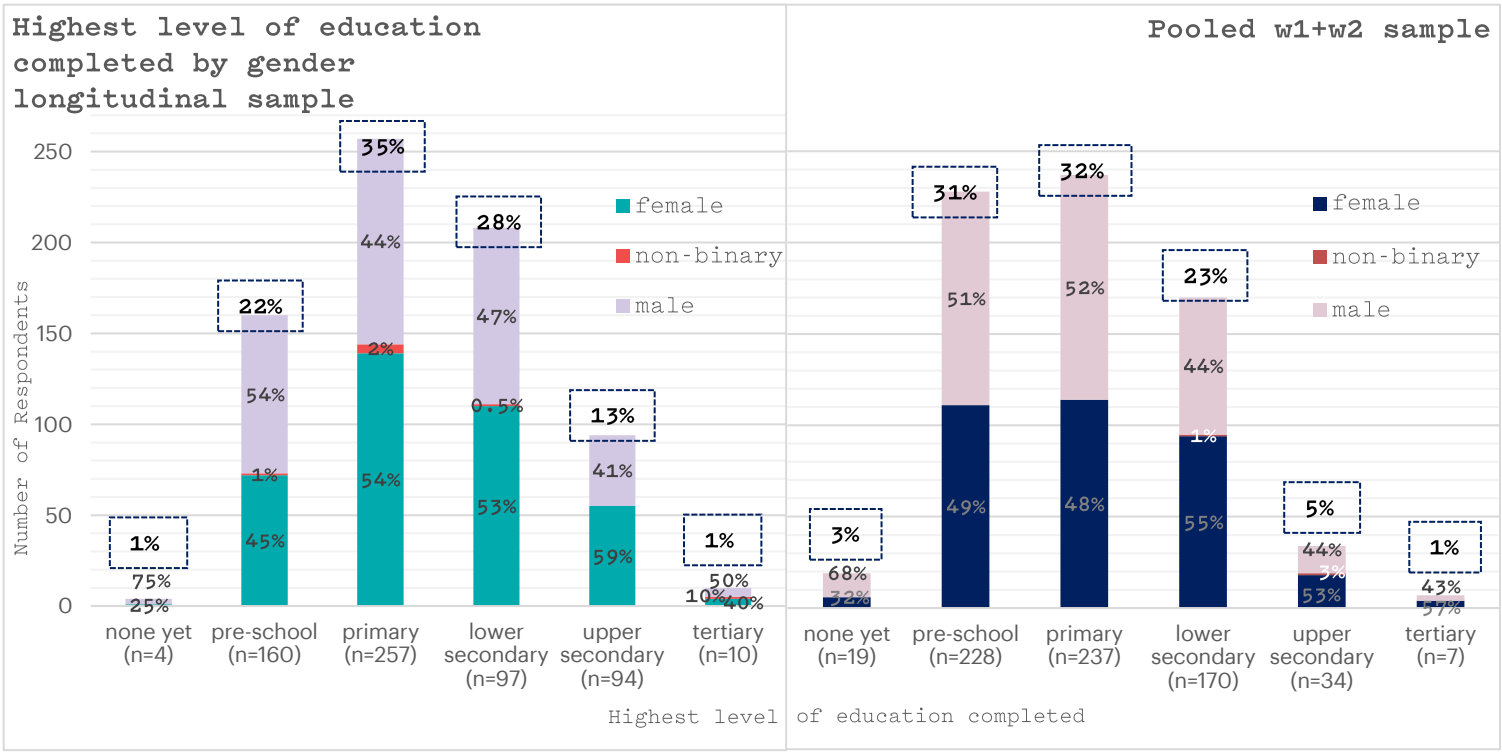


Figure 8 - Highest Level of Education by Gender, longitudinal sample (n_{long}=733), pooled w1+w2 sample (n_{w1+w2}=695)

As can be seen in *figure 8*, from a gender perspective all levels are roughly balanced, with the largest discrepancies amongst those learners that have not completed any level of education yet.

The vast majority (92%, n_{long}=736; 92%, n_{w1}=586; 89%, n_{w2}=146) of our surveyed learners is represented by **pupils and students,** a fraction of 4% of the longitudinal sample and 3% of learners only surveyed in wave 2 indicated going to university or relate-able institutions of tertiary education.

Whilst also being partly enrolled in schools, 6% of those learners only being part of wave 1, and 3% of the longitudinal respondents and newly included wave 2 respondents do an apprenticeship or are enrolled in vocational training. In total, 7% of longitudinally surveyed learners (6%$_{w1}$, 3%$_{w2}$) indicated working part- or fulltime. A **small fraction** of 3%$_{w1}$ to 4%$_{long\ \&\ w2}$ indicated not having a job, not being enrolled in any education (**NEETs**). In contrast to the NEETS only surveyed once, 18% of the longitudinal NEETS are, however, engaging in voluntary work, which is the case for a share 5% of all longitudinally surveyed learners.

At an aggregate level, 48% (n_{long}=713) of the longitudinally surveyed learners have already made their **first job experiences** (multiple experiences possible), be it a summer job (43%), an internship (27%), or a part time job (10%). 5% have already had a full-time job, whereas 3% have worked as contractors or consultants. Between wave 1 and wave 2 11% of our surveyed learners (75 of 712) have newly acquired first job experiences they have not had before. While learners, who only participated in wave 1 indicate similar levels of job-experiences (42%, n_{w1}=566), only 19% (n_{w2}=143) of respondents newly engaged in wave 2 suggest having worked already.

Where do our respondents live? The majority of our longitudinally surveyed learners, as well as most of those learners only part of wave 1 live in cities (55%, n_{long}= 708; 46% n_{w1}=575). Only a small share of longitudinal (11%) and wave 1 respondents (17%) live on the countryside. For our group of learners surveyed twice, wave 2 results enable an identification of newly moved participants. *Figure 9* plots the place of living indicated in wave 1 against responses from wave 2. Most of our longitudinal respondents (82%, n_{long}=708) have not moved across these levels. This is particularly visible with regard to learners living in cities in wave 1 and wave 2 (87%). More than a third of those, who have moved (36%, n= 125), lived in cities in wave 1 and live in the outskirts in wave 2 (representing a share of 11% of all learners living in outskirts in wave 2). In contrast, 27% (n= 125) took the other way and moved from the outskirts to the city. About every 7th learner who moved (15%, n= 125) left the city outskirts for the countryside.

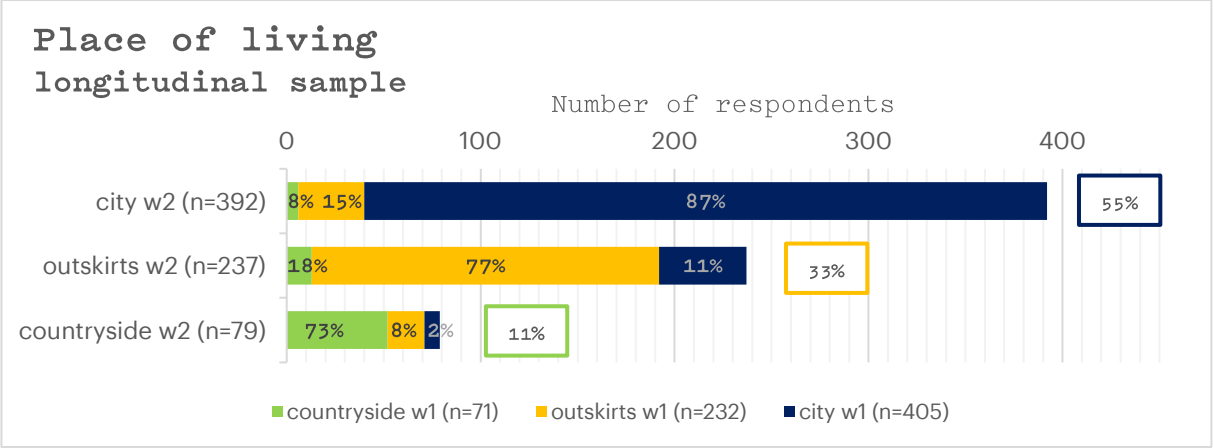


Figure 9 - Place of living, longitudinal sample (n=708)

At a partner level, the shares vary respectively as can be seen in *figure 10*. The largest share of longitudinal learners from the countryside (more than 40% of the respondents) has been reached by AE, followed by Technopolis, who reached more than a quarter of respondents living in the countryside (28% of their respondents). SG/TCD, WAAG, AE, Utesla, Raumschiff and Technopolis further reached more respondents from the city outskirts and city surroundings than learners directly living in the cities.

As visualised in *figure 10*, moving did not happen across all partner organisations equally, with Tom Tits (41%), WAAG (33%), Technopolis (33%), BSMJ (30%) an EMBL (25%) representing the highest shares of newly moved leaners. In contrast the longitudinal sample of Utesla and NOESIS does not include a single learner that moved between wave 1 and wave 2 (across the levels outlined).

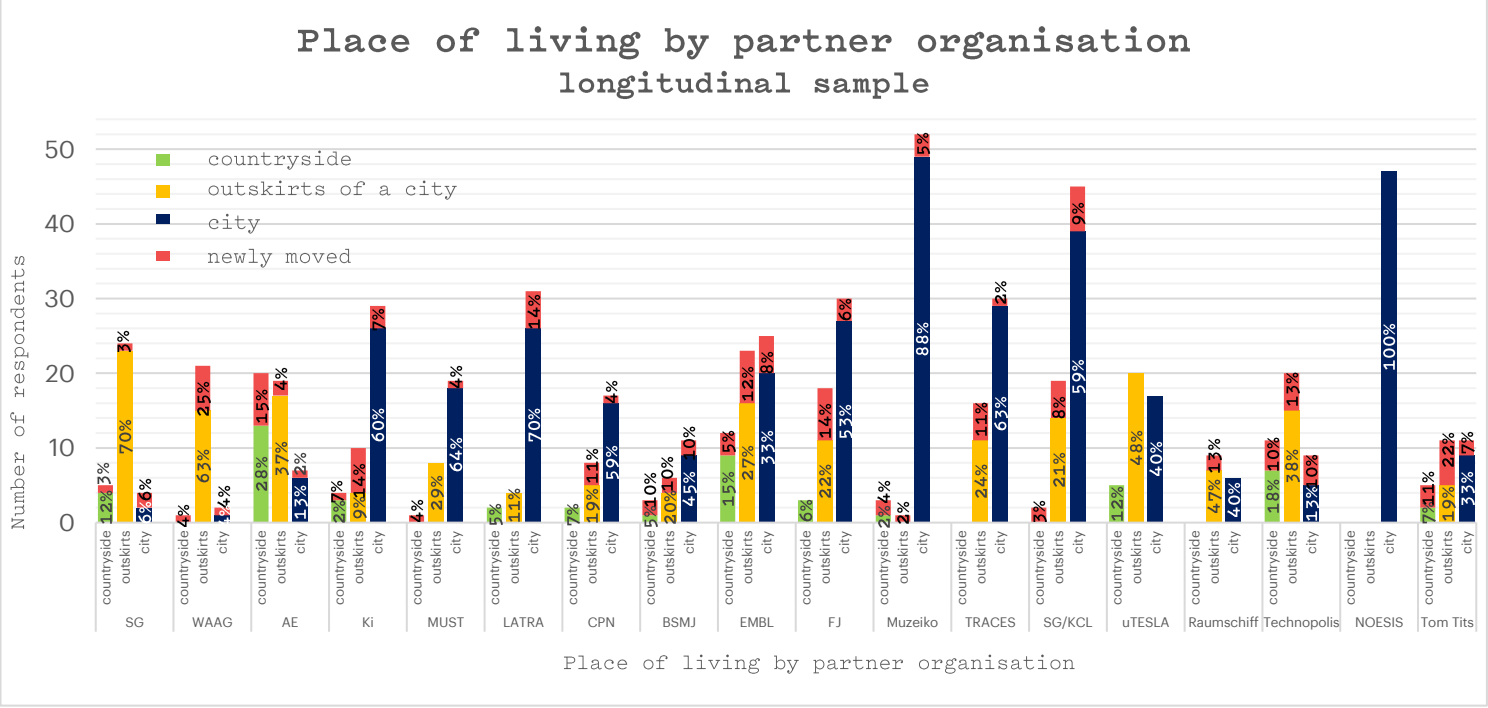


Figure 10 - Place of living by partner organisation, longitudinal sample, n=708, no change (n=583), newly moved (n=125)

Comparing the longitudinal sample with those participants, who only participated in wave 1, several participants living in the countryside could not be reached a second time (representing 17% 98 of 575 dropping out), albeit the overall representation only slightly lowered between all wave 1 participants (w1+long) and the longitudinal sample (11% of 720). More than a third of the learners newly involved in wave 2 of the survey indicated living in the countryside (36%, n_{w2}= 143), an equal share lives in the cities and the remaining 28% live close to a city.

What do the **homes of our learners** look like? About three quarters (73%, n_{long}=727; 75%, n_{w1}=578) of our surveyed learners indicated to live in two-parent households[7], while this is the case for 80% of the learners newly engaged in wave 2 (n_{w2}=145). More than two thirds of all surveyed learners (70%, n_{long}=736; 72% n_{w1}=586; 70%, n_{w2}=146) further live together with their siblings. 18% of the longitudinal sample and learners, who dropped out after wave 1, and 13% of newly included wave 2 respondents live together with one parent, which is in more than 80% of the cases the learner's mother.

2%$_{w2}$ to 3% $_{long+w1}$ live in patchwork families with their single parent's new partner. 7% of the longitudinally surveyed learners – and about equally as many learners part of w1 (8%) or w2 (6%) only – live in extended families, with at least one of their parents and at least one grandparent.

5% of all longitudinal respondents and 3% of respondents only surveyed once in wave 1 or wave 2 live together with their guardians or foster parents. While all three samples largely resemble each other, *figure 11* summarises the living environments of the longitudinally

[7]Two-parent households have been calculated on the basis of indications that a respondent lives together with their mother and father. In case, respondents indicated living with two mothers or two fathers, they were equally coded as living in a two-parent household.

surveyed group. 4% thereof live in differing living arrangements, whereas the majority of those not living with parents or guardians (73%) live on their own, only a small share (15%) lives with their grandparent(s), 8% with other relatives and 4% with siblings.

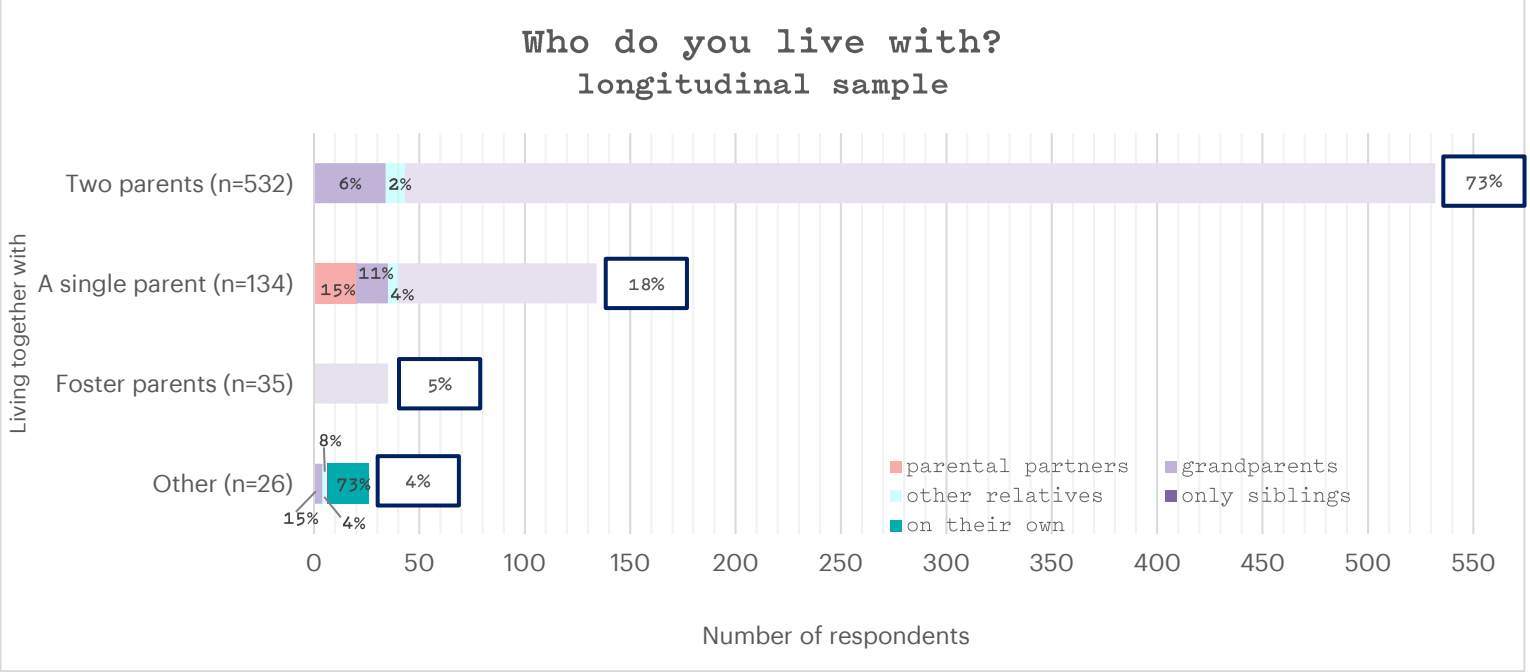


Figure 11 - Living environment, longitudinal sample (n=727)

Looking at the dynamics between wave 1 and wave 2, for more than two thirds (69%, 505 of 727) home constellations have not changed. Nearly every 5th learner (18%, 40 of 222, see *figure 12*) with changed living environments, newly lives together with siblings. In contrast, nearly a quarter (23%) of respondents no longer live together with sisters or brothers. Every 10th learner experienced one parent moving out (10%), while a share of 9% newly live together with two parents. Also, 8% moved out of parental homes. About equally as many learners no longer live in extended families (9%). Also, several new pets or learners' partners moved in (13%, labelled as 'Other' in *figure 12*). Since these changes might overlap, i.e. one learner experiencing several of these changes, the shares do not add up to 100%.

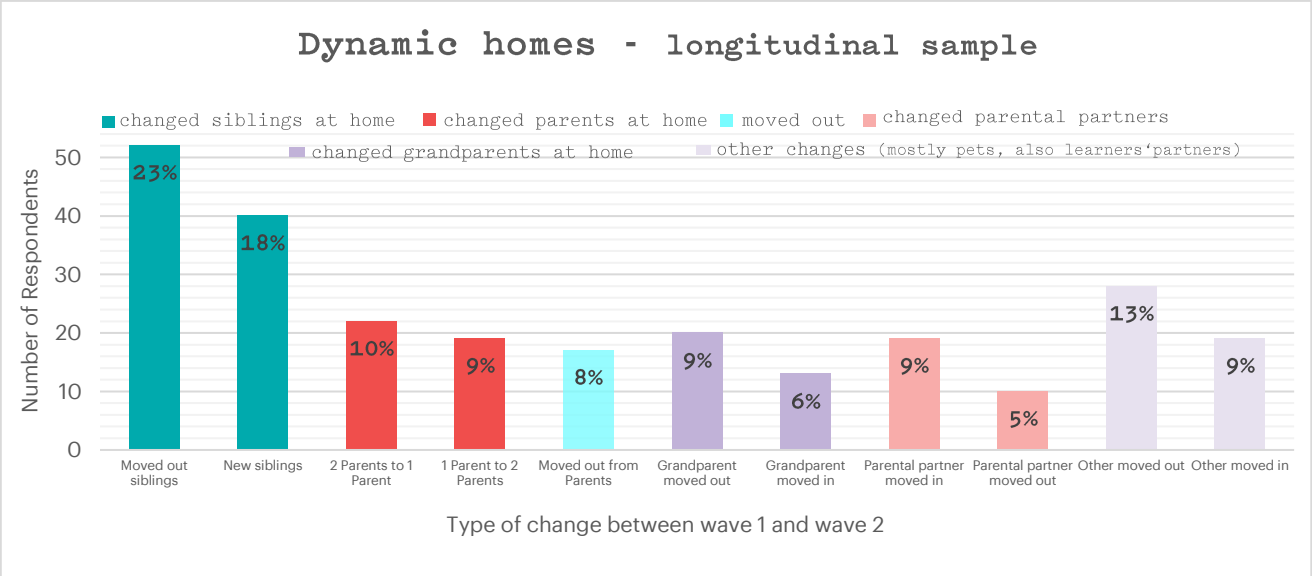


Figure 12 - Dynamic homes, longitudinal sample participants who experienced changes, multiple options possible (n=222)

The family shapes the learners' habitus and the **educational capital** they possess. With regard to the educational background, across all samples (longitudinal sample as well as wave 1 and wave 2 samples) low education backgrounds remain the least represented (shares between 12-17%), whereas respondents from medium educational strata and highly educated families make up for at least 38% to 52% of the samples.

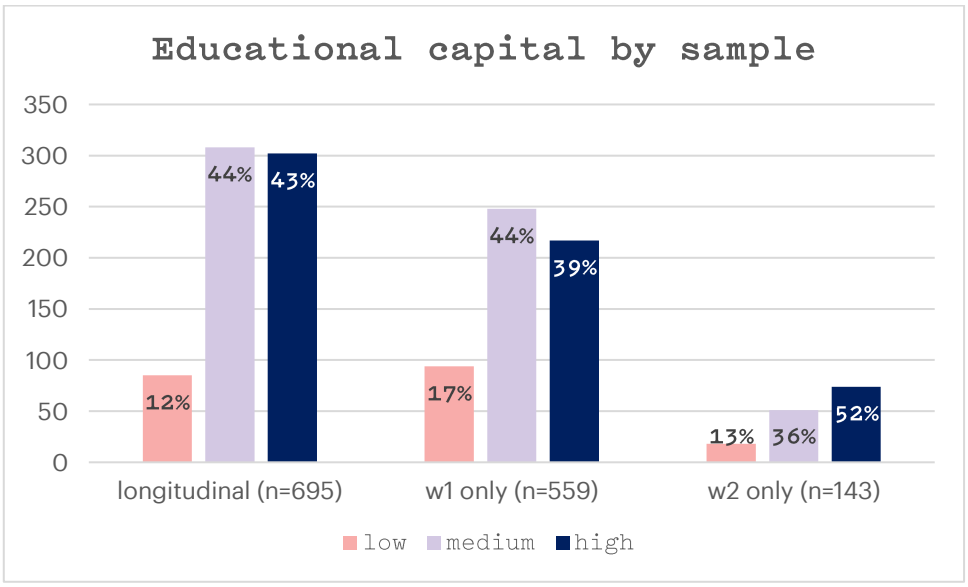


Figure 13 - Educational capital by group

In wave 1 (w1+long) learners from low educational households represented 14% (179 of 1254). This share has slightly fallen to 12% (n_{long}= 695) in the longitudinal sample. Consequently, learners with low educational capital represent a slightly higher share (17%, n_{w1}=559) of dropped out respondents between wave 1 and wave 2 (w1). Medium capital learners are equally represented (44%) in the longitudinal sample as well as in the dropouts after wave 1. High capital learners are slightly better represented in the longitudinal group 43% (n_{long}=695) than

in wave 1 (w1 and long, 41%, n= 1254). In contrast, every second participant newly involved in wave 2 stems from high education backgrounds (52%, n_{w2}=143), and 39% (n_{w1}= 559) with high education background dropped out after wave 1.

The way these strata divide on partner level, are, however, quite different, as can be seen using longitudinal data in *figure 14*. BSMJ and NOESIS are the sole partner institutions whose respondents from low educational strata represent 40% or more. In contrast, high education capital learners are oversampled by eight organisations, representing 50% and more of the longitudinally surveyed group (SG/TCD, KI, MUST, CPN, EMBL, MUZEIKO, SG/KCL and Raumschiff).

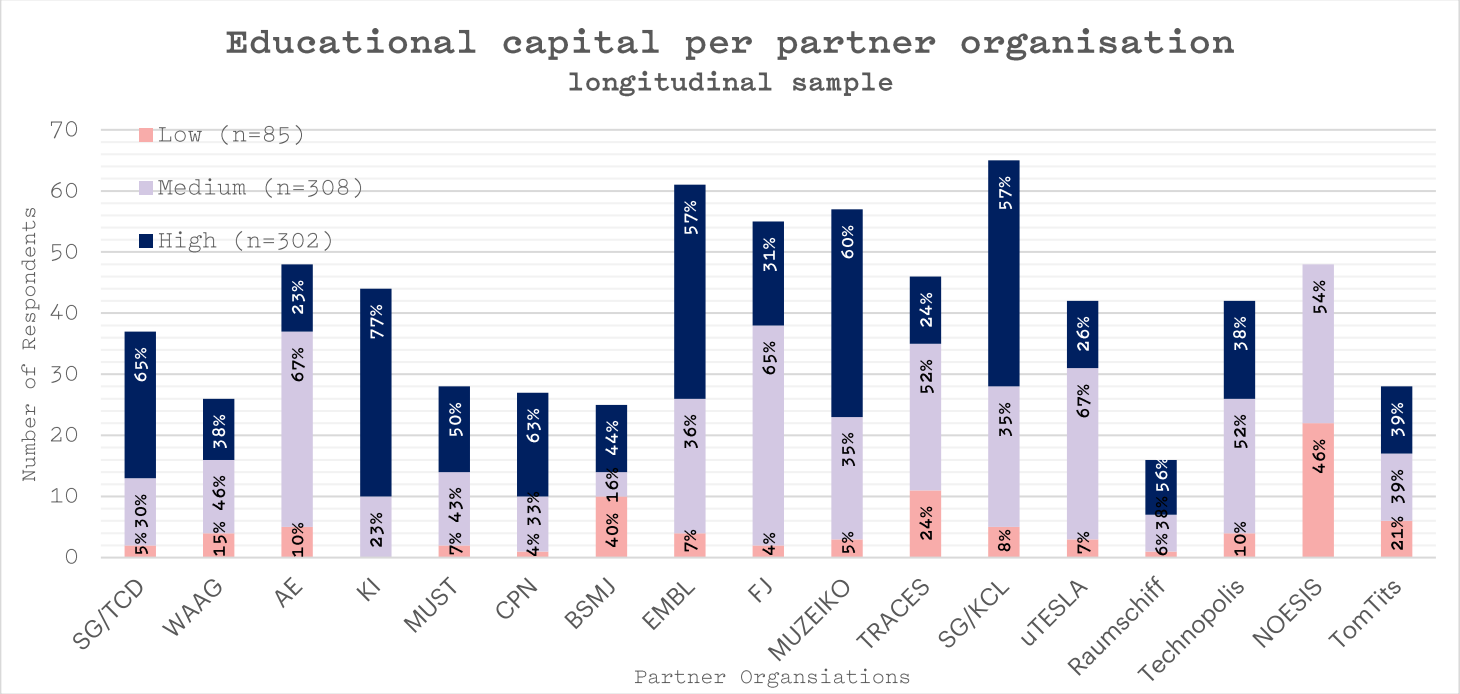


Figure 14 - Educational capital per partner organisation (longitudinal sample, n=695)

The SySTEM 2020 survey further investigated the material living realities of the learners, and more specifically tapped the availability of specific goods required to enable (accessibility to) broadly science-related activities.

Looking at the material living realities, the minority of all surveyed respondents do not have at least on television at home (5%, n_{long}=715; 4%, n_{w1}=553; 1%, n_{w2}=142). Shares of the longitudinal have not notably shifted between wave 1 and wave 2, with about 9% indicating that they have fewer TVs, but equally as many (9%,) reported having more TVs in wave 2.

Also, most learners' families (91%, n_{long}= 656; 86%, n_{w1}=567; 99%, n_{w2}=143) do have at least one car, van or truck at their home. Again, the shares of the longitudinal sample only changed marginally, with 9% (56 of 656) indicating having fewer and 8% (57 of 656) indicating having more cars at their homes in wave 2.

In wave 2, one newly included learner (1%, n_{w2}=143) and two longitudinal learners indicated having no smart phone at home (0%, n_{long}=714). In contrast, 3% of respondents dropping out of the survey after wave 1 (n_{w1}=544) indicated not having a smartphone at home that is still in use.

The vast majority of respondents (97%$_{long}$; 92%$_{w1}$; 98%$_{w2}$) reported having more than 2 smartphones at home, more than a third of the longitudinal sample and the w1-only-sample (36%$_{long}$; 35%$_{w1}$) indicated having more than 5 smartphones at home that are still in use.[8] In contrast to wave 1, 14% of the longitudinal sample indicated having more smartphones in wave 1; for more than three quarters (77%, 72 of 93) of them, this implied having one smartphone in wave 1 and at least five or more in wave 2. 12% thereof (80 of 695) reported having fewer smartphones at home. On a statistical level, these changes are not significant.

Similarly, the vast majority of our respondents (96%, n_{long}=707; 95%, n_{w1}=549; 97%, n_{w2}=142) indicated having at least one computer or tablet at home, more than every second respondent (59%$_{long}$; 60%$_{w1}$; 66%$_{w2}$) has between 2 and 4 computers or relatable tools at home, nearly a quarter of the longitudinal sample, and 18%$_{w2}$ to 19%$_{w1}$ have more than 5 computers at home. 17% of the longitudinally surveyed respondents (n_{long}= 698) indicated having more computers or similar items at home in wave 2, about equally as many, namely 16%, indicated having fewer items at home. On a statistical level, these changes are not significant.

Lastly, our surveyed learners were also asked about music instruments they have at home. More than a quarter (29%, n_{long}=695) of the longitudinal learners and a third of learners dropping out after wave 1 (34%, n_{w1}=571) reported not having an instrument at home, while this was only the case for 24% of learners newly included in w2 (n_{w2}=143). About 1 of 6 longitudinal learners (18%, n_{long}=695) reported having more instruments at home in wave 2, in contrast 14% (n_{long}=695) indicated a decrease of music instruments in their home.

5.2 Methods used for explorative analysis

The SySTEM 2020 project managed to engage a heterogeneous group of young learners across different countries and social strata. Descriptive analyses will be used to shed light on the learning ecologies of the included samples. As discussed in the analytical framework (section 2.3) learners' educational capital is highly influential when it comes to their learning ecologies. These influences intersect with gender stereotypes, who exacerbate differently by class and – in our case – educational strata. In addition, learning ecologies are age specific, an 8-year-old naturally learns quite differently from a 21-year-old. The explorative analyses examine the learning ecologies based on these potential group-based differences described in literature.

The analysis puts an emphasis on the findings of the longitudinal sample ('long', n=736). Nevertheless, answers from those respondents only reached once – be it in wave 1 or in wave 2 – will equally be described and contrasted. As we have seen in section 5.1 wave 1 dropouts differ from the group of newly included learners in wave 2. In order to reach a heterogeneous data set and sup-group sizes that allow for meaningful comparisons (group-size n>30 needed, described in section 5.2.1), answers of wave 1-drop outs and respondents newly engaged in wave 2 were pooled to a common dataset henceforth called 'w1+w2' (n=732). While the

[8] Being clearly dependent from the number of persons living in one household, respondents from LATRA living in the refugee camp and sharing homes with several cohabitants (between 5 and 35 have been reported in wave 1, resulting in the median of 15 in contrast to the median 4 of all other organisations' respondents). When excluding LATRA respondents from the longitudinal sample, still a share of 34% (230 of 679) report having more than 5 smartphones.

longitudinal sample will be used to identify significant intra-individual changes over time, the pooled w1+w2 sample will be analysed from a cross-sectional perspective.

Learners participating twice in the survey are, as outlined in subchapter 5.1, likely to differ from the sample of learners only surveyed once as they tend to express a particularly high interest in science (see section 5.3.2). The process of positive self-selection caused by the longitudinal design hence impacts the representativeness of the groups, which is why the **pooled sample of wave 1 or wave 2 only respondents** is likely to be **more representative of the learners reached** by the practice partner organisations in general. The following sections explain the selected groups of comparison for both samples as well as the used methodological tool kit to test for hypothetical group-based differences within the samples.

In order to avoid an inflated α-error and to keep group-sizes sufficiently high, **two composite indicators were created** combining (1) information on age and gender-identity of the learners and (2) information on educational capital and gender-identity of the learners.

According to the literature review, gender differences pronounce with age, with gender roles and stereotypes influencing the life of a teenager more strongly than the life of a child (e.g. Brickhouse 2001; Archer et al. 2013; Archer, DeWitt, and Willis 2014) The first composite indicator linking age with gender was hence created by splitting age in two groups – below age 12 and above age 12, coinciding with most of the learners above age 12 having finished primary education. These two groups were once again split by gender, resulting in 4 groups of comparison for both the longitudinal sample and the pooled w1+w2 sample: girls below age 12, boys below age 12, young female-identified learners above age 12, and young male learners above age 12.

age	gender	short name	group size **long**	share **long**	group size **w1+w2**	share **w1+w2**
below age 12	female	f<12	61	8.4%	91	13.1%
below age 12	male	m<12	70	9.7%	98	14.1%
above age 12	female	f>12	320	44.1%	257	37.0%
above age 12	male	m>12	274	37.8%	248	35.7%
		total sample size	725		694	

Table 11 - Composite age-gender index (longitudinal sample & w1+w2)

Since the SySTEM 2020 project addresses 9 to 20-year-olds, the majority (82%) of our surveyed learners in wave 2 are above age 12. The largest of the four compared groups are female-identified learners above age 12. Nevertheless, the group below and above 12-year-olds are roughly gender balanced.

The second indicator strives to include cultural capital and gender. This composite indicator was set up, splitting low, medium and high educational capital groups by gender and hence resulting in six categories for both samples: female and male identified learners stemming from low educational strata – representing the smallest groups, female and male identified learners socialised within medium educational strata and female and male identified learners with high educational capital. Notably, learners from LATRA are excluded from this composite

indicator since the way educational capital was operationalised did not fit their living realities as refugees.

educational capital	gender	short name	group size **long**	share **long**	group size **w1+w2**	share **w1+w2**
low	female	f-low	46	6.7%	59	8.9%
low	male	m-low	38	5.6%	49	7.4%
medium	female	f-med	157	23.0%	157	23.6%
medium	male	m-med	145	21.2%	128	19.2%
high	female	f-high	162	23.7%	127	19.1%
high	male	m-high	136	19.9%	145	21.8%
		total sample size	684		665	

Table 12 - Composite gender-educational capital index (longitudinal sample & w1+w2)

Age, gender, educational capital and changes between wave 1 and wave 2 were analysed one by one as well as in their intersections using robust comparisons of means suitable to the unequal group-sizes.

A comparison of means is a statistical method to test whether differences between two or more groups are attributable to chance or whether, with high probability, these differences really do exist, i.e. they are statistically significant. Significance, however, does not inform about the effect of this difference – also a highly significant difference ($p<0.001$, implying that the probability of this difference to exist lies beyond 99.9%) can only have a small effect in real life. To learn more about the effect of a difference, the effect size is calculated in addition. In educational research effect sizes (reported as r) above 0.5 are considered a large effect, effects between 0.3 and 0.5 are considered a medium effect and between 0.1 and 0.2 a small effect (Cohen 1992; Archer Ker et al. 2013).

In order to compare means with one another based on differing group-sizes non-parametrical methods were used. In case of independent means, i.e. means stemming from persons of potentially differing groups, Wilcoxon rank-sum test was used when comparing two groups with each other and the Kruskal-Wallis test was used for comparing more than two groups. In order not to inflate the α-error, levels of significance have been Bonferroni corrected. In case of dependent means i.e. means of values belonging to the same persons, which is the case for longitudinal data, the Wilcoxon signed-rank test was used for two group comparisons, a robust mixed two-way ANOVA was used to compare multiple groups with each other testing for in-group and between-group differences as well as interaction effects (Wilcox 2017). When doing multiple comparisons, levels of significance have again been Bonferroni corrected.

5.3 Findings of wave 1 and 2

Following Falk and colleagues (2016a) we have asked our participants about the frequency of their engagement in a set of 19 science related activities. The understanding of science

operationalized in these activities covers a broad range of potential moments of learning, including going to public libraries, cooking, reading, doing sports, repairing things, or caring for pets. The frequency-scale ranges from – '**every day** or **almost** every day' to '**hardly ever** or **never'**.

The majority of our longitudinal respondents (56%, n=736) engage in more than a quarter and up to 50% of all given activities on a regular basis in wave 2, 41% are engaging in up to three quarters of all given activities, resulting in 97% of our sample who participate in up to three quarters of all given activities on a some-how regular basis. The distribution also holds with regard to the newly engaged learners in wave 2 and those learners, who dropped out after participating in wave 1. We can thus conclude that the chosen set of activities makes part of most of our learners' science ecologies.

Is there any difference with regard to the specific activities our learners engage in?

5.3.1 STEAM learning activities pursued

Engagement in self-directed science learning activities in a narrow sense (calculated as mean value index ranging from 0 to 4) such as doing a science-experiment at home, taking things apart or repair them, or watching online videos about science did not significantly vary over time in the longitudinal sample. On a general level, 23% (n_{long}=735 & n_{w1+w2}=727) of the learners indicate that they engage in these activities at least on a weekly basis (a score of 3 or 4 on the index). Yet, only 7% of the learners in the longitudinal sample, but 12% of the pooled w1+w2 sample say they hardly ever engage in this kind of activity (score 0 on the index).

As suggested by the results of earlier studies (Archer et al. 2013), in our study, male learners are more likely to engage in these self-directed science learning activities. This effect is highly significant in the longitudinal sample (m_m=1.91, m_f=1.54, $p<0.001$, $r=0.22$)[9]. Also, our pooled sample identifies this relationship, albeit with a smaller effect-size (m_m=1.81, m_f=1.53, $p<0.001$, $r=0.14$). In the longitudinal sample, this relationship exacerbates at a young age, with a medium effect between young boys and young girls ($m_{m<12}$=1.47, $m_{f<12}$=2.02, $p<0.05$, $r=0.31$) and persists at the level of teenagers ($m_{m>12}$=1.89, $m_{f>12}$=1.55, $p<0.05$, $r=0.20$). Young boys are more likely to engage in these activities than female teens ($p<0.001$, $r=0.22$), and male-identified young adults are more likely to regularly do self-directed science learning activities than young girls ($p<0.05$, $r=0.18$).

In the pooled data-set no gender-based differences at a young age are identifiable. Similar to the longitudinal sample, however, significant age-based gender-differences in w1+w2 can be identified between young boys ($m_{m<12}$=1.83) and female teens ($m_{f>12}$=1.52, $p<0.05$, $r=0.16$), as well as female and male teens ($m_{m>12}$=1.8, $p<0.01$, $r=0.19$)

In case of male-identified learners, the likelihood to do these activities at home further varies with the educational background in both samples: male-identified learners from high education backgrounds are – on average – most likely to engage in self-directed science learning (long: $m_{m\text{-}high}$=2.12, sd=0.41; w1+w2: $m_{m\text{-}high}$=1.92, sd=0.9) and their probability to do so significantly differs from female-identified learners of all educational strata, with the strongest effects found in the longitudinal sample, when comparing male learners from highly educated

[9] The full table of results can be found in the Annex (section 10.5). When reporting results of time-insensitive longitudinal data, only wave 2 results are reported in the deliverable at hand. Reported standard deviations for longitudinal answers have, however, been adjusted to the longitudinal design using data from wave 1 and wave 2.

backgrounds with female-learners from medium ($m_{f\text{-}med}$= 1.52, p<0.001, r=0.34) and high educational strata ($m_{f\text{-}high}$= 1.53, p<0.001, r=0.34).

The engagement in **art-centred science learning activities** acting in a drama class, making music or dancing, was equally measured as mean value index ranging from 0 to 4.

Nearly one third (32%, n_{long}=735) of our longitudinally surveyed learners, however, only a quarter (25%, n_{w1+w2}=731) of our w1+w2 learners engage at least weekly in art-centred activities which can foster science learning. 16% of the longitudinal sample and 19% of the learners surveyed once hardly engage in this kind of activities.

With our longitudinal sample, the values for these activities are significantly higher in wave 2 (m_{w1}=1.65, m_{w2}=1.75, p<0.001, r=0.12). While the effect of time with r=0.12 is negligibly small at a general level, it exacerbates more strongly with male-identified learners, whose average engagement in art-centred science learning has significantly risen within the timeframe of one year ($m_{m\text{-}w1}$=1.39, $m_{m\text{-}w2}$=1.57, p<0.001, r=0.20).

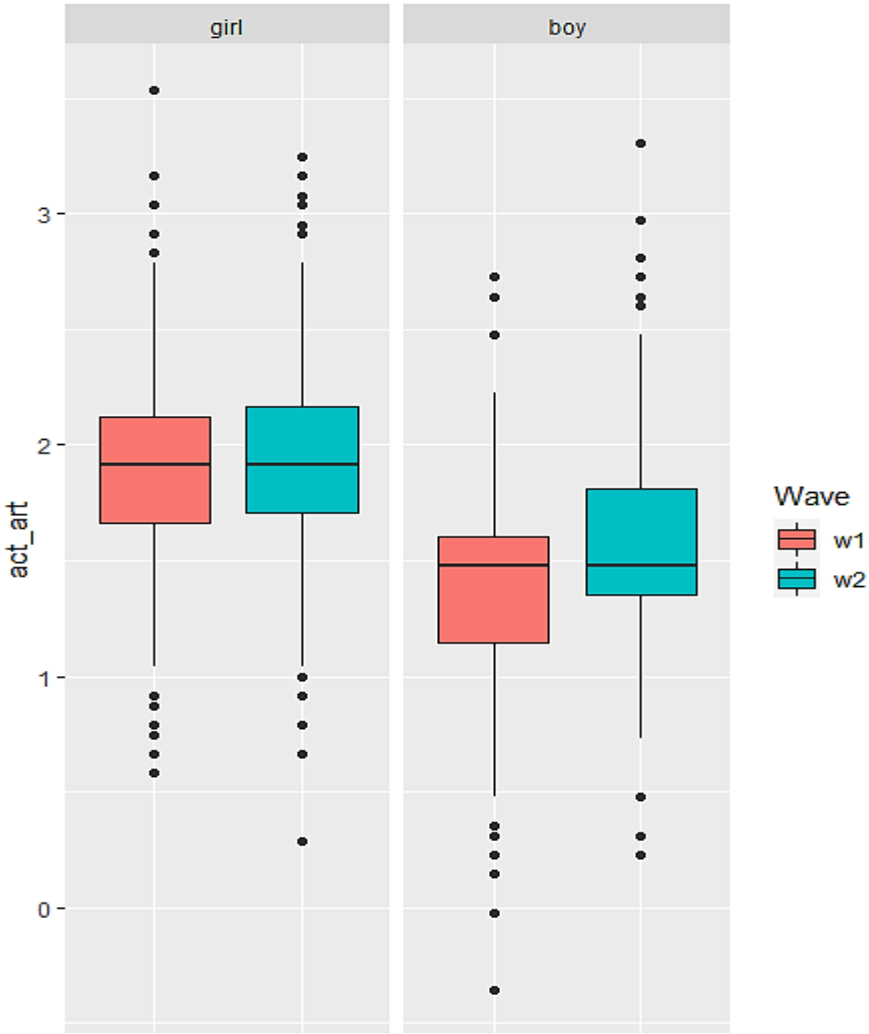


Figure 15 - Art-centred science learning (act_art) by gender over time, longitudinal sample (n=684)

As can be seen in *figure 15*, girls presumptively do more art-centred science learning across both waves ($m_{f\text{-}w1}$=1.90, $m_{f\text{-}w2}$=1.93), as a result of boys' elevated art-based activities, the effect of the difference between girls and boys has slightly decreased (p<0.001, r_{w1}=0.25, r_{w2}=0.17).

The reported frequency to engage in activities that foster art-centred science learning has not significantly varied with educational background of the learners between wave 1 and wave 2. Gender differences, however, strongly exacerbate with educational strata in our longitudinal sample. Despite the risen level of engagement in art-based science learning, male-identified learners from low educational groups are least likely to engage in this kind of activities ($m_{m\text{-}low}$=1.11). They are significantly less likely to do so than males from high education backgrounds ($m_{m\text{-}high}$=1.92, p<0.001, r=0.30). Girls from medium and high educational backgrounds significantly outreach male-identified learners from medium and low education households. The largest effect of

these intersecting influences of gender and educational capital hence exacerbates between boys from low educational backgrounds ($m_{m\text{-}low}$=1.11) and female-identified learners from highly educated families ($m_{f\text{-}high}$=2.20, p<0.001, r=0.41).

In addition to these gender-based differences between wave 1 and 2, changes over time were also identified to be more pronounced amongst younger age-groups than older ones. While in wave 1 data, no significant differences by age were identifiable, younger learners of the longitudinal sample in wave 2 on average engage more frequently in singing, dancing or acting ($m_{8\text{-}11}$=1.99, $m_{12\text{-}14}$=1.85) than young adults ($m_{18\text{-}21}$=1.46, $p_{9\text{-}11\&18\text{-}21}$<0.001, r=0.25, $p_{12\text{-}14\&18\text{-}21}$<0.01, r=0.19).

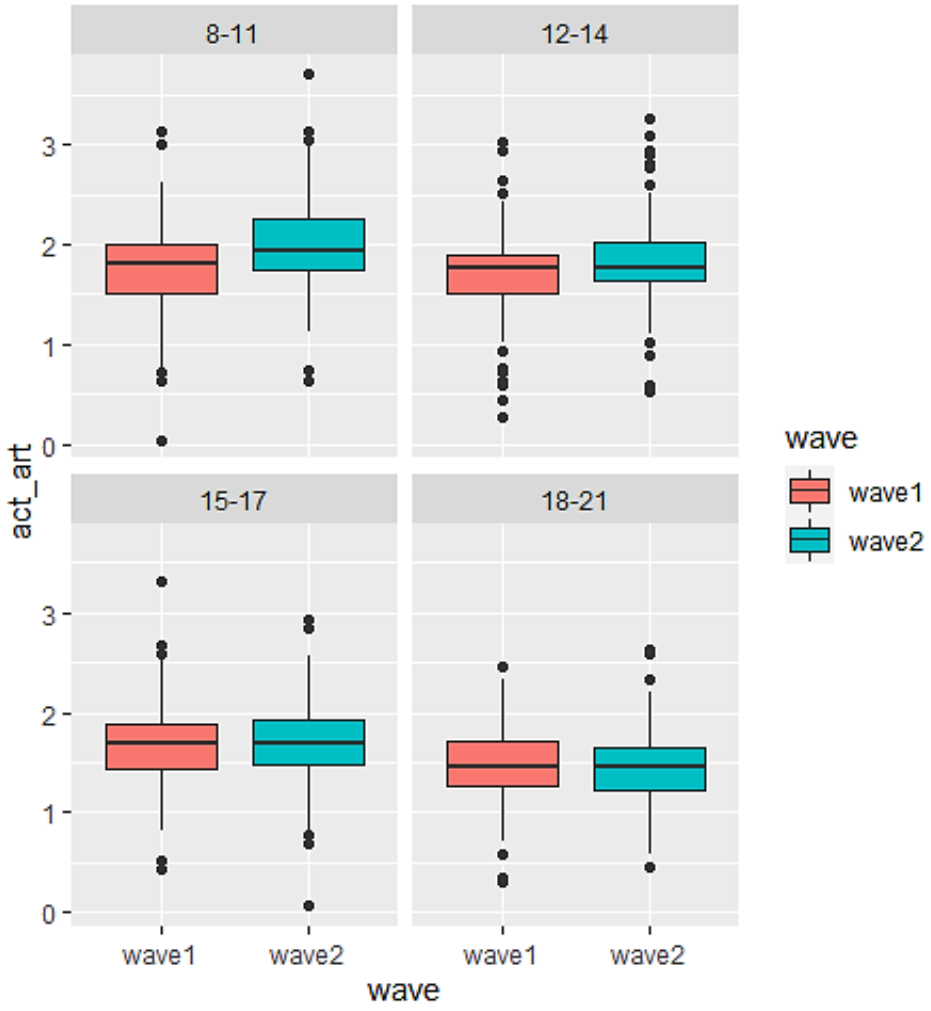


Figure 16 - Art-centred science learning (act_art) by age over time, longitudinal sample (n=732)

One possible reason for young boys, whose art-based science engagement has risen within the timeframe of one year, might be related to the engagement in the SySTEM 2020 project. However, given the relative stability of learning ecologies in general (Bevan 2016) – which is also visible throughout the following analyses – and the short period of one year between wave 1 and wave 2, these small effects of time in art-centred science learning should be interpreted with care.

While not capturing any changes over time, the general trends observed in the longitudinal sample also hold among the sample of learners only surveyed once. Likewise, girls are more likely to engage in art-centred science learning than boys, with a small effect size reflecting wave 2 results of the longitudinal sample (m_f=1.68, m_m=1.31, p<0.001, r=0.18). This differences, however, already exacerbate at an early age ($m_{f<12}$=1.83, $m_{m<12}$=1.31, p<0.01, r=0.26), whereas – unlike the longitudinal sample - young boys do not significantly engage more frequently in art-based science learning than older ones. The higher the educational background of the learner, the higher the probability to regularly make music, dance or act and thereby also (informally) learn something about science. This dynamic particularly exacerbates with gender. Also in the pooled sample of respondents only surveyed once, male-identified learners from low-educational backgrounds ($m_{m\text{-}low}$=1.10, sd=0.99) are the least likely to engage in art-centred science learning, albeit they do not significantly differ from boys of highly educated households. The largest effect of this intersectional comparison arises between male-learners from low educational strata and female-identified learners of highly educated backgrounds ($m_{f\text{-}high}$=1.87, p<0.001, r=0.34, indicating a medium effect).

As far as **science learning by engaging in team-sports** is concerned (mean value index, from 0 to 4), less than half (41%, n_{long}=735) of the longitudinal participants engage in team sport on a weekly basis. The sample of w1+w2 is slightly more active, with 44% (n_{w1+w2}=729) indicating to do team-sports regularly. Another quarter of the longitudinal survey (25%), and 21% of the sample only surveyed once, however, hardly ever does so.

Looking at the longitudinal sample and intra-personal differences, no significant differences between wave 1 and wave 2 were identified. In general, engagement in team-sports varies with age. In the longitudinal sample, learners above age 14 report doing significantly less sports than younger ones (p<0.001, effect sizes for various comparisons 0.20<r<0.38). This clear effect is not visible in the w1+w2 sample, where only the youngest age-group ($m_{8\text{-}11}$=2.15) does significantly more team-sports than the oldest group ($m_{18\text{-}21}$=1.44, p<0.01, r=0.22)

The gender of the learners seems to be a main structuring variable here, with male-identified learners (long: m_m=2.04; w1+w2: m_m=2.27) being more likely to engage in team sports on a regular basis than female learners (long: m_f=1.56, p<0.001, r=0.18; w1+w2: m_f=1.58, p<0.001, r=0.27).

The most pronounced differences in team-sports engagement the longitudinal sample can be found amongst girls ($m_{f\text{-}low}$= 1.26) and boys from low educational strata ($m_{m\text{-}low}$=2.05, p<0.05, r=0.34), girls from low educational strata and boys from highly educated households ($m_{m\text{-}high}$=2.12, p<0.001, r=0.32) and between female teens ($m_{f>12}$=1.46) and male kids ($m_{m<12}$=2.36, p<0.001, r=0.27).

Gender differences are even more strongly pronounced in the sample of learners only surveyed once, with largest effects between young girls ($m_{f<12}$=1.64) and boys ($m_{m<12}$=2.58, p<0.001, r=0.36), young boys and female teens ($m_{f>12}$=1.55, p<0.001, r=0.36), between girls from low educated households ($m_{f\text{-}low}$=1.36) and male-identified respondents from medium educational backgrounds ($m_{m\text{-}med}$=2.36, p<0.001, r=0.32), as well as between these boys from medium education households and girls from educationally affluent families ($m_{f\text{-}high}$=1.58, p<0.001, r=0.32).

The **majority** (83%, n_{long}=736) of the longitudinally surveyed learners and w2 learners (83% n_{w1+w2}= 146), as well as 78% of those learners, who dropped out after wave 1 (n=586) are **part of at least one institutionalized group** that facilitates an activity broadly related to science, such

as a sports club, a choir or a scout troop. These findings indicate that participants included in the longitudinal sample tend to show a generally higher score in science engagement than the ones who participated only once in the survey.

When being asked about their **favourite activity**, nearly a third (30%, n_{long}=712) of the longitudinally surveyed participants, and a quarter of the w2 participants (25%, n_{w2}=145) selected sports. Ten percent of the longitudinal sample likes listening to music best, the same share of participants newly included in wave 2 prefers playing computer or console games.

Most of the learners (79%, n_{long}=736, 71%; n_{w1}=586, 77%, n_{w2}=146) do their favourite activity together with someone else, be it friends (61%$_{long}$, 55%$_{w1}$, 54%$_{w2}$), parents (24%$_{long}$, 20%$_{w1}$, 31%$_{w2}$) or siblings (24%$_{long}$, 20%$_{w1}$, 28%$_{w2}$). More than half (57%) of our longitudinally surveyed learners and 42% of the learners only surveyed once in w1 or w2 (also) do their favourite activities on their own.

We have also asked our learners about the science-topics they are most interested in. 80% (n_{long}=702) of the longitudinally surveyed learners and the learners only included in w1 (n_{w1}=569) and 91% of the w2 learners (n_{w2}=146) indicated that they are particularly interested in specific science topics that were to be named. While the quantity of listed science topics might be an indication of the breadth of science interest, no conclusions on the intensity of these interests can be drawn; a learner being fascinated by one quite specific topic they knows a lot about, is hence, not less interested in science than a learner, who listed seven different topics. *Figure 17* depicts a word-cloud with the most named topics of all participants engaged in wave 2, i.e. longitudinal learners and learners newly included in w2 ($n_{long+w2}$=882). The **most popular topic listed is the human body** (indicated 144 times), followed by **animals** (138), **computers** (138), **planets** (132) and **genetics** (78). In comparison to all answers collected in wave 1 (including answers from longitudinal participants and those participants dropping out after wave 1), these top-listed topics have not changed between wave 1 and 2.

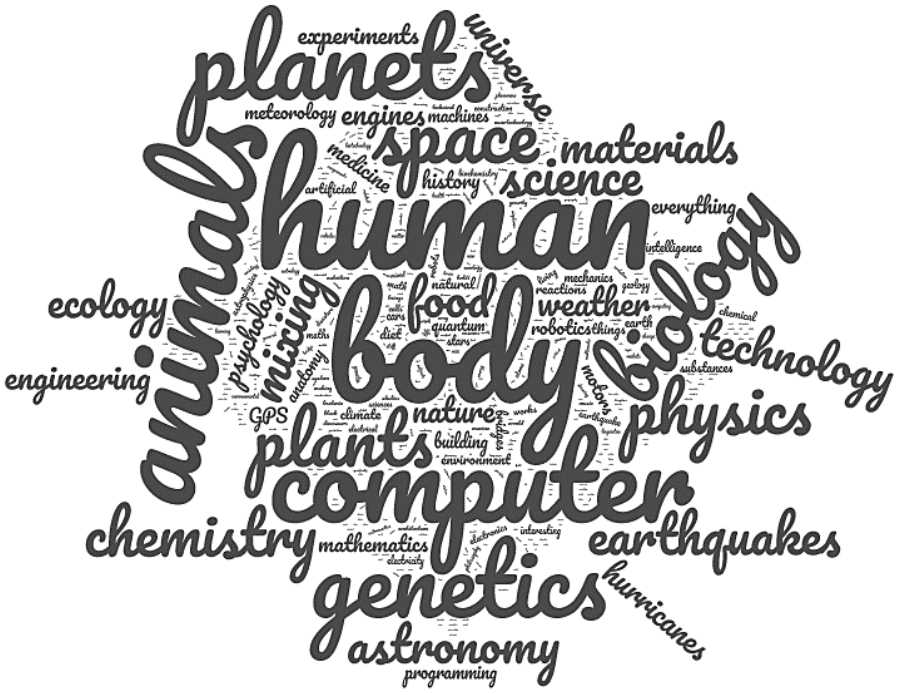


Figure 17 – Which science topics do you find particularly interesting, longitudinal and wave 2 samples (n=882)

On average, the learners of any sample listed two topics (median=2). More than half of the longitudinal participants (56%) and nearly three quarters of wave 2 only participants (73%) named between one and three topics. 2 longitudinal participants and two w1-only participants even listed as many as 15 topics that they find particularly interesting.

5.3.2 The learner's connection to science

As introduced in the theoretical framework, science can be perceived as community of practice whose norms and value systems might not be instantaneously compatible with the socialised value systems and the underlying identification or non-identification with science.

Based on the earlier introduced PCA the **non-identification with science** was identified as a factor set up with eight items tapping agreement and opposition to three negatively formulated items: 'Science is not for me', 'Other people of my age find it easier to learn science topics than I do' and 'My way of thinking and learning makes it hard to understand science'. The mean value index summarizing these items was build recoding the index from 1 to 5, whereas 1 indicates strong agreement on the negative item (strong opposition to a positive science identity), 3 indicating a neutral position and 5 a strong opposition to the negative science identity.

More than half of the longitudinally surveyed learners (56%, n_{long}=724) and nearly half of the respondents only surveyed once (48%, n_{w1+w2}=724) (strongly) distances themselves from a negative science identity. 15% of our longitudinal sample, and 19% of our pooled w1 and w2 only sample do not see science as part of their identity. 29% of the longitudinal sample and a third (33%) of the learners surveyed on average remain undecided on this matter.

The formation of a negative science attitude does not seem to significantly vary with time nor age. In line with findings of Archer and colleagues (2012), the likelihood of non-identifying with science significantly varies with the educational capital of the learner across both investigated samples, with the largest effect between learners from low educational capital backgrounds (long: m_{low}=3.13; w1+w2: m_{low}=3.03) and respondents from highly educated families (long: m_{low} =3.93m, p<0.01, r=0.26; w1+w2: m_{low}=3.63, p<0.01, r=0.25). While no significant differences between female- and male-identified learners were identified at a general level in both investigated samples, the differences by educational strata exacerbate with gender, with boys from highly educated backgrounds being the least likely to dis-identify with science (long: $m_{m\text{-}high}$=3.9, sd=0.37; w1+w2: $m_{m\text{-}high}$=3.75, sd=0.89). The largest effect of this difference can hence be found between boys from educationally affluent backgrounds and boys from low educational strata (long: $m_{m\text{-}low}$=3.04, p<0.001, r=0.39; w1+w2: $m_{m\text{-}low}$=3.03, p<0.001, r=0.31, medium effect) as well as in comparison to girls with low educational capital (long: $m_{f\text{-}low}$=3.21, p<0.01, r=0.29; w1+w2: $m_{f\text{-}low}$=3.02, p<0.001, r=0.33, indicating a medium effect). Also female-identified learners (long: $m_{f\text{-}high}$=3.6, sd=0.44; w1+w2, $m_{f\text{-}high}$= 3.52, sd= 1.16) significantly differ from males stemming from low educational backgrounds (long: p<0.01, r=0.25; w1+w2: p<0.05, r=0.24) and – in the pooled sample – equally from girls with low educational capital (p<0.05, r=0.22).

Non-identifying with science does not automatically rule out any interest in scientific matters. How many of our surveyed learners connect with science and develop a **positive-science attitude**? The corresponding index derived from the PCA summarises eight items tapping science interest, enjoyment as well as connecting science with their everyday life. The mean value index ranges from 1 to 5, with 1 denoting strong disagreement, 3 indicating a neutral position, and 5 signifying strong agreement.

A **quarter** (25%, n_{long}=728) **of the longitudinal respondents**, yet only **4% of our one-time surveyed learners** (n_{w1+w2}=730) reach the highest category and hence **exhibit a strongly positive science attitude**. In total, 70% of the longitudinal sample, but merely a quarter (24%) of the pooled sample indicate a positive connection with science. In contrast, 7% of the longitudinal sample, yet nearly half of the learners included only in w1 or w2 (48%) distance themselves from a positively framed science attitude. 23% of the longitudinal sample, and 28% of the pooled sample on average neither agree nor disagree to these positively framed statements.

Like the findings related to the non-identification with science, neither time, age, nor gender turned out to significantly influence a positive science attitude (on their own). The educational capital of the learner, however, significantly impacts the probability to exhibit a positively framed understanding of science and see how it relates to one's own life; learners from highly educated backgrounds are significantly more likely to show a positive science attitude (long: m_{high}= 3.93; w1+w2: m_{high}=3.92) than learners from low (long: m_{low}= 3.64, p<0.01, r=0.16; w1+w2: m_{low}=3.37, p<0.001, r=0.25) and medium educational strata (long: m_{med}= 3.7, p<0.01, r=0.16; w1+w2: m_{med}=3.68, p<0.01, r=0.14).

Again, these differences by educational strata intersect with gender-roles and identities across both samples, with the largest effects arising between male learners from high ($m_{m\text{-}high}$= 4.08) and low educational strata ($m_{m\text{-}low}$=3.46, p<0.01, r=0.29) in the longitudinal sample. In the pooled sample, about equally large effects can be found between male ($m_{m\text{-}high}$= 3.95) and female-identified learners ($m_{f\text{-}high}$=3.91) from educationally affluent families when compared with female learners from low educational strata ($m_{f\text{-}low}$=3.27, p<0.001, r=0.29).

While the SySTEM 2020 project focusses on informal and non-formal STEAM learning, the learning ecologies of our surveyed respondents are strongly shaped by the formal education system, whose role must not be forgotten (Jordan 2010; Archer Ker et al. 2013). The survey hence also investigated the **attitudes to science lessons in school**. The learners were asked whether they think 'Science lessons are exciting' and whether they 'look forward to [their] science lessons' on a 1-5 scale with 1 indicating strong disagreement, 3 being undecided and 5 agreeing a lot. Based on the PCA both items were summarised to a mean-based index.

About two thirds (67%, n_{long}=656; 65%, n_{w1+w2}=698) of all surveyed learners perceive their **science lessons in school positively**, and while 18% of both samples are undecided, about 15% of the longitudinal sample and 17% of the pooled w1 and w2 sample do not look forward to their science lessons. Looking at age and considering the related level of education learners are enrolled in, the youngest learners of the longitudinal sample do have a more positive perception of science lessons than older age-groups, with a significant decrease of liking school science once age 12 is crossed, with the largest effect between the youngest and the oldest respondents ($m_{9\text{-}11years}$=4.23, $m_{18\text{-}21years}$=3.5, p<0.001, r=0.33). Similarly, both young girls and boys below age 12 significantly differ from teens of both genders, who are less likely to like their science-lessons. On a general level, no differences with regard to time, gender nor educational capital were identified.
Interestingly, the pooled sample of learners only surveyed once does not mirror these age-group-based differences and on contrary does not reveal any significant differences by age, gender or educational background.

Are there differences with regard to the formal school system in general? We have asked our learners to rate their **school performance** (scale 1-5, 1=bad, 3= okay, 5=good) as they think their teachers perceive it. More than two thirds of our all our learners (70%, n_{long}=695; 68%,

n_{w1+w2}=719) reported good and very good school performance and while about a quarter (long:26%; w1+w2: 26%) indicated that their performance at school was perceived as okay, only 6% of our learners reported a negative school performance.
While no significant changes between wave 1 and wave 2 were identifiable, similar to the enjoyment of school science lessons in general also the rating of school performance varies with age, with the youngest age group rating their performance the highest in both samples (long: $m_{9\text{-}11}$= 4.13, sd=0.51; w1+w2: $m_{8\text{-}11}$ = 4.25, sd=0.99) and significantly differing from 15-17 year olds in the longitudinal sample ($m_{15\text{-}17}$ = 3.84, p<0.01, r=0.17) and from 12-14 year olds as well as 15-17 year olds in the pooled sample ($m_{12\text{-}14}$ = 4.00, p<0.05, r=0.26; $m_{15\text{-}17}$ = 4.02, p<0.05, r=0.15).

In both samples, a negligibly small effect of gender looked at on its own is identifiable with female-identified learners (long: m_f= 4.04; w1+w2: m_f= 4.13) on average indicating a better performance in school than male-identified respondents (long: m_m= 3.08, p<0.01, r=0.12; w1+w2: m_m= 3.92, p<0.01, r=0.11). These differences play out more strongly in a combined perspective of age and gender, with male teens of the longitudinal sample significantly indicate a worse school performance at school ($m_{m>12}$=3.73) than all three groups of comparison (p<0.05, 0.16<r<0.19). In the pooled sample, female children ($m_{f<12}$=4.44) significantly indicate a better school performance than male children and teenagers of both genders (p<0.05, 0.22<r<0.27).

The answers of the longitudinal sample further vary with the educational strata, with female-identified learners of highly educated backgrounds on average indicating the best performance in school ($m_{f\text{-}high}$=4.17, sd=0.45) and hence significantly differing from all other groups of comparison, with the largest effect in comparison to male learners from medium educational strata ($m_{m\text{-}med}$= 3.62, p<0.001, r=0.31). Differences by the educational capital of the learner are, however, not identified in the pooled w1 and w2 sample. No significant changes between wave 1 and wave 2 were identified.

5.3.3 The social dimension of STEAM learning ecologies

In general, our sample shows a **high amount of self-motivation**, with 98% (long, n=736), 99% (w2, n=146) and 96% (w1, n=586) indicating that they motivate themselves to do at least a quarter of all possible science-related activities. As far as encouragement from others is concerned, **parents** do play a major role - 90% of our longitudinal learners, and 94% of those respondents only included in wave 1 or newly included in wave 2 are encouraged by their parents to engage at least in a quarter of all possible broadly science related activities.

In both the longitudinal sample and the w1 group, friends are perceived slightly more encouraging than teachers. 63% of the longitudinal learners and 58% of the w1 learners indicate that their friends encourage them to engage in at least a quarter of all possible activities, whereas 58% of the longitudinally surveyed and 48% of those, who dropped out after wave 1 say that their teachers do so. On the contrary, in the w2 sample, teachers were reported more supportive (66%$_{w2}$) than peers (58%$_{w2}$). While the role of grandparents and relatives in encouraging learners to engage in broadly science related activities is small in the longitudinal sample and the w1 only sample – nearly two thirds (65%$_{long}$, 70%$_{w1}$) report no support - more than half of the learners of newly included wave 2 participants (53%) perceive

their relatives as supportive. The same relations are visible with regard to reported siblings' support – again 63% of the longitudinal sample and wave1 do not experience any encouragement, whereas every second participant that has been newly included for wave 2 (51%) does. The social environment hence differs between the three samples as depicted in *figure 18*.

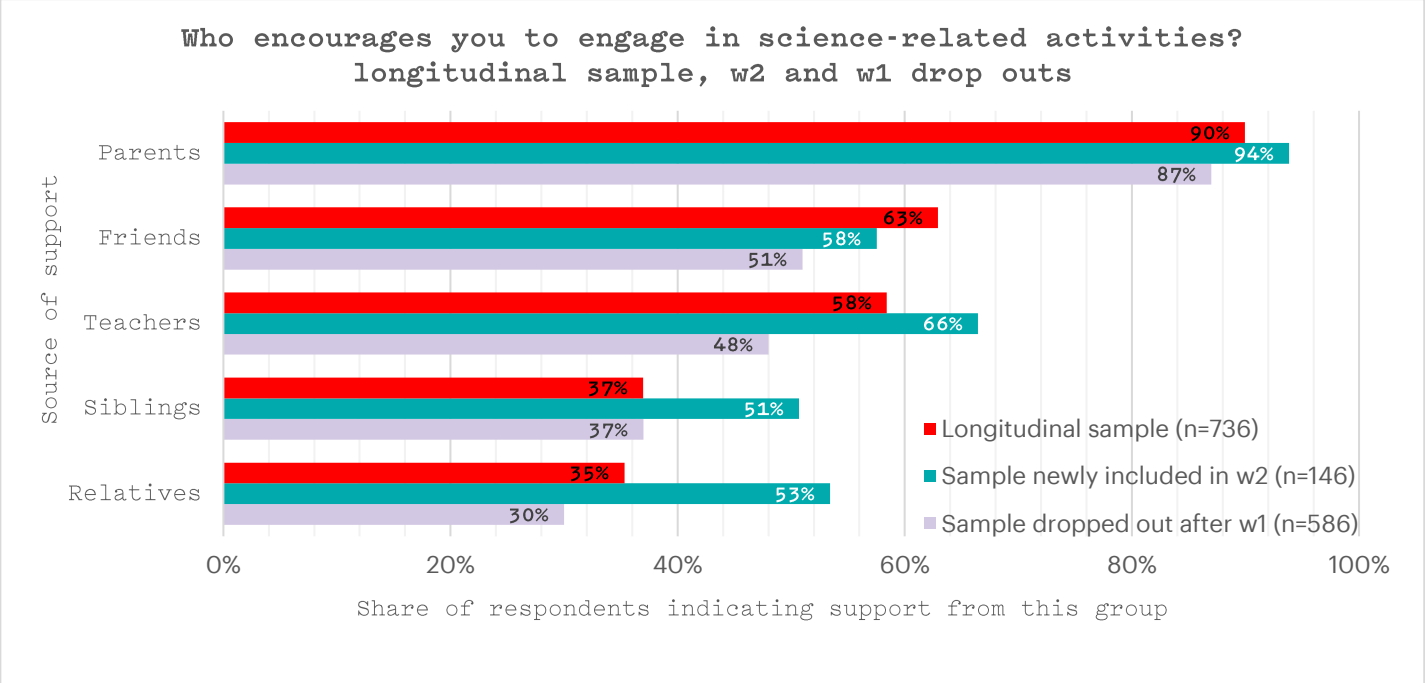


Figure 18 - Supporting social environment, longitudinal sample, w1-only sample and w2-only-sample

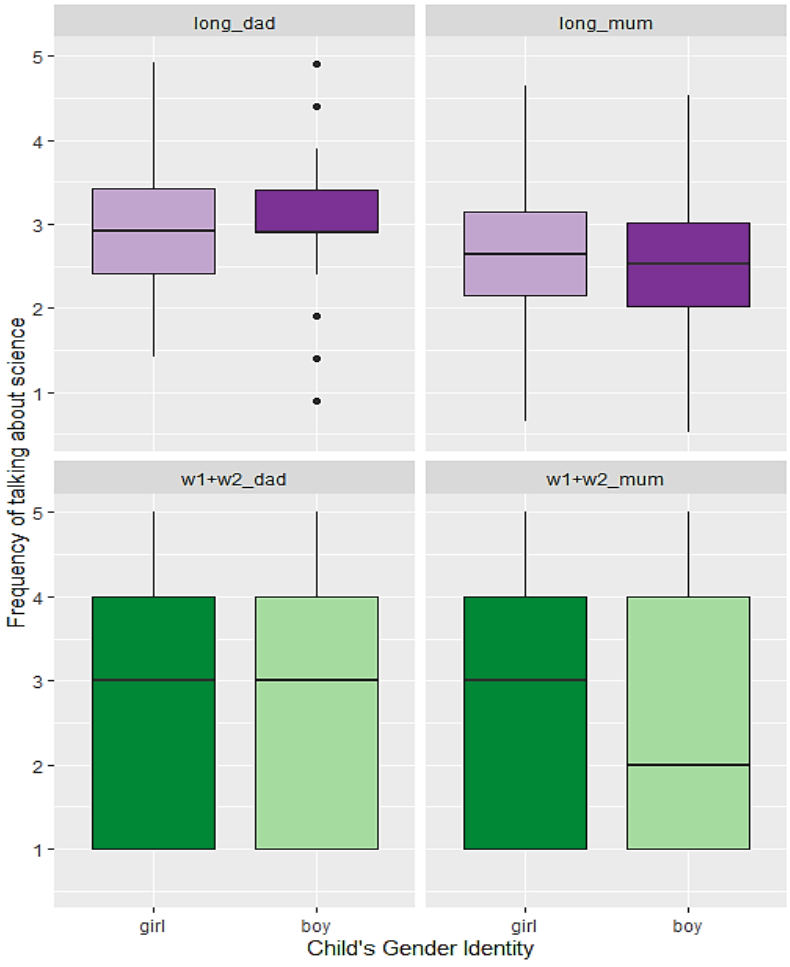
Parents represent an important part of the learners' social environment and further provide for the learners' educational capital, which is a resource that is passed on from the parents to their children. Based on educational capital, the science can or cannot be a part of the learners home (Archer et al. 2012). In our survey, **the importance of science at the learner's home** has been derived as a factor doing the PCA already introduced in chapter 3.3.2, comprising three items: '*my mother talks to me about science*', '*my father talks to me about science*' and '*my parents are interested in science*'. These items were summarised to a mean value index ranging from 1, indicating strong disagreement, to 5, signifying strong agreement, with 3 being undecided.

Accordingly, more than a third of all surveyed respondents (33%, n_{long}=720; 36%, n_{w1+w2}=724) agreed to these statements. About equally as many (37%$_{long}$; 35%$_{w1+w2}$) tend not to talk to their parents about science and do not think that their parents have an interest in science. The remaining shares on average neither agree nor disagree to these statements.

Young learners report a significantly higher presence of science in their homes than young adults – while significant differences in the longitudinal sample exacerbate between 9 to 14 year olds ($m_{9\text{-}11}$=3.18, $m_{12\text{-}14}$=3.02) in comparison with 15 to 21 year olds ($m_{15\text{-}17}$=2.74, $m_{18\text{-}21}$=2.78, $p<0.05$, $r=0.17$), the pooled w1 and w2 sample identifies significant differences between the youngest age group of 8 to 11 year olds ($m_{8\text{-}11}$=3.31) to all older age groups ($p<0.05$, $0.14<r<0.18$). This difference might be related to changing parent-child interactions once kids grow older with smaller offsprings getting more input and support from their parents to spark interests, whereas young adults shaping their learning ecology more independently.

As several studies suggest (DeWitt et al. 2013; Frome and Eccles 1998; Bell, Shouse, and Feder 2009; Jacobs et al. 2005; Tenenbaum, Rappolt-Schlichtmann, and Vogel Zanger 2004) the way parents address science with the learners can be gendered. From a gender perspective, age differences exacerbate more strongly in the context of male identified learners; adolescent male learners above the age of 12 of both samples report science being significantly less present in their home than younger boys (long: $m_{m<12}$=3.33, $m_{m>12}$= 2.83, p<0.05, r=0.17; w1+w2: $m_{m<12}$=3.27, $m_{m>12}$= 2.83, p<0.01, r=0.18). However, looked at on its own, gender does not yield any significant differences.

In line with earlier findings (Archer et al. 2012) our results confirm that educational capital influences the way science is a part of a family habitus, with learners from highly educated households (long: m_{high}=3.24, p<0.001, 0.22<r<0.24; w1+w2: m_{high}=3.21, p<0.01, 0.13<r<0.18) being more likely to call science an important part of their home culture than learners from medium or low educational backgrounds.
Based on our data, educational capital is the main structuring factor, which is, however, interacting with gender; in the longitudinal sample, the strongest effect can be identified when comparing female learners with low educational capital ($m_{f\text{-}low}$=2.51) to boys from highly educated backgrounds ($m_{m\text{-}high}$=3.35, p<0.001, r=0.30), with further significant differences across educational strata. In the pooled wave 1 and wave 2 sample, girls from low educational backgrounds ($m_{f\text{-}low}$=2.78) do not significantly differ from boys ($m_{m\text{-}high}$= 3.17) and girls ($m_{f\text{-}high}$= 3.36) of educationally affluent families, once the comparisons are Bonferroni corrected. The effect-sizes of these comparisons (r=0.21 in both comparisons), nevertheless suggests that educational capital might influence the likelihood of science being an important topic at home.



As outlined in the theoretical background, studies suggest that parent-child interactions are formed by gender stereotypes, talking more to boys about science than girls (Bell, Shouse, and Feder 2009). In our longitudinal data, no such effects are identifiable. The pooled w1+w2 data set reveals a small significant effect with regard to mothers being more likely to engage their daughters in science-related conversations than their sons (m_f=2.86, m_m=2.63, p<0.05, r=0.08). On a general level, discussions about science seem to happen more with fathers than with mothers across both samples (see *figure 19*).

Figure 19 - Frequency of parents talking about science to their children by gender of parents & learners longitudinal sample (long, 1st row) & w1+w2 sample (2nd row)

Friends and peers represent an important element of a young person's STEAM learning ecology (Bevan 2016). What do the peers of our surveyed learners think of science?
More than a third of both samples (38%, n_{long}=716; 39%, n_{w1+w2}=719) indicated that their close friends enjoy science, slightly fewer (31%$_{long}$; 36% $_{w1+w2}$) are undecided, an equal share of the longitudinal sample (31%) and slightly more than a quarter (26%) of the pooled w1 and w2 sample reject the idea of having close friends who are into science.

In the longitudinal sample, the youngest age group of 9 to 11 year olds ($m_{9\text{-}11}$=3.40) is on average most likely to have a science-positive peer environment and significantly differs from 12 to 14 year-olds ($m_{12\text{-}14}$=2.86, p<0.001, r=0.23). Whilst this difference is not identifiable in the pooled sample, across both samples young boys below age 12 (long: $m_{m<12}$=3.51; w1+w2: $m_{m<12}$=3.43) are significantly more likely to have friends, who like science than female teenagers (long: $m_{f>12}$=3.02, p<0.05, r=0.15; w1+w2: $m_{f>12}$=3.43, p<0.05, r=0.16) and – in the longitudinal sample - they also significantly differ from male teens ($m_{m>12}$=2.93, p<0.01, r=0.19). The longitudinal sample additionally visualizes significant, yet small differences by educational capital – which might be interpreted as a form of reproduction of a family habitus: learners from high educational backgrounds are slightly more likely to have friends who positively connect with science (m_{high}=3.21) than learners from medium (m_{med}=2.94, p<0.05, r=0.12) and low educational households (m_{low}=2.84, p<0.05, r=0.13).
The pooled sample instead identified a significant, yet negligibly small effect, of gender, with male-identified learners being in general more likely to have friends that are into science (m_m=3.20) than female-identified respondents (m_f=2.99, p<0.05, r=0.08), potentially hinting at persisting gender stereotypes of science having a male connotation (e.g. Carlone and Johnson 2007).

5.3.4 What is it that influences whether learners have a positive relationship with science?

What are potentially underlying factors that might help a learner to connect with science? Following Joey Sprague (2005), the focus is not put on learners finding it difficult to connect with learners and hence to 'study down' (i.e. posing questions in a way that makes learners from non-dominant groups seem 'not normal' and responsible for their own situation, while legitimising the position of the others) we need to "study up" (Sprague 2005, 186), i.e. study the dominant classes, and show how privilege works. In order to get some further insights on the way positive science attitudes form, two logistic regression models were created, one investigating the longitudinal sample, while the other model uses the pooled answers of respondents only surveyed once (w1+w2).

Similar to a comparison of means, a regression analysis looks at the influence of one or several independent variables, on a selected dependent variable. In our case influences explaining the variance of a **positive science attitude are explored.**

A positive science attitude is no linear consequence of potentially underlying factors, therefore a **logistic regression model** was chosen to inform about the probability of an event occurring or not occurring, given the value of independent variables (Field, Miles, and Field 2012).

In order to inform about the influence of independent variables on dependent variables, odds ratios are the most commonly used indicator (Field, Miles, and Field 2012). Odds ratios (OR) are "an indicator of the change in odds resulting from a unit change in the predictor" (Field, Miles, and Field 2012) ORs exceeding 1 imply that the odds for an event rise with a unit change, ORs below 1 signify the odds for an event shrinking from a unit change. Since ORs are difficult to compare both within and across different models, average marginal effects (AME) are an additional measure to pin down the effect of an independent variable on the variance of the dependent variable (Wolf and Best 2010). AMEs above 0 indicate a positive, AMEs below 0 a negative change with a unit change of the predictor.[10] In this deliverable both odds ratios (OR) as well as the average marginal effects (AMEs) are indicated with all significant variables and displayed in the accompanying tables (incl. their 95% confidence interval).

The regression model's assumptions were tested investigating the linear relationship between predictors and the logit of the outcome variable, testing the independence of errors using the Durbin Watson Test and investigating levels of multicollinearity using variance inflation factors.

The logistic regression models were built using a stepwise logistic regression selecting independent variables based on findings of earlier studies and laid out in the analytical framework (section 2) and listed in *table 13*. Model fits were judged using Cox and Snell's R^2 (R^2_{CS}) in connection with the Akaike Information Criterion and the likelihood-ratio test for nested models (see e.g. Field, Miles, and Field 2012 for more information).

Since PC respondents are over-represented in the pooled dataset w1+w2 (see *figure 5*), and a dummy-variable of this partner was a significantly influencing independent variable, the logistic regression model operating with the pooled data was weighted, reducing the influence of PC to the average representation of partner organisations. In contrast, no weights were used for modelling the regression analysis based on the longitudinal data.

Informed by the theoretical framework defined in section 2 of this deliverable, a set of potentially influencing variables covering the dimension of time (longitudinal model only), the socio-demographics of the learners, their social environment, the learners' activities, their formal environment, as well as the mode of participant selection was drafted. The full list of tested variables can be seen in *table 13*.

The **dependent variable** of both models is the earlier introduced PCA-based index of a **positive science attitude**. For the logistic regression, this variable was recoded as binary dependent variable with 0 indicating negative or neutral science attitude, and 1 indicating a strongly positive science attitude (scoring 4 or 5 on the original mean-based index).

Dependent Variable	Operationalisation
positive science attitude	0= negative or neutral science attitudes, 1= highly positive science attitudes

[10] In contrast to the commonly used OR, AMEs bear the advantage of being comparable with each other, i.e. an AME = 0.20 is twice as large as the AME = 0.10. This is not the case with OR, where an OR = 4 is not interpretable as being twice as high as an OR = 2 (Best and Wolf 2012).

Dimension (in order of integration in regression models)	Independent variable tested for influence on dependent variable
Influence of time (longitudinal sample only)	difference of science attitude between wave 1 and wave 2
Sociodemographic variables	Educational background
	Gender (dummy variable: 0=female, 1=male)
	Age (modelled with 4 (long) to 5(w1+w2) dummy-variables)
Sociodemographic variables (continued)	Migration experiences (dummy variable, 1= migration experiences)
	Ability (dummy variable, 1= perceived serious difficulties)
	Multilingualism (dummy variable, 1= being multilingual)
	Place of living (dummy variable, 0= living on countryside, 1= city or close by)
Social environment	2 Parent household (dummy variable, 1= living with 2 parents)
	Science importance at home
	Friends' science attitudes
	Parental support
	Friends' support
	Siblings' support
	Teachers' support
	Other relatives' support
	Aggregated level of support
Learners' actions	Engagement in self-directed science learning
	Engagement in art-centred science learning
	Engagement in sport-centred science learning
	Self-motivation
Formal education environment	Attitude towards science lessons in school
	STEM as favourite subject(s)
	Self-perceived school performance
	Highest level of education completed
	Working experience (dummy variable, 1= working experience)
	Sum of different employments experienced
Participant selection by partners	Collaborating with schools (longitudinal: in wave 1) to engage learners (dummy variable: 1= collaboration with schools)

Table 13- Variables used when modelling logistic regression models of positive science attitudes

Which are the factors that significantly impact the probability of our longitudinal learners to connect with science? In order to model the **longitudinal sample**, an additional new variable was created to capture possible differences over time. While science attitudes did not significantly vary over time (see section 5.3.2) between wave 1 and 2 at an aggregate level (see also *figure 20*), the way learners connect with science slightly changed (within the range of one point) for 41% (n=728) of the longitudinal learners within the time frame of one year.

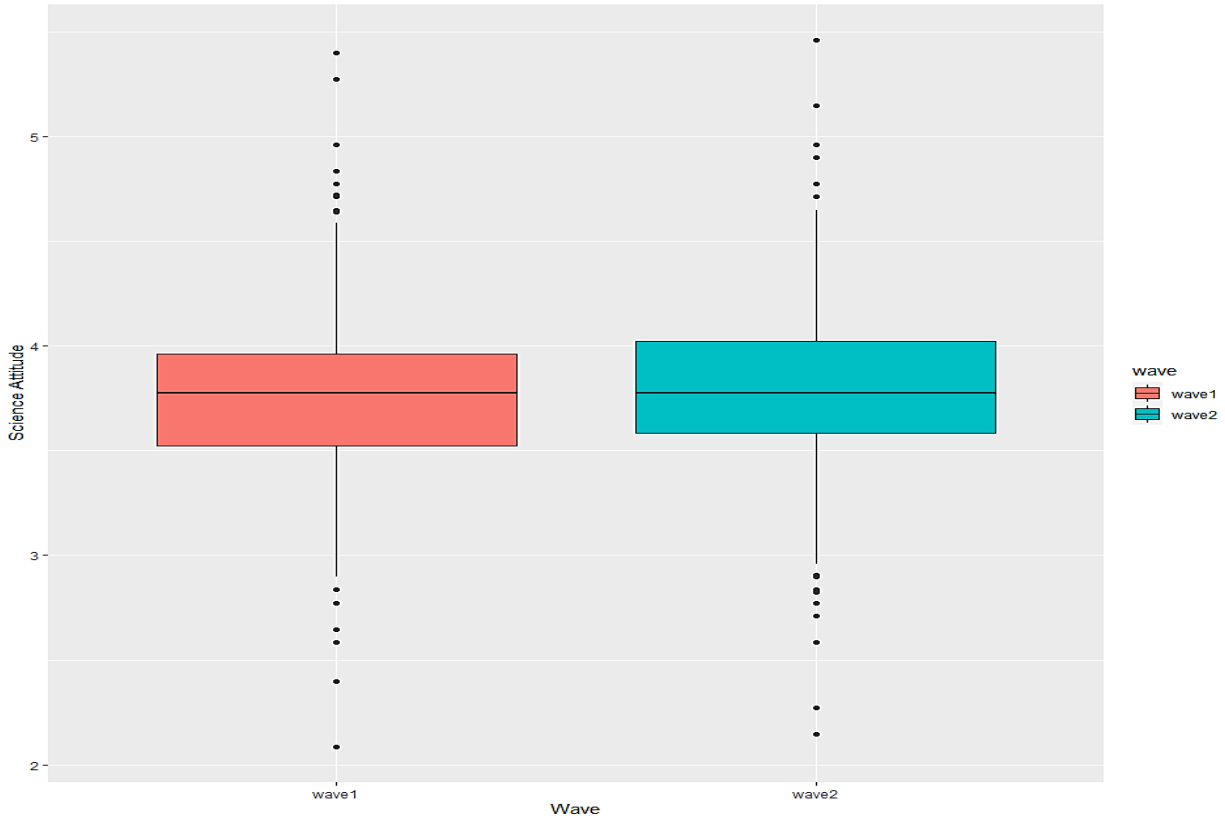


Figure 20 - Boxplot of science attitudes per wave (longitudinal sample only)

5% experienced higher positive changes (more than a one-point-difference between wave 1 and wave 2 values), 4% higher negative changes. These changes are visualised in *figure 21*. For half of our longitudinal learners the value achieved on this mean-based index has not changed between wave 1 and wave 2.

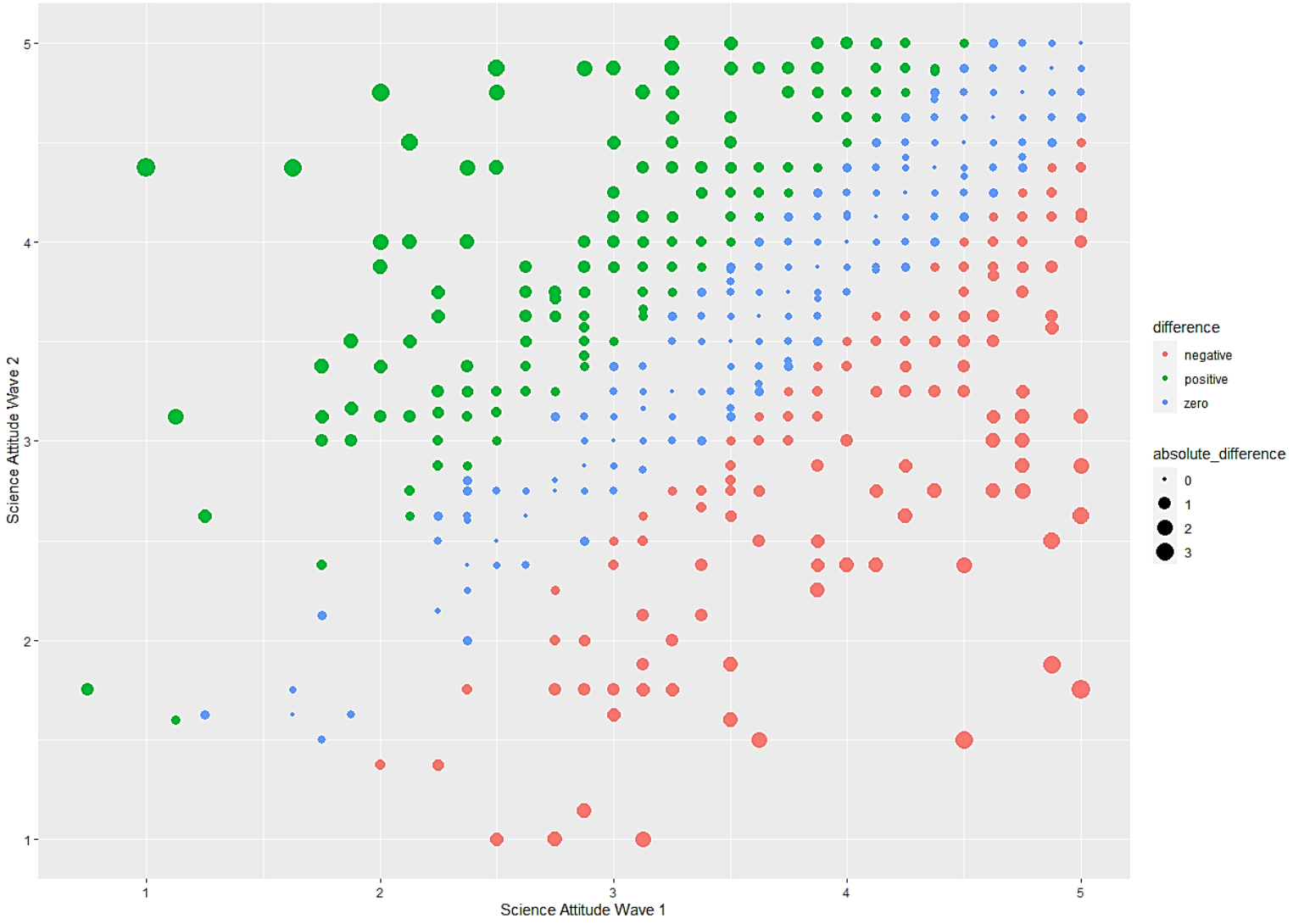


Figure 21 - Difference of science attitudes between wave 1 and wave 2 (longitudinal sample only), positive changes=green, zero changes=zero, negative change=red, size of dots influenced by degree of change – larger sizes imply larger absolute changes between wave 1 and 2.

The best-fitting logistic regression model identified explains more than a third (R^2_{CS} = 0.39) of the variations of a positive science attitude. The variable capturing the effect of time is highly significant (b=1.16, p<0.001) – those **respondents, who have experienced a high positive change within the period of one year are quite likely to exhibit a positive science** attitude after wave 2. More specifically, the odds of leaners who experienced a one-point-positive change between wave 1 and wave 2, changed by 3.18 (odds ratio, OR), or in other words, with the positive change of science attitude by one unit, the probability of having a highly positive science attitude rises by 0.12 (average marginal effect, AME). Since science attitudes vary (insignificantly, see section 5.3.2) with age, age-group-dummies were modelled in a way that gather similar science attitudes, resulting in 4 age groups[11]. Two of them, the 9 to 10 year olds

[11] 9 to 10 year olds (exhibiting less positive science attitudes on average), 11 to 14 year olds (exhibiting more positive science attitudes on average), 15 to 17 year olds (exhibiting high positive science attitudes on average), and 18 to 21 year olds (exhibiting less positive science attitudes on average)

(b=-1.17, p<0.01) and the 15 to 17 year olds (b=0.71, p<0.05) significantly improved the regression model once being included. In case the longitudinal learners are part of the youngest age group, their likelihood of having a highly positive attitude decreases by -0.12 (AME) or 0.31 (OR) respectively. **For learners aged between 15 to 17**, however, **probabilities of connecting with science rise** (AME=0.07, OR=2.03). Albeit, significantly impacting a positive science attitude in the mean-based comparison (see section 5.3.2), educational capital did not significantly add explanatory value to the regression model.

Also, the social environment significantly impacts the likelihood of enjoying science. **The higher the science importance at home, the higher the probability of having a positive science attitude** (b= 0.58, p<.001, AME = 0.06, OR=1.78). The **peer attitudes** towards science also significantly impact the learners' perspective of science – in case the learners' friends do like science, also the probability of the learners to enjoy science learning and to see how STEAM relates to their everyday lives increases significantly (b=0.36, p<.01, AME= 0.04, OR=1.43). Interestingly, **supportive siblings negatively impact a learner's probability to connect with science** (b=-2.55, p<0.01) – as one's siblings become more encouraging (by one imaginative unit), the probability of having a highly positive science attitude falls by 0.26 (AME) or 0.08 (OR) respectively. As outlined in section 5.3.3, within the longitudinal sample, only 35% of the longitudinally surveyed learners perceive their siblings as encouraging. Possibly, this encouragement is prompted by specific living conditions, and hence the siblings' support might not be a causality but a correlation with science attitudes caused by other factors not included in the regression model.

In addition, the learners' activities influence the possibility of developing a positive science attitude. A learner that regularly engages in **science learning on a self-directed basis** is more likely to have an overall positive science attitude (b=0.38, p<.05, AME= 0.04, OR=1.47). Art-centred science learning or team-sport based activities, however, did not add significant explanatory value to the model.

Learning happens in different areas following different rules. The way learning happens in in- and non-formal spaces is connected to the way learning happens in formal systems and vice versa. The largest effects relate to the way science lessons are perceived in school (b=0.98, p<0.001), which overall strongly correlates with the learner's science attitude (r_{w1}=0.5, r_{w2}=0.65**). Enjoying science lessons in school increases the probability of generally having a positive attitude towards science** (AME = 0.10, OR=2.66). Additionally, including the way the learner perceives their own school performance in the regression model significantly improves the explanatory power of the model (b=0.34, p<0.05). **Learners, who perceive themselves performing good at school, are more likely to exhibit a positive science attitude** (AME=0.04, OR=1.40).

Based on our model, longitudinal learners aged between 15 and 17, who regularly engage in self-directed science learning, do have supportive social environment (but non-supportive siblings) and like science in school are most likely to have a positive science attitude (with a 99.99% chance). In general, however, our learners' attitudes towards science are outstandingly positive – ranging averagely on all include variables, and belonging to the youngest age group with a slightly reduced likelihood of having a highly positive science attitude still leaves a chance of 58% of connecting with science.

POSITIVE SCIENCE ATTITUDE Longitudinal Sample	Coefficient B (Standard Error)	Average Marginal Effects (AME) with 95% Confidence Interval			Odds Ratios (OR) with 95% Confidence Interval		
Included Variables		Lower	AME	Upper	Lower	OR	Upper
Constant	1.481 (0.17)***						
Change between w1 & w2	1.156 (0.19)***	0.08	0.12	0.15	2.21	3.18	4.71
9 to 10-year olds	-1.173 (0.42)**	-0.21	-0.12	-0.04	0.14	0.31	0.71
15 to 17-year olds	0.708 (0.28)*	0.02	0.07	0.13	1.19	2.03	3.54
Science importance at home	0.577 (0.12)***	0.04	0.06	0.08	1.40	1.78	2.29
Friends' science attitude	0358 (0.11)**	0.01	0.04	0.06	1.15	1.43	1.79
Supportive siblings	-2.55 (0.95)**	-0.45	-0.26	-0.07	0.01	0.08	0.51
Engagement in self-directed science learning	0.383 (0.15)*	0.01	0.04	0.07	1.09	1.47	1.99
Enjoying science in school	0.978 (0.13)***	0.08	0.10	0.13	2.08	2.66	3.46
Self-perceived school performance	0.338 (0.14)*	0.01	0.04	0.06	1.07	1.40	1.85

*Table 14 - Logistic regression: positive science attitude, longitudinal sample,. n= 638, R^2_{CS} =0.39, p<0.001 ***, p<0.01 **, p<0.05 **

Looking at the **pooled wave 1 and wave 2 sample** gives a slightly different picture. The explanatory value of the final model is R^2_{CS}=0.28 and hence, while the model was created using the same variables (with the exception of the time-effect, see *table 12*) the **used items tend to capture the variance of positive science attitudes of the longitudinal sample better**.

Also for this sample, age-groups were formed according to group-based tendencies.[12] Similarly to the longitudinal survey, the age-group of **14 to 16 year olds significantly added**

[12] 8 to 9 year olds (exhibiting less positive science attitudes on average), 10 to 12 year olds (exhibiting more positive science attitudes on average), 13 year olds (exhibiting less positive science attitudes on

explanatory value to the model (b=0.74, p<0.01). Learners part of this age group, who have only been surveyed once, are more likely to have a highly positive science attitude than learners aged differently. This age-effect is slightly more pronounced in this pooled sample in comparison to the longitudinal group (AME=0.10, OR=2.09).

Looking at the social environment of the learners, science importance at home is not significant at the general threshold of p<0.05 but scoring p=0.05 and hence included in the model (b=0.21). In line with the findings for the longitudinal respondents, also in this sample, the **presence of science at a learner's home increases their probability of connecting with science** and exhibiting a positive science attitude (AME=0.03, OR=1.24). The effect of science importance at home, is, however, twice as large in the longitudinal sample (AME=0.06). The way **friends** perceive science again significantly impacts the learner's science attitudes - in case the learners' friends do like science, also the probability of the learners to enjoy science learning and to see how STEAM relates to their everyday lives increases significantly (b=0.32, p<.01, AME= 0.04, OR=1.37). While not adding significantly to the model (b=-1.55, p<0.1), also in this model, the **support of siblings is negatively related and to a learners' probability to connect with science**. Whilst being non-significant, its effect on the probability of developing a positive science attitude is nearly twice as large (AME=-0.48).

In contrast to the longitudinal learners, the **self-motivation of learners** in the pooled w1+w2 sample adds significant explanatory value to the regression model (b=1.93, p<0.001). Once a learner's self-motivation rises by one unit, their likelihood to enjoy science and see how it relates to their life rises by 0.27 (AME), their odds change with 6.88 (OR) respectively. Learners, who **regularly engage in** activities that potentially foster **art-based science learning are more likely to develop a positive science attitude** (b=0.28, p<=0.05, AME 0.04, OR=1.33). Non-significantly, but with a similar effect, respondents, who do science activities in a self-determined manner frequently, are more likely to enjoy science learning (b=0.26, p=0.056; AME=0.04, OR=1.29).

Also in this model the link of the formal and informal science learning environments is strongly visible (b=0.98, p<0.001). In contrast to the longitudinal regression model, the model for the pooled sample indicates a significant effect of the **sampling technique** used by partner organisations to engage learners in the SySTEM 2020 survey (b=0.87, p<0.01). In case the partners cooperated with schools, the probability of the respondent to enjoy science and to see how it connects to their world rises by 0.12 (AME) and 2.38 (OR) respectively. While Parque de las Ciencias is overrepresented in the pooled sample and collaborated with schools for participant engagement, this effect is equally significant in the weighted regression model, where the influence of PC is decreased (see section 5.2.2) and even, in case respondents from PC are completely removed from the sample. In line with the longitudinal regression model, **the more a learner of the pooled sample enjoys science lessons in school, the higher the chance that this learner likes science in general** and connects science to their living situation (AME=0.14, OR=2.67). Again, the way learners assess their school performance also significantly adds explanatory value to the model (b=0.32, p<0.01) – a unit change in the school attainment leads to an increase in the probabilities to exhibit a positive science attitude by 0.05 (AME) and changes the odds by 1.38 (OR).

In the pooled sample, the possibility to have a highly positive science attitude is highest once a respondent is aged between 14 and 16, has a science-positive social environment, is highly

average), 14 to 16 year olds (exhibiting higher positive science attitudes on average) and 17 to 21 year olds (exhibiting less positive science attitudes on average).

self-motivated, engages in art-based and narrowly defined science learning on a regular basis, who stems from a school-organised sample, likes science lessons, perceives themselves as a good student.

POSITIVE SCIENCE ATTITUDE Pooled w1+w2 Sample	Coefficient B (Standard Error)	Average Marginal Effects (AME) with 95% Confidence Interval			Odds Ratios (OR) with 95% Confidence Interval		
Included Variables		Lower	AME	Upper	Lower	OR	Upper
Constant	-0.178 (0.27)						
14 to 16-year olds	0.739 (0.25)**	0.04	0.10	0.17	1.29	2.09	3.45
Science importance at home	0.212 (0.11) ·	0.00	0.03	0.06	1.00	1.24	1.53
Friends' science attitude	0.312 (0.12)*	0.01	0.04	0.08	1.08	1.37	1.74
Supportive siblings	-1.548 (0.93) ·	-0.48	-0.22	0.04	0.03	0.21	1.33
Self-motivation	1.929 (0.58)***	0.12	0.27	0.43	2.23	6.88	1.90
Engagement in self-directed science learning	0.257 (0.13) ·	0.00	0.04	0.07	1.00	1.29	1.69
Engagement in art-centred science learning	0.284 (0.12)*	0.01	0.04	0.07	1.05	1.33	1.69
Enjoying science in school	0.984 (0.12)***	0.11	0.27	0.43	2.14	2.67	3.41
Self-perceived school performance	0.325 (0.12)**	0.01	0.05	0.08	1.10	1.38	1.75
School's involved in data collection	0.865 (0.30)**	0.04	0.14	0.20	1.33	2.38	4.26

*Table 15 - Logistic regression: positive science attitude, w1+w2, n= 679 R^2_{CS} =0.28, p<0.001 ***, p<0.01 **, p<0.05 *, p<0.10 ·*

6 Limitations

Whilst the WP3 survey managed to reach a high number of respondents two times and excavated many interesting results, the survey methodology and results also bear notable limitations.

The first limitation comes with the change of methodology induced by switching from fully paper-based survey in wave 1 to an online survey in wave 2. Whilst this switch was necessary to ensure high participation rates and data collection in terms of the COVID-19 crisis (see section 3.3), it adds a layer of methodological complications to the interpretation of survey results. Changes of respondents answering in wave 1 and wave 2 might hence also be related to the change of the survey instrument and the related, newly introduced technological effects.

Based on the specific COVID-19 induced situation, further the foreseen supervised settings of data collection could not be implemented by most partners. Thereby, a level of data quality insurance was lost. Further, the online-survey option did negatively impact the accessibility of the survey e.g. those respondents not having access to individual smart phones or computers living in remote areas (e.g. reported by CPN and BSMJ). In the context of young children, partners were particularly dependent from parental support to collect data on wave 2, which in turn bore aspects of inclusiveness as overburdened parents might not have the additional resources to do so (e.g. reported by Raumschiff). Learners with reading-difficulties, who were actively supported when answering the survey in wave 1 potentially were unreachable for wave 2.

The attribution of participant IDs was difficult for some partners, leading to detected mistakes. Potentially, however, albeit checking on major time-insensitive socio-demographics, not all mistakes might have been detected. The high stability of values over time, however, suggests that this could have only happened on a marginal scale.

The three different samples presented and discussed in this deliverable raise questions on the representativeness of the findings for the general population of young learners participating in non-formal science learning offers across Europe and Israel/Palestine. As outlined in section 5.2, processes of positive self-selection with the longitudinal sample of learners, make it likely that the sample of learners only surveyed once – be it in wave 1 or wave 2 – are more representative of the learners visiting non-formal science learning institutions and organisations. Nevertheless, these findings might not be directly relatable to young learners, who do not get in touch with non-formal science learning institutions such as museums or science centres.

Whilst actively working to ensure a strong implementation of equity aspects along the survey design, the focus on non-dominant groups was not a perfect match for the survey methodology at hand. The necessary process of parental consent for minors was reported being a barrier for potential survey respondents of non-dominant groups, who were otherwise reached by practice partner institutions. Future research projects should consider easily accessible formats for non-dominant groups.

7 Conclusions

The theoretical lens chosen in the SySTEM 2020 project perceives learning as cognitive, behavioural and emotional process that is socio-culturally embedded. Using the conception of STEAM learning ecologies, a particular focus was put on learning process happening outside of the classroom, i.e. in- and non-formal learning processes.

The report in hand focuses on the process and results of a longitudinally designed quantitative survey in 19 different non-formal science learning institutions across Europe and in Israel/Palestine. In contrast to the other tools used in SySTEM 2020 to assess learning ecologies, it provides information on the learners social and family background, allowing for the analysis of inequalities in science learning.

This investigation builds on the findings of former studies of science learning in the context of the Global North. Most notably, the study is based on the ASPIRES project and the Synergies project. Its analytical framework further rests on the evidence brought forward by multiple empirical studies of persisting inequity in science learning with regard to class and educational capital, gender identities, ethnicity and age.

The survey instrument was developed as self-administered paper-based survey that was additionally replicated as online survey for the second wave. The survey was tested using cognitive probing interviews.

Survey participants were chosen by the collaborating 19 partner institutions based on a convenience sampling strategy: Young learners across Europe and Israel/Palestine, who were aged between 9 and 20 and participated in non-formal science learning offers by partner organisations were eligible to be engaged in the SySTEM 2020 survey.

In wave 1, 1322 unique answers were collected. The data collection of the second wave resulted in 56% (n=736) thereof who were reached a second time, 586 of wave 1 were not reached a second time, additional 146 answers were collected from newly engaged respondents in wave 2. Overall, 2204 surveys have been answered, whereas a total number of 1468 individuals participated in the SySTEM 2020 WP3 survey.

Based on the descriptive and explorative analyses of the data, a detailed perspective on young learners' science learning ecologies, the way socio-demographics continue to structure a learner's connection with STEAM as well as the dynamic nature of learning ecologies were investigated.

All three samples – the longitudinal sample as well as the wave 1 only and wave 2 only sample – are gender balanced with most non-binary identifying learners being part of the longitudinal sample. Most of our surveyed learners are currently enrolled in formal education systems. The longitudinal sample tends to be the oldest sample group, with most respondents being aged between 12 and 17 years. Therefore, they also tend to have a higher level of education completed than wave 1 or wave 2 only respondents and are more likely to have working experiences than wave 2 respondents. They are also more likely to speak multiple languages at home, to live in families with a higher educational capital than wave 1-participants, and a smaller share of longitudinal respondents has made migration experiences than this is the case wave1-only-participants. Learners of the longitudinal sample are further even more likely to live in cities than the learners only surveyed once.

Learners of the longitudinal sample are a distinct group of positively self-selected participants who seem to be particularly interested into science – their connection with science might be one reason for them to stay a part of the demanding survey process. The factors underlying this positive self-selection potentially cause variations between the longitudinal sample and the pooled sample of respondents only surveyed once, which might hence be considered more representative of the learners reached by the participating non-formal science education organisations. On a general level, the representation of non-dominant groups has slightly fallen with members of non-dominant groups dropping out after wave 1 and not being reachable for wave 2. Newly included members of wave 2 in contrast largely belong to dominant and more privileged classes.

Most learners do have devices in their home that might enable science learning, such as computers or smart phones and TVs. Music instruments, on the other hand are less frequently present. The surveyed learners are highly interested in scientific topics, most of them engages in several activities which potentially foster informal science learning on a regular basis. They are also highly motivated to encourage themselves to do so more often.

An investigation of activities which might foster a particular kind of informal science learning, visualises group-based differences based on age and gender. Boys and young male-identified learners are more likely to engage in self-directed science learning, a gender-based difference that exacerbates in the longitudinal sample already at a young age, but is also present amongst male and female-identified teenagers in all samples. These gender-based differences also intersect with educational strata; boys from highly educated households are most likely to learn science informally doing self-directed science learning.

Female-identified learners on the other hand are more likely to engage in art-based science learning. Interestingly, boys of the longitudinal sample increased their level of art-based learning within the timeframe of one year, decreasing gender differences, which, however, proceed to be significant. Girls and female teenagers from highly educated families in both samples are most likely to foster this kind of science learning on a regular basis.

Science learning based on the regular engagement in team sports is equally gendered. Male-learners tend to be more likely to periodically employ these kinds of activities. Independently from gender, sport-based science learning also seems to happen more frequently at a younger age.

Similar to the findings in the ASPIRES project, the educational capital of learners' home influences whether they dis-identify with science. The higher the educational capital, the lower the probability to non-identify with science, whereas these differences exacerbate with gender – boys and male learners from educationally affluent families are the least likely to dis-identify with science.

A quarter of the longitudinal respondents, yet only 4% of our one-time surveyed learners exhibit a strongly positive science attitude. The probability to do so significantly varies with the educational capital of the respondents, with male-identified learners with high educational capital being the most likely to connect with science, enjoy science learning, but also seeing how science relates to their living realities. In contrast, the perception of science lessons in school is not impacted by educational capital of the learner. Two-thirds of all surveyed learners like their school-science lessons. In the longitudinal sample, the positive perception is likely to decrease, once learners are older than 12 years, this effect is not visible in the – on average – younger pooled sample. Attainment in school is, similar to earlier findings, gendered, but also

age-dependent; girls below age 12 are the most likely to report performing good in school. The longitudinal sample additionally shows significant effects by educational capital, with more educationally affluent learners also indicating better school attainment.

All of the surveyed learners are highly motivated to engage in activities which might potentially foster in- and non-formal science learning. Apart from this intrinsic motivation, parents, teachers, and friends are named as the most important sources of encouragement and support.

Science is not a part of every learner's home culture; the higher the educational capital of a respondent, the higher the probability that science is present in their homes. Younger learners are more likely than older learners to talk to their parents about science. These parental-child interactions were not found to be largely influenced by gender-stereotypes, vice versa, however, fathers are addressing science more often with their offsprings than mothers do. At a younger age, learners are also more likely to have peers who connect with science, whereas this is particularly the case for boys below age 12. In the longitudinal sample, a higher educational capital of the learner also makes having friends that are into science more likely.

Based on our logistic regression models, the probability to connect with science and develop a highly positive science attitude rises with:

* **change over time** (longitudinal sample)
  potentially pointing to the impact of engaging in the SySTEM 2020 project on developing a positive science attitude

* **high science importance at home**
  re-emphasising the role of socialisation

* **having friends, who like science**
  re-emphasising the role of the social environment

* **non-supportive siblings**
  potentially pointing to the fact that not all influencing factors are part of the model

* **high self-motivation** (pooled sample only)
  pointing to potential reasons for self-selection

* **liking science lessons in school**
  re-emphasising the connection between formal and non- and informal learning

* **perceiving one's own school performance as good**
  re-emphasising importance of a positive feedback on learning efforts made in school

* **regularly engaging in self-directed science learning**
  re-emphasising the role of continuous engagement

* **regularly engaging in art-based science learning** (pooled sample only)
  re-emphasising the need for a broad concept of science learning which considers informal science learning stemming from art-based activities

* **having reached a certain age**

9 to 11 year olds are less likely to (already) have a positive science attitude (longitudinal sample), 15 to 17 (longitudinal sample) / 14 to 16 (pooled sample) are more likely to have a positive science attitude (potentially pointing to the process of science attitude formation over time and processes of positive self-selection of certain age-groups)

Additionally, the regression analysis has also visualised the impact sampling mechanisms might have on the data collected. The collaboration with schools for the roll-out of the SySTEM 2020 survey led to higher positive science attitudes for respondents in the pooled sample.

These factors explain a large part of variance for the longitudinal sample (39%), but do not seem to fit the living realities of the pooled –and potentially more representative - sample equally well (28%).

Based on the comprehensive data collection and analysis undertaken, we can draw many parallels to findings confirmed by earlier studies. The STEAM learning ecologies of our learners vary with age, gender-identities and educational capital. All of these socio-demographics potentially structure the learners' self-identities, their social environments and cultures, as well as their chances to connect with science. While learning ecologies are dynamic, and form and shape themselves with time, hardly any time-related differences were detected investigating the longitudinally observed values and indices. This high stability might be in part related to the short period of one time between wave 1 and wave 2, in part, the influence of the tested socio-demographic variables – in particular of age, gender and educational capital – might have shaped the learning ecologies irrevocably.

The evidence of persisting inequities in science learning that extend beyond the classroom to the realm of in- and non-formal science learning across Europe and Israel/Palestine raises important questions of the way STEAM learning can become more equitable. These insights hence provide the empirical basis for other activities in the SySTEM 2020 project, tapping the way different methodological tools can cater for the needs of diverse learners and non-dominant groups in an inclusive and accessible way.

8 References

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9 ANNEX

9.1 Ethical Considerations

Since minors are involved in the SySTEM2020 data collection processes, specific ethical considerations have been taken in consideration when designing the survey, the recommendations for engaging potential participants as well as storing and analysing the data.

9.1.1 Survey Development

Developing both the paper-based survey as well as the online survey as instruments for data collection were guided by specific considerations of suitability and the diverse living realities of the learners to be involved in the SySTEM2020 project. The concepts and items used in the surveys were derived from other studies specifically designed for children.

The learners were directly involved in survey testing (see section 3.2 of this deliverable) (Seebacher 2019)(Seebacher 2019)(Seebacher 2019)(Seebacher 2019)(Seebacher 2019)(Seebacher 2019)(Seebacher 2019), their feedback on the piloted survey as well as during the data collection process of wave 1 was thoroughly considered in the following steps to ensure the suitability of the designed process and instrument. The ZSI ethics committee has checked and approved the source survey version for wave 1.

The online survey version was created using the ZSI-hosted version of Lime Survey to ensure data protection when collecting and analysing the responses.

9.1.2 Consent Process

When doing research with minors, giving themselves a say in whether they would like to participate and what their participation involves is recommended from an early age on (Morrow & Richards, 1996).

In order to support the involved partner institutions in the process of gaining consent, three model consent sheets have been set up by the ZSI team, whereas EMBL was crucial in supporting these efforts:

(1) A consent sheet for minor survey participants themselves

(2) A consent sheet for a guardian of minor participants, where the guardians of the involved minors are informed in a detail manner which sensitive data is going to be collected about their children.

(3) A consent sheet for survey participants who have already reached majority (whereas the legal threshold of achieving majority depends on national regulations and hence varies from country to country)

All of the consent sheet versions have been approved by ZSI's ethics committee.

The consent sheets informed the learners and their guardians in a transparent manner about the longitudinal research undertaken. Equally, it collected contact details of the learners as

well as the permission to reconnect once wave 2 is rolled-out. Lastly, the consent sheet was used to collect additional information about the family background of the learners by asking for the highest level of education completed as well as the current occupation of at least on guardian. These questions were included directly in the consent sheet in order not to overburden younger survey respondents, whereas those filling them in, are informed that their answers will be linked to the survey responses of their children (in case of minors) or themselves (in case of majors).

Participation in the study without consent was omitted. The consent sheets were thoroughly stored at the partner institutions and not shared with other institutions. In order to facilitate linking the additional questions included in the consent sheets with the surveys, as well as linking the answers given in wave 1 with answers of the same respondent in wave 2, a process of pseudonymisation was designed. That process resulted in attributing every participant a pseudonymised code consisting of a letter attributed to the organisation, the number of the data collection event and a sequential number indicating the chronological order of processing.

A key document storing all the contact details of the respondents and their guardians as well as the code was created by the partner organisation collecting the data. These key-documents were stored safely within the institutions, were not shared and will be deleted at the earliest possible time and latest at the end of the SySTEM 2020 project.

9.1.3 Data collection

Data collection with paper surveys in wave 1 and wave 2 happened supervised settings with personnel trained in working with children and young learners, being able to support especially younger or slow learners in the answering process and hence specifically strived to be accessible and inclusive (see chapter 5).

When reaching out to participants of wave 1 for wave 2, practice partners used the agreed contact details of the consent sheet and got in touch with the learners' parent(s) (in case of minors) and the learners themselves.

The online survey version increased the accessibility of the tool, however, the particular survey for data collection of wave 2 was only accessible using token-based, personalised links, which were sent out by the practice partner institution in charge. When additional new respondents were engaged in wave 2, partners were required to obtain the learners' parent(s) and the learners' consent prior to their inclusion in the survey. The additional Lime Survey for new respondents offered link-based access.

9.1.4 Data storage and analysis

The paper-based surveys were coded directly by the collecting partner institution and only virtually sent to ZSI in a pseudonymised version using the participant code explained in the previous section (4.2). ZSI stored these files at its local servers and did not distribute these data files beyond consortium members. The online survey version was created with Lime Survey that is directly hosted at ZSI servers to ensure data protection.

Further, data was analysed in an aggregate manner, groups too small for aggregation were excluded in group-specific analysis to prevent personal identification of respondents. The

results of the analysis will be openly available, for research purposes, the underlying data will be indefinitely stored at ZSI servers. [13]

9.2 Table of results

(All p-values are Bonferroni-corrected based on the number of comparisons)

concept	influencing variables	group	mean	test statistics						group size(n)
Self-directed science learning in a narrow sense (long. sample) [0-4]0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Time	no significant changes between wave 1 and wave 2 identified								
	Age	no significant differences by age-groups identified								
	Age & Gender	**group**	**mean**	**female<12**		**male<12**		**female>12**	**male>12**	**n**
		female<12	1.47			p<0.05 r=0.31			p<0.05 r=0.18	61
		male<12	2.02	p<0.05 r=0.31				p<0.001 r=0.22		70
		female>12	1.55			p<0.001 r=0.22			p<0.001 r=0.20	320
		male>12	1.89	p<0.05 r=0.18				p<0.001 r=0.20		273
	Gender	**group**	**mean**	**female**				**male**		**n**
		female	1.54					p<0.001 r=0.22		381
		male	1.91	p<0.001 r=0.22						343
	Educ. Capital	no significant differences by educational strata identified								
	Educational Capital & Gender	**group**	**mean**	**f-low**	**m-low**	**f-med**	**m-med**	**f-high**	**m-high**	**n**
		f-low	1.51						p<0.01 r=0.28	46
		m-low	1.71							38
		f-med	1.52				p<0.05 r=0.18		p<0.001 r=0.34	157
		m-med	1.82			p<0.05 r=0.18		p<0.05 r=0.17		145
		f-high	1.53				p<0.05 r=0.17		p<0.001 r=0.34	162
		m-high	2.12	p<0.01 r=0.28		p<0.001 r=0.34		p<0.001 r=0.34		135

[13] The Consent Sheets informed the participants about these data storage and analyses procedures.

concept	influencing variables	group	mean	test statistics						group size(n)
Self-directed science learning in a narrow sense (w1+w2 sample) [0-4]0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Age	no significant differences by age-groups identified								
	Age & Gender	group	mean	female<12		male<12		female>12	male>12	n
		female<12	1.58							90
		male<12	1.83					p<0.05 r=0.16		97
		female>12	1.52			p<0.05 r=0.16			p<0.01 r=0.19	255
		male>12	1.8					p<0.01 r=0.19		248
	Gender	group	mean	female				male		n
		female	1.53					p<0.001 r=0.15		345
		male	1.81	p<0.001 r=0.15						345
	Educational Capital	group	mean	low		medium		high		n
		low	1.47					p<0.05 r=0.12		111
		medium	1.62							399
		high	1.72	p<0.05 r=0.12						289
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	1.35						p<0.01 r=0.28	58
		m-low	1.61							49
		f-med	1.59						p<0.01 r=0.20	157
		m-med	1.70							128
		f-high	1.57						p<0.05 r=0.19	127
		m-high	1.92	p<0.01 r=0.28		p<0.01 r=0.20		p<0.05 r=0.19		145

concept	influencing variables	group	mean	test statistics								group size(n)
Art--centred Science Learning (long. sample - part I) [0-4]0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Time	group	mean	wave 1				wave 2				n
		wave 1	1.65					p=0.001 r=0.12				734
		wave 2	1.75	p=0.001 r=0.12								735
	Age & Time	group	mean	8-11 w1	9-11 w2	12-14 w1	12-14 w2	15-17 w1	15-17 w2	18-20 w1	18-21 w2	n
		8-11 w1	1.74		p<0.05 r=0.25							132
		9-11 w2	1.97	p<0.05 r=0.25							p<0.001 r=0.25	132
		12-14 w1	1.64				p<0.05 r=0.20					221
		12-14 w2	1.77			p<0.05 r=0.20					p<0.01 r=0.19	221
		15-17 w1	1.69									245
		15-17 w2	1.69									245
		18-20 w1	1.24									134
		18-21 w2	1.26		p<0.001 r=0.25		p<0.01 r=0.19					134
	Age & Gender w2	group	mean	female<12		male<12		female>12		male>12		n
		female<12	2.14							p<0.001 r=0.23		61
		male<12	1.87							p<0.05 r=0.15		70
		female>12	1.89							p<0.001 r=0.19		320
		male>12	1.49	p<0.001 r=0.23		p<0.05 r=0.15		p<0.001 r=0.19				273
	Gender & Time	group	mean	female w1		female w2		male w1		male w2		n
		female w1	1.90					p<0.001 r=0.25				342
		female w2	1.93							p<0.001 r=0.17		342
		male w1	1.39	p<0.001 r=0.25						p<0.001 r=0.20		342
		male w2	1.57			p<0.001 r=0.17		p<0.001 r=0.20				342

concept	influencing variables	group	mean	test statistics						group size(n)
Art--centred Science Learning (long. sample part II) [0-4]0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Educational Capital & Gender w2	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	1.49					p<0.001 r=0.32		46
		m-low	1.11			p<0.001 r=0.30		p<0.001 r=0.41	p<0.001 r=0.33	38
		f-med	1.88		p<0.001 r=0.30		p<0.01 r=0.22			157
		m-med	1.40			p<0.01 r=0.22		p<0.001 r=0.37		145
		f-high	2.20	p<0.001 r=0.32	p<0.001 r=0.41		p<0.001 r=0.37			162
		m-high	1.92		p<0.001 r=0.33					135
	Educational Capital & Time	group	mean	low w1	low w2	med w1	med w2	high w1	high w2	n
		low w1	1.15			p<0.01 r=0.17		p<0.001 r=0.33	p<0.001 r=0.32	85
		low w2	1.32							85
		med w1	1.56	p<0.01 r=0.17				p<0.001 r=0.19		306
		med w2	1.63						p<0.001 r=0.21	306
		high w1	1.95	p<0.001 r=0.33		p<0.001 r=0.19			p<0.05 r=0.14	301
		high w2	2.07		p<0.001 r=0.32		p<0.001 r=0.21	p<0.05 r=0.14		301

concept	influencing variables	group	mean	test statistics						group size(n)
Art-centred science learning (w1+w2 sample) [0-4]0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Age	no significant differences by age-groups identified								
	Age & Gender	group	mean	female<12		male<12		female>12		male>12		n
		female<12	1.83			p<0.01 r=0.26				p<0.001 r=0.22		91
		male<12	1.31	p<0.01 r=0.26				p<0.05 r=0.15				98
		female>12	1.62			p<0.05 r=0.15				p<0.01 r=0.16		257
		male>12	1.31	p<0.001 r=0.22				p<0.01 r=0.16				248
	Gender	group	mean	female				male				n
		female	1.68					p<0.001 r=0.18				348
		male	1.31	p<0.001 r=0.18								346
	Educational Capital	group	mean	low		medium		high				n
		low	1.17			p<0.05 r=0.14		p<0.001 r=0.22				112
		medium	1.50	p<0.05 r=0.14								299
		high	1.67	p<0.001 r=0.22								291
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high			n
		f-low	1.27					p<0.01 r=0.29				59
		m-low	1.10			p<0.01 r=0.25		p<0.001 r=0.34				49
		f-med	1.70		p<0.01 r=0.25		p<0.001 r=0.23					157
		m-med	1.23			p<0.01 r=0.23		p<0.001 r=0.33				128
		f-high	1.87	p<0.01 r=0.29	p<0.001 r=0.34		p<0.001 r=0.33		p<0.05 r=0.19			127
		m-high	1.47					p<0.05 r=0.19				145

concept	influencing variables	group	mean	test statistics				group size(n)
Sport-centred science learning (long. sample) [0-4] 0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Time	no significant changes between wave 1 and wave 2 identified						
	Age	group	mean	9-11	12-14	15-17	18-21	n
		9-11	2.21			p<0.001 r=0.25	p<0.001 r=0.34	133
		12-14	2.06			p<0.001 r=0.20	p<0.001 r=0.28	222
		15-17	1.54	p<0.001 r=0.25	p<0.001 r=0.20			245
		18-21	1.33	p<0.001 r=0.34	p<0.001 r=0.28			134
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	2.05			p<0.05 r=0.16		61
		male<12	2.36			p<0.001 r=0.27		70
		female>12	1.46	p<0.05 r=0.16	p<0.001 r=0.27		p<0.001 r=0.19	320
		male>12	1.96			p<0.001 r=0.19		273
	Gender	group	mean	female		male		n
		female	1.56			p<0.001 r=0.18		381
		male	2.04	p<0.001 r=0.18				343
	Educ. Capital	no significant differences by educational strata identified						
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	1.16		p<0.05 r=0.34		p<0.05 r=0.23		p<0.001 r=0.32	46
		m-low	2.05	p<0.05 r=0.34						38
		f-med	1.56						p<0.01 r=0.22	157
		m-med	1.87	p<0.05 r=0.23						145
		f-high	1.77							162
		m-high	2.12	p<0.001 r=0.32		p<0.01 r=0.22				135

concept	influencing variables	group	mean	test statistics				group size(n)
Sport-centred science learning (w1+w2 sample) [0-4] 0= hardly ever or never, 1= yearly, 2=monthly, 3=weekly, 4=daily	Age	group	mean	8-11	12-14	15-17	18-21	n
		8-11	2.15				p<0.01 r=0.22	193
		12-14	1.90					228
		15-17	1.86					239
		18-21	1.44	p<0.01 r=0.22				63
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	1.64		p<0.001 r=0.36		p<0.01 r=0.17	90
		male<12	2.58	p<0.001 r=0.36		p<0.001 r=0.36	p<0.05 r=0.15	98
		female>12	1.55				p<0.001 r=0.23	256
		male>12	2.15	p<0.01 r=0.17	p<0.05 r=0.15	p<0.001 r=0.23		248
	Gender	group	mean	female		male		n
		female	1.58			p<0.001 r=0.27		346
		male	2.27	p<0.001 r=0.27				346
	Educ. Capital	no significant differences by educational strata identified						
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	1.36				p<0.001 r=0.32		p<0.001 r=0.28	57
		m-low	2.10							49
		f-med	1.68				p<0.001 r=0.27		p<0.001 r=0.22	157
		m-med	2.36	p<0.001 r=0.32		p<0.001 r=0.27		p<0.001 r=0.32		128
		f-high	1.58				p<0.001 r=0.32		p<0.001 r=0.27	127
		m-high	2.25	p<0.001 r=0.28		p<0.001 r=0.22		p<0.001 r=0.27		145

concept	influencing variables	group	mean	test statistics						group size (n)
Non-identification with science (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified								
	Age	no significant differences between age groups identified								
	Age & Gender	no significant differences between age groups and gender identified								
	Gender	no significant differences by gender identified								
	Educational Capital	group	mean	low		medium		high		n
		low	3.13			p<0.01 r=0.16		p<0.001 r=0.26		83
		medium	3.48	p<0.01 r=0.16				p<0.01 r=0.13		304
		high	3.73	p<0.001 r=0.26		p<0.01 r=0.13				296
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	3.21						p<0.01 r=0.29	44
		m-low	3.04			p<0.05 r=0.29		p<0.01 r=0.25	p<0.001 r=0.39	38
		f-med	3.52		p<0.05 r=0.29				p<0.01 r=0.21	155
		m-med	3.43						p<0.001 r=0.24	144
		f-high	3.6		p<0.01 r=0.25					160
		m-high	3.9	p<0.01 r=0.29	p<0.001 r=0.39	p<0.01 r=0.21	p<0.001 r=0.24			133

concept	influencing variables	group	mean	test statistics						group size (n)
Non-identification with science (w1+w2 sample) [1-5] <3=disagreement, >3=agreement	Age	no significant differences between age-groups identified								
	Age & Gender	no significant differences between age-groups by gender identified								
	Gender	no significant differences between age-groups by gender identified								
	Educational Capital	group	mean	low		medium		high		n
		low	3.03			p<0.05 r=0.14		p<0.01 r=0.25		111
		medium	3.35	p<0.05 r=0.14				p<0.001 r=0.16		295
		high	3.63	p<0.01 r=0.25		p<0.001 r=0.16				290
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	3.02					p<0.05 r=0.22	p<0.001 r=0.33	58
		m-low	3.03					p<0.05 r=0.24	p<0.001 r=0.31	49
		f-med	3.31						p<0.001 r=0.24	156
		m-med	3.39						p<0.05 r=0.20	127
		f-high	3.52	p<0.05 r=0.22	p<0.05 r=0.24					127
		m-high	3.75	p<0.001 r=0.33	p<0.001 r=0.31	p<0.001 r=0.24	p<0.05 r=0.20			145

concept	influencing variables	group	mean	test statistics						group size (n)
Positive science attitude (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified								
	Age	no significant differences between age-groups identified								
	Age & Gender	no significant differences between age-groups by gender identified								
	Gender	no significant differences between age-groups by gender identified								
	Educational Capital	group	mean	low		medium		high		n
		low	3.64					p<0.01 r=0.16		83
		medium	3.7					p<0.001 r=0.16		306
		high	3.93	p<0.01 r=0.16		p<0.001 r=0.16				298
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	3.77							44
		m-low	3.46						p<0.01 r=0.29	38
		f-med	3.76						p<0.01 r=0.21	156
		m-med	3.63						p<0.001 r=0.28	144
		f-high	3.79							160
		m-high	4.08		p<0.01 r=0.29	p<0.01 r=0.21	p<0.001 r=0.28			134

concept	influencing variables	group	mean	test statistics						group size (n)
Positive science attitude (w1+w2 sample) [1-5] <3=disagreement, >3=agreement	Age	no significant differences between age-groups identified								
	Age & Gender	no significant differences between age-groups by gender identified								
	Gender	no significant differences between age-groups by gender identified								
	Educational Capital	group	mean	low		medium		high		n
		low	3.37			p<0.05 r=0.13		p<0.001 r=0.25		112
		medium	3.68	p<0.05 r=0.13				p<0.01 r=0.14		298
		high	3.92	p<0.001 r=0.25		p<0.01 r=0.14				291
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	3.27					p<0.001 r=0.29	p<0.001 r=0.29	59
		m-low	3.54							49
		f-med	3.72							157
		m-med	3.68							128
		f-high	3.91	p<0.001 r=0.29						127
		m-high	3.95	p<0.001 r=0.29						145

concept	influencing variables	group	mean	test statistics				group size (n)
Positive perception of science lessons (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified						
	Age	group	mean	9-11	12-14	15-17	18-21	n
		9-11	4.23		p<0.001 r=0.25	p<0.001 r=0.22	p<0.001 r=0.33	121
		12-14	3.68	p<0.001 r=0.25				205
		15-17	3.75	p<0.001 r=0.22				220
		18-21	3.5	p<0.001 r=0.33				110
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	4.16			p<0.05 r=0.16	p<0.05 r=0.18	57
		male<12	4.3			p<0.001 r=0.23	p<0.001 r=0.24	63
		female>12	3.67	p<0.05 r=0.16	p<0.001 r=0.23			286
		male>12	3.68	p<0.05 r=0.18	p<0.001 r=0.24			243
	Gender	no significant differences by gender identified						
	Educ. Capital	no significant differences by educational strata identified						
	Educ. Capital & Gender	no significant differences by educational strata and gender identified						

concept	influencing variables	group	mean	test statistics	group size (n)
Positive perception of science lessons (w1+w2 sample)	Age	no significant differences by age group identified			
	Age & Gender	no significant differences by age and gender identified			
	Gender	no significant differences by gender identified			
	Educ. Capital	no significant differences by educational strata identified			
	Educ. Capital & Gender	no significant differences by educational strata and gender identified			

concept	influencing variables	group	mean	test statistics						group size (n)
Self-reported school performance (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified								
	Age	group	mean	9-11		12-14		15-17		n
		9-11	4.13					p<0.01 r=0.17		127
		12-14	3.91							213
		15-17	3.84	p<0.01 r=0.17						234
		18-21	3.92							121
	Age & Gender	group	mean	female<12		male<12		female>12		n
		female<12	4.14						p<0.05 r=0.18	57
		male<12	4.1						p<0.01 r=0.19	69
		female>12	4.02						p<0.01 r=0.16	299
		male>12	3.73	p<0.05 r=0.18		p<0.01 r=0.19		p<0.01 r=0.16		262
	Gender	group	mean	female				male		n
		female	4.04					p<0.01 r=0.12		356
		male	3.08	p<0.01 r=0.12						331
	Educational Capital	group	mean	low		medium		high		n
		low	3.58					p<0.001 r=0.26		83
		medium	3.81					p<0.001 r=0.20		296
		high	4.16	p<0.001 r=0.26		p<0.001 r=0.20				291
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	3.7					p<0.05 r=0.25		44
		m-low	3.45					p<0.01 r=0.27	p<0.01 r=0.27	38
		f-med	3.99				p<0.05 r=0.20			151
		m-med	3.62			p<0.05 r=0.20		p<0.001 r=0.31	p<0.001 r=0.28	141
		f-high	4.17	p<0.05 r=0.25	p<0.01 r=0.27		p<0.001 r=0.31			156
		m-high	4.13		p<0.01 r=0.27		p<0.001 r=0.28			132

concept	influencing variables	group	mean	test statistics				group size (n)
Self-reported school performance (w1+w2 sample) [1-5] <3=disagreement, >3=agreement	Age	group	mean	8-11	12-14	15-17	18-21	n
		8-11	4.25		p<0.05 r=0.15	p<0.001 r=0.26		192
		12-14	4.00	p<0.0gi5 r=0.15				225
		15-17	3.89	p<0.001 r=0.26				238
		18-21	4.02					63
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	4.44		p<0.05 r=0.23	p<0.001 r=0.22	p<0.001 r=0.27	91
		male<12	4.04	p<0.05 r=0.23				96
		female>12	4.02	p<0.001 r=0.22				255
		male>12	3.88	p<0.001 r=0.27				244
	Gender	group	mean	female		male		n
		female	4.13			p<0.01 r=0.11		346
		male	3.92	p<0.01 r=0.11				340
	Educ. Capital	no significant differences by educational strata identified						
	Educ. Capital & Gender	no significant differences by educational strata and gender identified						

concept	influencing variables	group	mean	test statistics				group size (n)
Science importance at home (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified						
	Age	group	mean	9-11	12-14	15-17	18-21	n
		9-11	3.18			p<0.01 r=0.17	p<0.05 r=0.17	133
		12-14	3.02					216
		15-17	2.74	p<0.01 r=0.17				241
		18-21	2.78	p<0.05 r=0.17				133
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	3.02					60
		male<12	3.33			p<0.05 r=0.15	p<0.05 r=0.17	69
		female>12	2.88		p<0.05 r=0.15			315
		male>12	2.83		p<0.05 r=0.17			267
	Gender	no significant differences by gender identified						
	Educational Capital	group	mean	low	medium	high		n
		low	2.53			p<0.001 r=0.24		83
		medium	2.72			p<0.001 r=0.22		304
		high	3.24	p<0.001 r=0.24	p<0.001 r=0.22			296
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	2.51					p<0.05 r=0.22	p<0.001 r=0.30	44
		m-low	2.54						p<0.01 r=0.28	38
		f-med	2.79						p<0.001 r=0.25	155
		m-med	2.68					p<0.01 r=0.21	p<0.001 r=0.29	144
		f-high	3.15	p<0.05 r=0.22			p<0.01 r=0.21			160
		m-high	3.35	p<0.001 r=0.30	p<0.01 r=0.28	p<0.001 r=0.25	p<0.001 r=0.29			133

concept	influencing variables	group	mean	test statistics				group size (n)
Science importance at home (w1+w2 sample) [1-5] <3=disagreement, >3=agreement	Age	group	mean	8-11	12-14	15-17	18-21	n
		8-11	3.31		p<0.05 r=0.14	p<0.01 r=0.18	p<0.05 r=0.18	191
		12-14	2.95	p<0.05 r=0.14				228
		15-17	2.87	p<0.01 r=0.18				239
		18-21	2.78	p<0.05 r=0.18				239
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	3.36				p<0.01 r=0.18	90
		male<12	3.27				p<0.01 r=0.16	96
		female>12	3.01					256
		male>12	2.83	p<0.01 r=0.18	p<0.01 r=0.16			248
	Gender	no significant differences by gender identified						
	Educational Capital	group	mean	low	medium	high		n
		low	2.70			p<0.001 r=0.18		111
		medium	2.90			p<0.01 r=0.13		295
		high	3.21	p<0.001 r=0.18	p<0.01 r=0.13			290
	Educational Capital & Gender	group	mean	f-low	m-low	f-med	m-med	f-high	m-high	n
		f-low	2.78							58
		m-low	2.46							49
		f-med	2.97							156
		m-med	2.9					p<0.05 r=0.20		127
		f-high	3.36				p<0.05 r=0.20			127
		m-high	3.17							145

concept	influencing variables	group	mean	test statistics				group size (n)
Positive peer attitudes to science (long. sample) [1-5] <3=disagreement, >3=agreement	Time	no significant changes between wave 1 and wave 2 identified						
	Age	group	mean	9-11	12-14	15-17	18-21	n
		9-11	3.40		p<0.001 r=0.23			130
		12-14	2.86	p<0.001 r=0.23				215
		15-17	3.04					238
		18-21	3.07					133
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	3.3					60
		male<12	3.51			p<0.05 r=0.15	p<0.01 r=0.19	69
		female>12	3.02		p<0.05 r=0.15			311
		male>12	2.93		p<0.01 r=0.19			267
	Gender	no significant differences by gender identified						
	Educational Capital	group	mean	low	medium	high		n
		low	2.84			p<0.05 r=0.13		83
		medium	2.94			p<0.05 r=0.12		302
		high	3.21	p<0.05 r=0.13	p<0.05 r=0.12			295
	Educ. Capital & Gender	no significant differences by educational capital and gender identified						

concept	influencing variables	group	mean	test statistics				group size (n)
Positive peer attitudes to science (w1+w2 sample) [1-5]	Age	no significant differences by age group identified						
	Age & Gender	group	mean	female<12	male<12	female>12	male>12	n
		female<12	3.1					88
		male<12	3.43			p<0.05 r=0.16		97
		female>12	2.96		p<0.05 r=0.16			253
		male>12	3.11					247
	Gender	group	mean	female		male		n
		female	2.99			p<0.05 r=0.08		341
		male	3.20	p<0.05 r=0.08				344
	Educ. Capital	no significant differences by educational strata identified						
	Educ. Capital & Gender	no significant differences by educational strata and gender identified						

9.3 Survey Versions Wave 1

9.3.1 English Standard Survey Wave 1

QUESTIONNAIRE:
Things I Like To Do Both In and Out of School

Thank you for your help with this survey! Our aim is to find out what young people between 9 and 20 years like to do and what they think about a range of issues related to science, their leisure activities or the groups they are part of.

Please read each question carefully and choose the answer that applies to you.

- With most questions you simply tick the circle "○"next to the answer that describes you best.
- When you see questions with boxes "☐"instead, you can select more than one answer.
- Whenever you find a line like this: "_____" you are asked to write something down.

Some of the questions specifically ask about your mother or your father – if this does not relate to your personal situation, please answer these questions in relation to people who are like a mother or a father to you, for example guardians, stepparents, foster parents...

This is not a test, there are no right or wrong answers - we are interested in your honest answers and opinions only!

➔ First, please tell us **YOUR NAME**:_____

THINGS I LIKE TO DO

1. **HOW OFTEN** do you do the following activities **outside of school hours**? Please tick the circle in the corresponding column.

Activity	Every day or almost every day	1-2 times a week	1-2 times a month	A few times a year	Hardly ever or never
Use a library	O	O	O	O	O
Visit a farm, a zoo or an aquarium	O	O	O	O	O
Visit a science gallery, exhibition or museum	O	O	O	O	O
Participate in an after-school activity (e.g. music or dance classes)	O	O	O	O	O
Cook or bake	O	O	O	O	O
Do sport in a team (e.g. soccer)	O	O	O	O	O
Do sport by yourself (e.g. running, dancing)	O	O	O	O	O
Spend time outdoors	O	O	O	O	O
Garden or grow plants at home	O	O	O	O	O
Do science experiments at home	O	O	O	O	O
Read a book or magazine not for school	O	O	O	O	O
Visit websites to learn about things you're interested in out-of-school-hours	O	O	O	O	O
Use a computer, game console, pad or mobile phone to play games at home	O	O	O	O	O
Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter	O	O	O	O	O
Watch a video about science, maths, or technology in out-of-school-hours	O	O	O	O	O
Build or take things apart or repair things	O	O	O	O	O
Take care of pets	O	O	O	O	O
Play a musical instrument or sing or hum	O	O	O	O	O
Actively listen to music	O	O	O	O	O
Do you do an activity not listed? Tell us what it is: _____ _____ _____	O	O	O	O	O

2. If you had to **pick just one** of the activities from the list above (including the ones you added), **which ONE** do you **like most**?

_____

3. **WHO** do you usually do **this activity** with? (You can tick more than one answer)
   - ☐ A Parent or Guardian
   - ☐ A Sister or Brother
   - ☐ A Grandparent or other Relative
   - ☐ A Teacher
   - ☐ A Friend or Friends
   - ☐ I do this activity on my own
   - ☐ Someone else – who is it? _____

GROUPS I'M PART OF

What teams or groups are you a part of or have been a part of? Which groups would you like to join if you could?

- Tick the **first circle** if you already participate in such a group or have been part of.
- Tick the **second circle** if you don't participate in the group, but would like to if you could.
- Tick the **last circle**, if you are not in such a group, and also not interested in joining.

4. **Groups I'm part of or would like to join / Groups I have been part of for some time**

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
A sports club (such as soccer, tennis)	o	o	o
Scout troop	o	o	o
A choir, music or dance class	o	o	o
Drama or acting class	o	o	o
Cooking or sewing class	o	o	o

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
Religious youth group	○	○	○
Another group or club _____ _____ _____	○	○	○

WHO ENCOURAGES YOU TO DO THE THINGS YOU DO?

For each activity, **tick a box for each person who encourages you to do this.** You can put **more than one tick** in one row, if necessary.

For example, if your mother and sister encourage you to use the library, put a check by "A parent or guardian encourages me to do this" and by "A sister or brother encourages me to do this."

5. Who encourages you to do the things you do?

	I don't do this	A **parent** or guardian encourages me	A **sister** or **brother** encourages me	A **grand-parent** or **other relative** encourages me	A **teacher** encourages me	A **friend** encourages me	**I** motivate **myself**
Go to a science gallery, exhibition or museum	☐	☐	☐	☐	☐	☐	☐
Use a library	☐	☐	☐	☐	☐	☐	☐
Take part in sports	☐	☐	☐	☐	☐	☐	☐
Spend time outdoors	☐	☐	☐	☐	☐	☐	☐
Garden or grow plants at home	☐	☐	☐	☐	☐	☐	☐
Cook or bake	☐	☐	☐	☐	☐	☐	☐

	I don't do this	A parent or guardian encourages me	A sister or brother encourages me	A grand-parent or other relative encourages me	A teacher encourages me	A friend encourages me	I motivate myself
Read a book or magazine not for school	☐	☐	☐	☐	☐	☐	☐
Visit web-sites to learn about things you're interested in	☐	☐	☐	☐	☐	☐	☐
Watch a video about science, maths, or technology	☐	☐	☐	☐	☐	☐	☐
Build or take things apart	☐	☐	☐	☐	☐	☐	☐
Take care of pets	☐	☐	☐	☐	☐	☐	☐
Play a musical instrument or sing or hum	☐	☐	☐	☐	☐	☐	☐
Your favourite activity (the activity you have listed in the previous section in Question 2): _____ _____ _____ _____	☐	☐	☐	☐	☐	☐	☐

4

QUESTIONS ABOUT SCIENCE

6. **How do you feel** when you think of '**SCIENCE**'? Please answer the following 3 questions and tick the circle on each of the three rows which best describes your feelings:

○	○	○	○	○	
Bored		Neutral		Fascinated	
○	○	○	○	○	
Means nothing		Neutral		Means a lot	
○	○	○	○	○	
Afraid		Neutral		Excited	

7. Are there **science topics** that you find **particularly interesting?** (To give you some examples: planets, mixing materials, computers, the weather, plants, the human body, genetics, earthquakes, animals, hurricanes, building bridges, engines, GPS, ecology and food can all be science topics you are interested in.)	Yes	No
	○	○

8. If **yes, which ones**? Please list them in the box below!

Below you find a list of statements. Some people agree with them and others do not. **What do you think?** For each line, please only tick one circle.

9. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot
I enjoy learning science	O	O	O	O	O
Other people of my age find it easier to learn science topics than I do	O	O	O	O	O
My close friends like science	O	O	O	O	O
My mother talks to me about science	O	O	O	O	O
I find science to be really interesting	O	O	O	O	O
I think I would make a good scientist	O	O	O	O	O
I see how science relates to my life	O	O	O	O	O
My close friends enjoy science	O	O	O	O	O
My parents are interested in science	O	O	O	O	O
Science is helpful in understanding today's world	O	O	O	O	O
My father talks to me about science	O	O	O	O	O
I have no idea what my family thinks of science	O	O	O	O	O
My way of thinking and learning makes it hard to understand science	O	O	O	O	O
Science is not for me	O	O	O	O	O

QUESTIONS ABOUT SCHOOL

10. Please choose your **circumstances**: (More than one answer is possible)

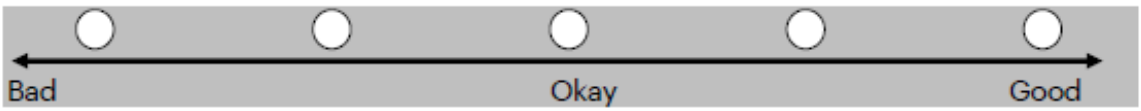
- ☐ Going to **school** or university
- ☐ **Apprenticeship** / vocational work
- ☐ Part time or full time **employed** or self-employed
- ☐ Undertaking **voluntary work**
- ☐ **Unemployed** and looking for a job
- ☐ **Unemployed** and **not looking** for a job
- ☐ **Carer** / homemaker
- ☐ **Military Service**
- ☐ Other: _____

The following questions deal with your **school-experiences**. If you are currently **not enrolled**, please answer them with regard to your **last school year**.

11. Which, if any of these, is your **favourite subject at school**? Tick the circle next to the category that contains your favourite. (Please choose only one answer)

- ○ **Natural Sciences** (Biology, Physics, Chemistry, Geology)
- ○ **Arts and humanities** (music, history, religious education, languages, art, geography, social sciences)
- ○ **Mathematics**
- ○ **Physical education**
- ○ **None** of these
- ○ I **like all** of them **equally**
- ○ Other:_____

12. In general, how do **your teachers** perceive **your achievement at school?**



Below you find **two statements**. Some people agree with them and others do not. What do you think? For each statement, please choose and tick one circle that captures your opinion in the best possible way.

13. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	I don't have science in school
Science lessons are exciting.	○	○	○	○	○	○
I look forward to my science lessons.	○	○	○	○	○	○

ABOUT ME

The following questions want to get to know you better. Please help us with this!

14. How **old** are you? _____ years old

15. What **gender** do you identify with? _____

16. Where do you **live**? (Please tick one!)

- ○ In the country side
- ○ In the outskirts of a city or close to a city
- ○ In the city

17. In which **country** were you **born**? I was born in _____

18. Have you ever lived in a different country?

- ○ Yes
- ○ No

19. Is English your **first language?**

- ○ Yes
- ○ No

If not, what is your first language?

_____

Below you find **two statements**. Some people agree with them and others do not. What do you think? For each statement, please choose and tick one circle that captures your opinion in the best possible way.

13. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	I don't have science in school
Science lessons are exciting.	O	O	O	O	O	O
I look forward to my science lessons.	O	O	O	O	O	O

ABOUT ME

The following questions want to get to know you better. Please help us with this!

14. How **old** are you? _____ years old

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- O In the outskirts of a city or close to a city
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17. In which **country** were you **born**? I was born in _____

18. Have you ever lived in a different country?

- O Yes
- O No

19. Is English your **first language?**

- O Yes
- O No

If not, what is your first language?

_____

20. What **languages** do **adults in your home** use when talking to each other?

_____

21. What **languages** do **you speak at home**?

_____

22. **How many people** live in **your home** in total – **including yourself**?

_____

23. **Who** do you live **at home** with?

Your mother	☐
Your father	☐
Your guardians or foster parents	☐
Your grandparents	☐
Your sisters and brothers	☐
Other relatives	☐
Your child or children	☐
Someone else? Who? _____ _____	☐

24. Do you experience serious **difficulties** with hearing, seeing, speaking or moving?

- ○ Yes
- ○ No

25. Which of these **education levels** have you **completed fully**? (More than one answer is possible)

- ☐ Pre-school education
- ☐ Primary education
- ☐ Secondary education (Junior Certificate)
- ☐ Secondary education (Leaving Certificate)
- ☐ Third Level Education
- ☐ Other:_____

26. Have you any experience of working a job?

- ○ No
- ○ Yes

If **yes, WHAT** did you do? (More than one answer is possible)

- ☐ Summer job
- ☐ Internship
- ☐ Consultant or contractor
- ☐ Part time job
- ☐ Full time job

27. How many books can be found in your **home**? (Do not count magazines, newspapers or school books)

- ○ **None** or very **few** (0-10 books)
- ○ Enough to fill **one shelf** (11-25 books)
- ○ Enough to fill **one bookcase** (26-100 books)
- ○ Enough to fill **two bookcases** (101-200 books)
- ○ Enough to fill **three or more bookcases** (more than 200 books)

28. How many of the following **items** can be found in your **home**?

	None	1	2-4	5 or More
Televisions	○	○	○	○
Cars, vans or trucks	○	○	○	○
Smart phones in use	○	○	○	○
Computers and tablets	○	○	○	○
Music instruments (e.g. a guitar or a piano)	○	○	○	○

THANK YOU FOR ANSWERING ALL THESE QUESTIONS!

9.3.2 Translated Surveys Wave 1

WAS ICH GERNE MACHE AUßERHALB DER SCHULZEIT

1. **WIE OFT** machst du die folgenden Dinge **außerhalb der Schulzeit**? Bitte kreuze den Kreis in der entsprechenden Spalte an.

Aktivität	**Jeden Tag** oder **fast** jeden Tag	**1-2-mal pro Woche**	**1-2-mal pro Monat**	**Ein paar Mal im Jahr**	**Fast nie** oder **nie**
Eine Bibliothek benutzen	o	o	o	o	o
Einen Bauernhof, einen Zoo oder ein Aquarium besuchen	o	o	o	o	o
Wissenschaftsausstellung Wissenschaftsmuseum oder Wissenschaftsgalerie besuchen	o	o	o	o	o
An einer außerschulischen Aktivität teilnehmen (z. B. Instrument, Musik- oder Tanzkurs)	o	o	o	o	o
Kochen oder Backen	o	o	o	o	o
Sport in einer Mannschaft treiben (z. B. Fußball spielen)	o	o	o	o	o
Sport allein treiben (z. B. Laufen oder Tanzen)	o	o	o	o	o
Zeit draußen verbringen	o	o	o	o	o
Gärtnern oder Pflanzen zu Hause ziehen	o	o	o	o	o
Wissenschaftliche Experimente zu Hause durchführen	o	o	o	o	o
Ein Buch oder eine Zeitschrift nicht für die Schule lesen	o	o	o	o	o
Internetseiten außerhalb der Schulzeit besuchen, um mehr über Dinge zu erfahren, die dich interessieren	o	o	o	o	o
Spiele an einem Computer, einer Spielkonsole, einem Tablet oder einem Handy zu Hause spielen	o	o	o	o	o
Soziale Medien wie Instagram, YouTube, Snapchat, Facebook oder Twitter benutzen	o	o	o	o	o
Ein Video über Wissenschaft, Mathematik oder Technologie außerhalb der Schulzeit ansehen	o	o	o	o	o
Dinge bauen, zerlegen oder reparieren	o	o	o	o	o
Haustiere versorgen	o	o	o	o	o
Ein Musikinstrument spielen, Singen oder Summen	o	o	o	o	o
Aktiv Musik hören	o	o	o	o	o
Machst du etwas, was hier nicht aufgeführt ist? Teile uns bitte mit, <u>was</u> das ist: _____ _____ _____	o	o	o	o	o

KAJ RAD-A POČNEM

1. **KAKO POGOSTO** opravljaš spodnje izvenšolske dejavnosti? Označi krogec v ustreznem stolpcu.

Dejavnost	**Vsak dan** ali **skoraj** vsak dan	**1–2 x tedensko**	**1–2 x mesečno**	**Nekajkrat na leto**	**Skoraj nikoli** ali **nikoli**
Grem v knjižnico	o	o	o	o	o
Obiščem kmetijo, živalski vrt ali akvarij	o	o	o	o	o
Obiščem znanstveno galerijo, razstavo ali muzej	o	o	o	o	o
Sodelujem v **izvenšolskih** dejavnostih (npr. glasbeni ali plesni tečaji)	o	o	o	o	o
Kuham ali pečem	o	o	o	o	o
Treniram ekipni šport (npr. nogomet)	o	o	o	o	o
Treniram individualni šport (npr. tek ali ples)	o	o	o	o	o
Preživljam čas na prostem	o	o	o	o	o
Vrtnarim ali doma gojim rastline	o	o	o	o	o
Doma opravljam znanstvene poskuse	o	o	o	o	o
Preberem knjigo ali revijo, a ne za šolo	o	o	o	o	o
V prostem času obiščem spletne strani o stvareh, ki me zanimajo	o	o	o	o	o
Doma igram igre na računalniku, igralni konzoli, tablici ali mobilnem telefonu	o	o	o	o	o
Uporabljam družabna omrežja, kot so Instagram, YouTube, Snapchat, Facebook ali Twitter	o	o	o	o	o
V prostem času si ogledam videoposnetek o znanosti, matematiki ali tehnologiji	o	o	o	o	o
Kaj zgradim, razstavim ali popravim	o	o	o	o	o
Skrbim za hišne ljubljenčke	o	o	o	o	o
Igram glasbeni inštrument, pojem ali si brundam pesem	o	o	o	o	o
Aktivno poslušam glasbo	o	o	o	o	o
Opravljaš dejavnost, ki je ni na seznamu? Povej nam, katera je: _____ _____ _____	o	o	o	o	o

SAKER JAG TYCKER OM ATT GÖRA

1. **HUR OFTA** ägnar du dig åt följande aktiviteter **utanför skoltid**? Kryssa för cirkeln i motsvarande kolumn.

Aktivitet	**Varje dag** eller **nästan** varje dag	**1-2 gånger i veckan**	**1-2 gånger i månaden**	**Ett par gånger om året**	**Nästan aldrig** eller **aldrig**
Använder bibliotek	O	O	O	O	O
Besöker en bondgård, en djurpark eller ett akvarium	O	O	O	O	O
Besöker, Science center, en utställning, ett museum eller ett vetenskapsgalleri	O	O	O	O	O
Deltar i någon aktivitet utanför skolan (t.ex. musik- eller danskurser)	O	O	O	O	O
Lagar mat eller bakar	O	O	O	O	O
Ägnar dig åt sport i ett lag (t.ex. fotboll)	O	O	O	O	O
Ägnar dig åt idrott på egen hand (t.ex. löpning eller dans)	O	O	O	O	O
Tillbringar tid utomhus	O	O	O	O	O
Trädgårdsarbete eller odlar växter hemma	O	O	O	O	O
Gör vetenskapliga experiment hemma	O	O	O	O	O
Läser en bok eller tidning som inte har med skolan att göra	O	O	O	O	O
Besöker webbplatser för att lära dig mer om saker du är intresserad av utanför lektionstid	O	O	O	O	O
Använder dator, spelkonsol, surfplatta eller mobiltelefon för att spela spel hemma	O	O	O	O	O
Använder sociala medier såsom Instagram, YouTube, Snapchat, Facebook eller Twitter	O	O	O	O	O
Tittar på videoklipp om naturvetenskap, matematik eller teknik på min fritid	O	O	O	O	O
Bygger, tar isär eller reparera saker	O	O	O	O	O
Sköter om husdjur	O	O	O	O	O
Spelar ett musikinstrument, sjunger eller nynnar	O	O	O	O	O
Lyssnar aktivt på musik	O	O	O	O	O
Annan aktivitet som inte nämnts? Vad:_____	O	O	O	O	O

Coisas Que Eu Gosto De Fazer

1. **Com que frequência** fazes uma das seguintes atividades **fora do horário escolar**? Por favor marca o círculo na coluna correspondente.

Atividades	**Todos os dias ou quase todos os dias**	**1-2 vezes por semana**	**1-2 vezes por mês**	**Algumas vezes por ano**	**Quase nunca ou nunca**
Utilizar a biblioteca	o	o	o	o	o
Visitar uma quinta, um zoo ou um aquário	o	o	o	o	o
Visitar uma galeria de ciência, uma exposição ou um museu	o	o	o	o	o
Participar num programa depois da escola (exemplo: aula de música ou dança)	o	o	o	o	o
Cozinhar ou assar	o	o	o	o	o
Praticar desporto em equipa (exemplo: futebol)	o	o	o	o	o
Praticar desporto individual (exemplo: correr)	o	o	o	o	o
Passar o tempo ao ar livre	o	o	o	o	o
Jardinagem ou cultivar plantas em casa	o	o	o	o	o
Fazer experiências científicas em casa	o	o	o	o	o
Ler um livro ou revista que não seja para a escola	o	o	o	o	o
Visitar websites para aprenderes mais sobre algo em que estás interessado fora da escola	o	o	o	o	o
Usar o computador, consola, ipad ou telemóvel para jogar jogos em casa	o	o	o	o	o
Usar redes sociais como Instagram, Youtube, Snapchat, Facebook ou Twitter	o	o	o	o	o
Assistir a vídeos sobre ciências, matemática ou tecnologia fora do horário escolar	o	o	o	o	o
Construir ou desmontar ou reparar coisas	o	o	o	o	o
Tomar conta de animais	o	o	o	o	o
Tocar um instrumento musical ou cantar ou cantarolar	o	o	o	o	o
Ouvir música ativamente	o	o	o	o	o
Fazes mais alguma atividade que não esteja listada? Diz nos qual é: _____	o	o	o	o	o

2. Se tivesses que **escolher apenas uma** das atividades da lista acima (incluindo a que adicionaste), **qual gostas mais**?
_____

3. **Com quem** é que costumas fazer esta **atividade**? (Pode escolher mais do que uma resposta
   - ☐ Um pai ou tutor
   - ☐ Uma irmã ou irmão
   - ☐ Um avô ou outro familiar
   - ☐ Um professor
   - ☐ Um amigo ou amigos
   - ☐ Fazes sozinho
   - ☐ **Outra Pessoa: quem é?** _____

COSAS QUE ME GUSTA HACER

1. **¿CON QUÉ FRECUENCIA** haces las siguientes actividades fuera del horario escolar? Por favor, selecciona el círculo en la columna correspondiente.

Actividad	Todos los días o casi	1-2 veces a la semana	1-2 veces al mes	Algunas veces al año	Raramente o nunca
Ir a la biblioteca pública	○	○	○	○	○
Visitar una granja-escuela, un zoológico o un acuario	○	○	○	○	○
Visitar museos de ciencia, otros museos o ver exposiciones	○	○	○	○	○
Participar en actividades extraescolares en grupos (p. ej. música, clases de baile)	○	○	○	○	○
Cocinar	○	○	○	○	○
Hacer un deporte de equipo (p.ej. baloncesto, fútbol, …)	○	○	○	○	○
Hacer deporte solo/a (p. ej. correr, bailar)	○	○	○	○	○
Hacer actividades al aire libre	○	○	○	○	○
Hacer jardinería y cuidar de las plantas de casa	○	○	○	○	○
Hacer experimentos científicos en casa	○	○	○	○	○
Leer un libro o una revista que no sea una tarea escolar	○	○	○	○	○
Visitar páginas web para interesarme por distintas materias dentro y fuera del horario escolar	○	○	○	○	○
Usar un ordenador, una videoconsola, un ipad, o un móvil para jugar en casa	○	○	○	○	○
Usar redes sociales como Instagram, YouTube, Snapchat, Facebook or Twitter	○	○	○	○	○
Ver vídeos sobre ciencias, matemáticas o tecnología fuera del horario escolar	○	○	○	○	○
Construir o reparar cosas	○	○	○	○	○
Cuidar mascotas	○	○	○	○	○
Tocar un instrumento musical o cantar	○	○	○	○	○
Escuchar música atentamente (no como música de fondo)	○	○	○	○	○
¿Haces alguna actividad aparte de las especificadas en el listado anterior? ¿Cuál?: _____ _____ _____	○	○	○	○	○

LES ACTIVITES QUE J'AIME FAIRE

1. **A QUELLE FREQUENCE** est-ce que tu fais les activités suivantes **en dehors de l'école** ? Merci de cocher le cercle dans la colonne correspondant à ta réponse.

Activité	Tous les jours ou presque	1 à 2 fois par semaine	1 à 2 fois par mois	Plusieurs fois par an	Presque jamais/ Jamais
J'emprunte des livres à la bibliothèque municipale	○	○	○	○	○
Je vais visiter une ferme, un zoo ou un aquarium	○	○	○	○	○
Je vais voir une galerie, une exposition scientifique, un musée ou un centre de sciences	○	○	○	○	○
Je participe à des activités extra-scolaires (par ex. des cours de musique, de danse, etc.)	○	○	○	○	○
J'aide à faire à manger ou je fais des gâteaux	○	○	○	○	○
Je fais du sport en équipe (par ex. du foot)	○	○	○	○	○
Je fais du sport seul·e (par ex. de la course, de la danse)	○	○	○	○	○
Je passe du temps dehors	○	○	○	○	○
Je m'occupe du jardin ou de plantes à la maison	○	○	○	○	○
Je fais des expériences scientifiques à la maison	○	○	○	○	○
Je lis un livre, des magazines, qui ne sont pas demandés par l'école	○	○	○	○	○
Je vais sur Internet pour apprendre des choses qui m'intéressent sur des sites, en dehors de l'école	○	○	○	○	○
Je joue à des jeux sur un ordinateur, une console, une tablette ou un téléphone portable à la maison	○	○	○	○	○
Je vais sur les réseaux sociaux comme Instagram, YouTube, Snapchat, Facebook ou Twitter	○	○	○	○	○
Je regarde des vidéos en rapport avec la science, les maths, la techno, en dehors des heures de cours	○	○	○	○	○
Je construis, je démonte ou je répare des objets/des choses	○	○	○	○	○
Je dresse ou je m'occupe de nos animaux	○	○	○	○	○
Je joue d'un instrument, je chante, ou je fredonne des chansons	○	○	○	○	○

DINGEN DIE IK GRAAG DOE

1. **HOE VAAK** doe je de volgende activiteiten buiten schooltijd? Kruis de cirkel in de bijbehorende kolom aan.

Activiteit	elke dag of bijna elke dag	1-2 keer in de week	1-2 keer in de maand	een paar keer per jaar	bijna nooit of nooit
Een bibliotheek bezoeken	o	o	o	o	o
Een boerderij, een dierentuin of aquarium bezoeken	o	o	o	o	o
Een wetenschappelijke galerie, tentoonstelling of museum bezoeken	o	o	o	o	o
Deelnemen aan een naschoolse activiteit (bijvoorbeeld muziek- of danslessen)	o	o	o	o	o
Koken of bakken	o	o	o	o	o
Sporten in een team of groep (bijvoorbeeld voetbal)	o	o	o	o	o
Sporten in je eentje (bijvoorbeeld hardlopen)	o	o	o	o	o
Tijd doorbrengen in de natuur	o	o	o	o	o
Tuinieren of planten verzorgen thuis	o	o	o	o	o
Wetenschappelijke experimenten in huis	o	o	o	o	o
Een boek of tijdschrift lezen (niet voor school)	o	o	o	o	o
Een website bezoeken om informatie op te zoeken over dingen waar je in geïnteresseerd bent buiten schooltijd	o	o	o	o	o
Games spelen op een computer, gameconsole, tablet of mobiele telefoon	o	o	o	o	o
Gebruik van social media zoals Instagram, YouTube, Snapchat, Facebook of Twitter	o	o	o	o	o
Video's over wetenschap of technologie kijken buiten schooltijd	o	o	o	o	o
Dingen bouwen, uit elkaar halen of repareren	o	o	o	o	o
Een huisdier verzorgen	o	o	o	o	o
Zingen of een muziekinstrument spelen	o	o	o	o	o
Actief naar muziek luisteren	o	o	o	o	o
Doe je een activiteit die niet in dit lijstje staat? Welke activiteit is dit en hoe vaak doe je die? _____	o	o	o	o	o

2. Als je maar één activiteit uit de ingevulde lijst bij vraag 1. mag kiezen, welke activiteit vind je dan het leukst?

_____

СТВАРИ КОЈЕ ВОЛИМ ДА РАДИМ

1. **КОЛИКО ЧЕСТО** радиш ове ствари **ван времена проведеног у школи**? Молимо те да означиш кружић у одговарајућој колони.

Активност	Свакодневно или скоро свакодневно	1-2 пута седмично	1-2 пута месечно	Неколико пута годишње	Скоро никада или никада
Користим библиотеку	o	o	o	o	o
Посећујем ботаничку башту, зоолошки врт или јавни акваријум	o	o	o	o	o
Посећујем научне галерије, изложбе или музеје.	o	o	o	o	o
Похађам ваннаставне активности (нпр. часове музике или плеса)	o	o	o	o	o
Припремам храну	o	o	o	o	o
Бавим се тимским спортом (нпр. фудбал)	o	o	o	o	o
Бавим се индивидуалним спортом (нпр. трчање)	o	o	o	o	o
Проводим време напољу	o	o	o	o	o
Садим или негујем биљке код куће	o	o	o	o	o
Радим научне експерименте код куће	o	o	o	o	o
Читам књиге или часописе који ми нису потребни за школу	o	o	o	o	o
Посећујем интернет странице које ми помажу да научим више о стварима које ме занимају	o	o	o	o	o
Користим компјутер, конзолу за видео игре, таблет или телефон како би играо/играла ове игре код куће.	o	o	o	o	o
Користим друштвене мреже као што су Инстаграм, Фејсбук или Твитер	o	o	o	o	o
Гледам видео садржаје о науци, математици или технологији и када ми то није потребно за школу	o	o	o	o	o
Правим, растављам или поправљам ствари	o	o	o	o	o
Водим рачуна о кућним љубимцима	o	o	o	o	o
Свирам музички инструмент, певам или певушим	o	o	o	o	o
Активно слушам музику	o	o	o	o	o

Věci, které rád dělám

1. Jak často se věnujete následujícím **mimoškolním** činnostem ? Zaškrtněte prosím kolečko v příslušném sloupci.

Aktivita	Každý den, nebo téměř každý den	1-2 krát týdně	1-2 krát měsíčně	Několikrát ročně	Sotva někdy nebo nikdy
Chodím do knihovny	O	O	O	O	O
Navštěvuji farmu, zoo nebo akvárium	O	O	O	O	O
Navštěvuji vědecko-technickou galerii, výstavu nebo muzeum	O	O	O	O	O
Účastním se na mimoškolní činnosti (např. kurzy hudby nebo tance)	O	O	O	O	O
Vařím nebo peču	O	O	O	O	O
Sportuji v týmu (např. Fotbal)	O	O	O	O	O
Sportuji sám (například běh, tanec)	O	O	O	O	O
Trávím čas venku	O	O	O	O	O
Starám se nebo pěstuji doma rostliny	O	O	O	O	O
Provádím doma vědecké experimenty.	O	O	O	O	O
Čtu si knihy nebo časopisy, které nesouvisí se školou.	O	O	O	O	O
Navštěvuji webové stránky, na kterých si čtu nebo sleduji videa o věcech, které mě zajímají.	O	O	O	O	O
Používám počítač, herní konzoli, game-pad nebo mobilní telefon k hraní her doma.	O	O	O	O	O
Používám sociální média jako Instagram, YouTube, Snapchat, Facebook nebo Twitter	O	O	O	O	O
V mimoškolních hodinách sleduji videa o vědě, matematice nebo technologii	O	O	O	O	O
Vytvářím / stavím věci, nebo je zkoumám či opravuji	O	O	O	O	O
Starám se o domácí zvířata	O	O	O	O	O
Zahraji si na hudební nástroj nebo zpívám anebo si jen tak broukám	O	O	O	O	O
Aktivně poslouchám hudbu	O	O	O	O	O
Děláte činnost, která není uvedena v seznamu? Řekni nám, co to je: _____ _____	O	O	O	O	O

ΤΙ ΜΟΥ ΑΡΕΣΕΙ ΝΑ ΚΑΝΩ

1. ΠΟΣΟ ΣΥΧΝΑ κάνεις τις παρακάτω δραστηριότητες, **εκτός του σχολικού ωραρίου**; Τσέκαρε με V στον κύκλο της στήλης που σε εκφράζει.

Δραστηριότητα	Κάθε μέρα ή σχεδόν κάθε μέρα	1-2 φορές την εβδομάδα	1-2 φορές το μήνα	Μερικές φορές το χρόνο	Σχεδόν ποτέ ή ποτέ
Πηγαίνω στη βιβλιοθήκη	O	O	O	O	O
Πάω στο ζωολογικό κήπο ή στο ενυδρείο	O	O	O	O	O
Επισκέπτομαι μια έκθεση ή ένα μουσείο	O	O	O	O	O
Έχω ένα χόμπι μετά το σχολείο (πχ., μουσική ή χορό)	O	O	O	O	O
Μαγειρεύω	O	O	O	O	O
Είμαι μέλος μιας αθλητικής ομάδας (πχ. ποδοσφαιρική)	O	O	O	O	O
Κάνω αθλητισμό μόνος / μόνη μου (πχ., τρέξιμο)	O	O	O	O	O
Περνώ την ώρα μου εκτός σπιτιού	O	O	O	O	O
Καλλιεργώ φυτά στο σπίτι	O	O	O	O	O
Κάνω πειράματα στο σπίτι	O	O	O	O	O
Διαβάζω ένα βιβλίο ή περιοδικό	O	O	O	O	O
Σερφάρω στο ίντερνετ και μαθαίνω πράγματα που με ενδιαφέρουν	O	O	O	O	O
Παίζω παιχνίδια στον Η/Υ, τάμπλετ, κινητό	O	O	O	O	O
Χρησιμοποιώ τα κοινωνικά δίκτυα (Instagram, YouTube, Snapchat, Facebook,Twitter...)	O	O	O	O	O
Παρακολουθώ video για την επιστήμη, τα μαθηματικά, την τεχνολογία	O	O	O	O	O
Κατασκευάζω ή επιδιορθώνω αντικείμενα	O	O	O	O	O
Φροντίζω κατοικίδια ζώα	O	O	O	O	O
Παίζω μουσική ή τραγουδώ	O	O	O	O	O
Ακούω μουσική	O	O	O	O	O
Κάνεις κάποια άλλη δραστηριότητα; Πες μας **ποια** είναι αυτή και πόσο συχνά την κάνεις: _____ _____ _____	O	O	O	O	O

COSA MI PIACE FARE

1. **QUANTO SPESSO** ti dedichi alle seguenti attività al di fuori dell'orario scolastico? Segna la tua risposta barrando il cerchio nella colonna corrispondente.

Attività	**Ogni giorno** o **quasi** ogni giorno	**1-2 volte a settimana**	**1-2 volte al mese**	**Un paio di volte all'anno**	**Mai o quasi mai**
Andare in biblioteca	o	o	o	o	o
Visitare una fattoria, uno zoo o un acquario	o	o	o	o	o
Visitare un museo, una mostra o un salone dedicati alla scienza	o	o	o	o	o
Partecipare a un'attività extrascolastica (per esempio lezioni di musica o di danza)	o	o	o	o	o
Cucinare o preparare dolci	o	o	o	o	o
Praticare sport di squadra (per esempio calcio)	o	o	o	o	o
Praticare sport individuali (per esempio corsa o danza)	o	o	o	o	o
Uscire all'aria aperta	o	o	o	o	o
Fare giardinaggio (in casa o in uno spazio aperto)	o	o	o	o	o
Fare esperimenti scientifici in casa	o	o	o	o	o
Leggere un libro o una rivista (non per scuola)	o	o	o	o	o
Visitare siti web per imparare cose nuove	o	o	o	o	o
Usare in casa un computer, una *console*, un tablet o un cellulare per giocare ai videogiochi	o	o	o	o	o
Usare i social media come Instagram, YouTube, Snapchat, Facebook o Twitter	o	o	o	o	o
Guardare un video riguardante la scienza, la matematica o la tecnologia in orario extrascolastico	o	o	o	o	o
Costruire, smontare o riparare oggetti	o	o	o	o	o
Prendersi cura di un animale	o	o	o	o	o

الأنشطة المفضلة

1. كم مرة تتشارك/ي في الأنشطة التالية خارج ساعات الدوام المدرسي؟ يرجى وضع علامة - V في الدائرة المناسبة.

فعالية	كل يوم أو تقريبًا كل يوم	مرة- مرتين في الأسبوع	مرة- مرتين في الشهر	عدة مرات في السنة	لا أتشارك على الإطلاق ، أو لا أتشارك تقريبًا على الإطلاق
زيارة المكتبة	o	o	o	o	o
زيارة مزرعة، حديقة الحيوانات أو حوض الأسماك	o	o	o	o	o
زيارة إلى معرض علمي / متحف العلوم	o	o	o	o	o
دورة، على سبيل المثال، رقص أو لعب	o	o	o	o	o
طبخ أو خبز	o	o	o	o	o
رياضة جماعية (على سبيل المثال كرة القدم)	o	o	o	o	o
رياضة مستقلة (على سبيل المثال الجري أو الرقص)	o	o	o	o	o
فعالية في الخارج (على سبيل المثال قضاء الوقت في ملعب الألعاب)	o	o	o	o	o
بستنة، أو العناية بالأشجار	o	o	o	o	o
تجارب علمية في المنزل	o	o	o	o	o
قراءة الكتب والمجلات من أجل المتعة خارج ساعات التعليم	o	o	o	o	o
تصفح المواقع الألكترونية لمعرفة المزيد عن المواضيع المثيرة للاهتمام خارج ساعات التعليم	o	o	o	o	o
لعبة على جهاز الحاسوب أو وحدة تحكم في الألعاب أو هاتف محمول في المنزل	o	o	o	o	o
استخدام وسائل التواصل الاجتماعي مثل الإنستغرام، اليوتيوب، سنابشات، فيسبوك، تويتر وغيرها.	o	o	o	o	o
مشاهدة مقاطع فيديو عن العلوم أو الرياضيات أو التكنولوجيا خارج ساعات التعليم	o	o	o	o	o
بناء، تفكيك أو تصليح الأجهزة والأغراض أو فعالية إنتاج	o	o	o	o	o
رعاية الحيوانات الأليفة	o	o	o	o	o
عزف أو غناء (أيضًا لنفسي)	o	o	o	o	o
الاستماع الفعّال للموسيقى (القصد للموسيقى حسب إختيارك، وليس لموسيقى التي تعزف بالصدفة في الخلفية)	o	o	o	o	o
نشاط آخر غير مدرج في القائمة – ما هو؟ _____	o	o	o	o	o

Занимания	Всеки ден или почти всеки ден	1-2 пъти седмично	1-2 пъти месечно	Няколко пъти годишно	Рядко или никога
Използване на обществена библиотека	O	O	O	O	O
Посещение на ферма, зоологическа градина или аквариум	O	O	O	O	O
Посещение на галерия, изложба или музей	O	O	O	O	O
Участие в извънучилищна дейност (напр. уроци по музика или танци)	O	O	O	O	O
Готвене	O	O	O	O	O
Групов спорт (напр.футбол)	O	O	O	O	O
Индивидуален спорт (напр.бягане, танци)	O	O	O	O	O
Прекарване на време навън	O	O	O	O	O
Градинарство, отглеждане на растения у дома	O	O	O	O	O
Правене на научни експерименти у дома	O	O	O	O	O
Четене на книга или списание, които не са за училище	O	O	O	O	O
Ползване на уебсайтове, за да научишнещо, които са ти интересни	O	O	O	O	O
Използване на компютър, конзола, таблет или мобилен телефон, за да играешигри у дома	O	O	O	O	O
Използване на социални медии, като Instagram, YouTube, Snapchat, Facebook или Twitter	O	O	O	O	O
Гледане на видеоклипове за наука, математика или технологии	O	O	O	O	O
Строене, разглобяване или поправяне на нещо	O	O	O	O	O
Занимания	**Всеки ден или почти всеки ден**	**1-2 пъти седмично**	**1-2 пъти месечно**	**Няколко пъти годишно**	**Рядко или никога**
Игра със и/или грижа за домашен любимец	O	O	O	O	O
Свирене на музикален инструмент, пеене или тананикане	O	O	O	O	O
Слушане на музика	O	O	O	O	O
Занимавашли се с дейност, която не е в списъка? Ако да, напиши каква е тя: _____ _____ _____ _____	O	O	O	O	O

פעילויות מועדפות

1. **כל כמה זמן** את/ה עוסק/ת בפעילויות הבאות **מחוץ לשעות הלימודים**? נא לסמן ב-V את העיגול המתאים.

פעילות	כל יום או כמעט כל יום	פעם-פעמיים בשבוע	פעם-פעמיים בחודש	כמה פעמים בשנה	בכלל לא, או כמעט בכלל לא
ביקור בספרייה	o	o	o	o	o
ביקור בחווה חקלאית בגן חיות או באקווריום	o	o	o	o	o
ביקור בתערוכה מדעית/מוזיאון מדע	o	o	o	o	o
חוג, למשל ריקוד או נגינה	o	o	o	o	o
בישול או אפייה	o	o	o	o	o
ספורט קבוצתי (למשל כדורגל)	o	o	o	o	o
ספורט עצמאי (למשל ריצה או ריקוד)	o	o	o	o	o
פעילות בחוץ (למשל בילוי במגרש משחקים)	o	o	o	o	o
גינון, או טיפול בעציצים	o	o	o	o	o
ניסויים מדעיים בבית	o	o	o	o	o
קריאת ספרים או מגזינים להנאה מחוץ לשעות הלימודים	o	o	o	o	o
גלישה באתרי אינטרנט כדי ללמוד על נושאים מעניינים מחוץ לשעות הלימודים	o	o	o	o	o
משחק במחשב, בקונסולת משחקים או בטלפון נייד בבית	o	o	o	o	o
שימוש במדיה חברתית כמו אינסטגרם, יוטיוב, סנאפצ'ט, פייסבוק, טוויטר וווטסאפ וכו'	o	o	o	o	o
צפייה בסרטונים בנושאי מדע, מתמטיקה או טכנולוגיה מחוץ לחובות הלימודים	o	o	o	o	o
בנייה, פירוק או תיקון של מכשירים וחפצים או פעילות יצירה	o	o	o	o	o
טיפול בחיות מחמד	o	o	o	o	o
נגינה או שירה (גם לעצמי)	o	o	o	o	o
האזנה פעילה למוסיקה (הבוונה למוזיקה לבתירתך, ולא למשהו שמתנגן במקרה ברקע)	o	o	o	o	o
פעילות אחרת שאינה ברשימה – איזו? _____	o	o	o	o	o

מתוך 132

SY•• STEM •••• 2020

SCIENCE LEARNING OUTSIDE THECLASSROOM

QUESTIONNAIRE:

Things I Like To Do Both In and Out of School

Thank you for your help with this survey! Our aim is to find out what young people between 9 and 20 years like to do and what they think about a range of issues related to science, their leisure activities or the groups they are part of.

Please read each question carefully and choose the answer that applies to you.

- With most questions you simply tick the circle "○"next to the answer that describes you best.
- When you see questions with boxes "☐"instead, you can select more than one answer.
- Whenever you find a line like this: "_____" you are asked to write something down.

Some of the questions specifically ask about your mother or your father – if this does not relate to your personal situation, please answer these questions in relation to people who are like a mother or a father to you, for example guardians, stepparents, foster parents...

This is not a test, there are no right or wrong answers - we are interested in your honest answers and opinions only!

➔ First, please tell us **YOUR NAME**:_____

THINGS I LIKE TO DO

1. **HOW OFTEN** do you do the following activities **outside of school hours**? Please tick the circle in the corresponding column.

Activity	**Every day** or **almost** every day	**1-2 times a week**	**1-2 times a month**	**A few times a year**	**Hardly ever** or **never**
Use a library	○	○	○	○	○
Visit a science gallery, exhibition or museum	○	○	○	○	○
Participate in an after-school activity (e.g. music or dance classes)	○	○	○	○	○
Do sport in a team (e.g. soccer)	○	○	○	○	○
Spend time outdoors	○	○	○	○	○
Read a book or magazine not for school	○	○	○	○	○
Visit websites to learn about things you're interested in out-of-school-hours	○	○	○	○	○
Use a computer, game console, pad or mobile phone to play games at home	○	○	○	○	○
Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter	○	○	○	○	○
Watch a video about science, maths, or technology in out-of-school-hours	○	○	○	○	○
Build or take things apart or repair things	○	○	○	○	○
Play a musical instrument or sing or hum	○	○	○	○	○
Actively listen to music	○	○	○	○	○
Do you do an activity not listed? Tell us what it is: _____ _____ _____	○	○	○	○	○

2. If you had to **pick just one** of the activities from the list above (including the ones you added), **which ONE** do you **like most**?

_____

3. **WHO** do you usually do **this activity** with? (You can tick more than one answer)
   - ☐ A Parent or Guardian
   - ☐ A Sister or Brother
   - ☐ A Grandparent or other Relative
   - ☐ A Teacher
   - ☐ A Friend or Friends
   - ☐ I do this activity on my own
   - ☐ Someone else – who is it? _____

GROUPS I'M PART OF

What teams or groups are you a part of or have been a part of? Which groups would you like to join if you could?

- Tick the **first circle** if you already participate in such a group or have been part of.
- Tick the **second circle** if you don't participate in the group, but would like to if you could.
- Tick the **last circle**, if you are not in such a group, and also not interested in joining.

4. **Groups I'm part of or would like to join / Groups I have been part of for some time**

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
A sports club (such as soccer, tennis)	○	○	○
A choir, music or dance class	○	○	○
Drama or acting class	○	○	○
Religious youth group	○	○	○
Another group or club _____ _____ _____	○	○	○

WHO ENCOURAGES YOU TO DO THE THINGS YOU DO?

For each activity, **tick a box for each person who encourages you to do this.** You can put **more than one tick** in one row, if necessary.
For example, if your mother and sister encourage you to use the library, put a check by "A parent or guardian encourages me to do this" and by "A sister or brother encourages me to do this."

5. **Who encourages you to do the things you do?**

	I don't do this	A **parent** or guardian encourages me	A **sister** or **brother** encourages me	A **grand-parent** or **other relative** encourages me	A **teacher** encourages me	A **friend** encourages me	**I** motivate **myself**
Go to a science gallery, exhibition or museum	☐	☐	☐	☐	☐	☐	☐
Use a library	☐	☐	☐	☐	☐	☐	☐
Take part in sports	☐	☐	☐	☐	☐	☐	☐
Spend time outdoors	☐	☐	☐	☐	☐	☐	☐
Read a book or magazine not for school	☐	☐	☐	☐	☐	☐	☐
Visit web-sites to learn about things you're interested in	☐	☐	☐	☐	☐	☐	☐
Watch a video about science, maths, or technology	☐	☐	☐	☐	☐	☐	☐

	I don't do this	A **parent** or guardian encourages me	A **sister** or **brother** encourages me	A **grand-parent** or **other relative** encourages me	A **teacher** encourages me	A **friend** encourages me	I motivate **myself**
Build or take things apart	☐	☐	☐	☐	☐	☐	☐
Play a musical instrument or sing or hum	☐	☐	☐	☐	☐	☐	☐
Your favourite activity (the activity you have listed in the previous section in Question 2): _____ _____ _____ _____	☐	☐	☐	☐	☐	☐	☐

QUESTIONS ABOUT SCIENCE

6. How do you feel when you think of '**SCIENCE**'? Please answer the following 3 questions and tick the circle on each of the three rows which best describes your feelings:

○	○	○	○	○
Bored		Neutral		Fascinated
○	○	○	○	○
Means nothing		Neutral		Means a lot
○	○	○	○	○
Afraid		Neutral		Excited

7. Are there **science topics** that you find **particularly interesting?** (To give you some examples: planets, mixing materials, computers, the weather, plants, the human body, genetics, earthquakes, animals, hurricanes, building bridges, engines, GPS, ecology and food can all be science topics you are interested in.)

Yes	No
○	○

8. If **yes, which ones**? Please list them in the box below!

Below you find a list of statements. Some people agree with them and others do not. **What do you think?** For each line, please only tick one circle.

9. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot
I enjoy learning science	○	○	○	○	○
Other people of my age find it easier to learn science topics than I do	○	○	○	○	○
My close friends like science	○	○	○	○	○
My mother talks to me about science	○	○	○	○	○
I find science to be really interesting	○	○	○	○	○
I think I would make a good scientist	○	○	○	○	○
I see how science relates to my life	○	○	○	○	○

ABOUT ME

The following questions want to get to know you better. Please help us with this!

14. How **old** are you? _____ years old

16. Where do you **live**? (Please tick one!)

- ○ In the country side
- ○ In the outskirts of a city or close to a city
- ○ In the city

17. In which **country** were you **born**? I was born in _____

18. Have you ever lived in a different country?

- ○ Yes
- ○ No

19. Is English your **first language?**

- ○ Yes
- ○ No

If not, what is your first language?

_____

20. What **languages** do **adults in your home** use when talking to each other?

_____

21. What **languages** do **you speak at home**?

_____

22. How many people live in **your home** in total – **including yourself**?

_____

23. Who do you live **at home** with?

Your mother	☐
Your father	☐
Your guardians or foster parents	☐
Your grandparents	☐
Your sisters and brothers	☐
Other relatives	☐
Your child or children	☐
Someone else? Who? _____ _____	☐

24. Do you experience serious **diffioulties** with hearing, seeing, speaking or moving?

- ○ Yes
- ○ No

25. Which of these **eduoation levels** have you **oompleted fully**? (More than one answer is possible)

- ☐ Pre-school education
- ☐ Primary education
- ☐ Secondary education (Junior Certificate)
- ☐ Secondary education (Leaving Certificate)
- ☐ Third Level Education
- ☐ Other:_____

26. Have you any experienoe of working a job?

- ○ No
- ○ Yes

If **yes**, **WHAT** did you do? (More than one answer is possible)

- ☐ Summer job
- ☐ Internship
- ☐ Consultant or contractor
- ☐ Part time job
- ☐ Full time job

27. How many books can be found in your **home**? (Do not count magazines, newspapers or school books)

- ○ **None** or very **few** (0-10 books)
- ○ Enough to fill **one shelf** (11-25 books)
- ○ Enough to fill **one bookcase** (26-100 books)
- ○ Enough to fill **two bookcases** (101-200 books)
- ○ Enough to fill **three or more bookcases** (more than 200 books)

28. How many of the following **items** can be found in your **home**?

	None	1	2-4	5 or More
Televisions	○	○	○	○
Cars, vans or trucks	○	○	○	○
Smart phones in use	○	○	○	○
Computers and tablets	○	○	○	○
Music instruments (e.g. a guitar or a piano)	○	○	○	○

29. What **gender** do you identify with? _____

THANK YOU FOR ANSWERING ALL THESE QUESTIONS!

9.3.4 English Survey BSMJ Ultraorthodox Wave 1

SY STEM 2020

SCIENCE LEARNING OUTSIDE THECLASSROOM

QUESTIONNAIRE:

Things I Like To Do Both In and Out of School

Thank you for your help with this survey! Our aim is to find out what young people between 9 and 20 years like to do and what they think about a range of issues related to science, their leisure activities or the groups they are part of.

Please read each question carefully and choose the answer that applies to you.

- With most questions you simply tick the circle "○"next to the answer that describes you best.
- When you see questions with boxes "☐"instead, you can select more than one answer.
- Whenever you find a line like this: "_____" you are asked to write something down.

Some of the questions specifically ask about your mother or your father – if this does not relate to your personal situation, please answer these questions in relation to people who are like a mother or a father to you, for example guardians, stepparents, foster parents...

This is not a test, there are no right or wrong answers - we are interested in your honest answers and opinions only!

➔ First, please tell us **YOUR NAME**:_____

THINGS I LIKE TO DO

1. **HOW OFTEN** do you do the following activities **outside of school hours**? Please tick the circle in the corresponding column.

Activity	Every day or almost every day	1-2 times a week	1-2 times a month	A few times a year	Hardly ever or never
Use a library	○	○	○	○	○
Visit a farm, a zoo or an aquarium	○	○	○	○	○
Visit a science gallery, exhibition or museum	○	○	○	○	○
Cook or bake	○	○	○	○	○
Do sport in a team or group (e.g. soccer)	○	○	○	○	○
Do sport by yourself (e.g. running)	○	○	○	○	○
Spend time outdoors	○	○	○	○	○
Garden or grow plants at home	○	○	○	○	○
Do science experiments at home	○	○	○	○	○
Read a book or children's newspapers not for school	○	○	○	○	○
Watch a video about science, maths, or technology in out-of-school-hours	○	○	○	○	○
Build or take things apart or repair things	○	○	○	○	○
Take care of pets	○	○	○	○	○
Play a musical instrument or sing or hum	○	○	○	○	○
Actively listen to music	○	○	○	○	○
Do you do an activity not listed? Tell us what it is: _____ _____ _____	○	○	○	○	○

2. If you had to **pick just one** of the activities from the list above (including the ones you added), **which ONE** do you **like most**?

_____

3. **WHO** do you usually do **this activity** with? (You can tick more than one answer)
   - ☐ A Parent or Guardian
   - ☐ A Sister or Brother
   - ☐ A Grandparent or other Relative
   - ☐ A Teacher
   - ☐ A Friend or Friends
   - ☐ I do this activity on my own
   - ☐ Someone else – who is it? _____

GROUPS I'M PART OF

What teams or groups are you a part of or have been a part of? Which groups would you like to join if you could?

- Tick the **first circle** if you already participate in such a group or have been part of for quite some time.
- Tick the **second circle** if you don't participate in the group, but would like to if you could.
- Tick the **last circle**, if you are not in such a group, and also not interested in joining.

4. **Groups I'm part of or would like to join / Groups I have been part of for some time**

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
A sports club (such as soccer, tennis)	○	○	○
A choir, music or dance class	○	○	○
Cooking or sewing class	○	○	○
Religious youth group	○	○	○
Another group or club _____ _____	○	○	○

WHO ENCOURAGES YOU TO DO THE THINGS YOU DO?

For each activity, **tick a box for each person who encourages you to do this.** You can put **more than one tick** in one row, if necessary.

For example, if your mother and sister encourage you to use the library, put a check by "A parent or guardian encourages me to do this" and by "A sister or brother encourages me to do this."

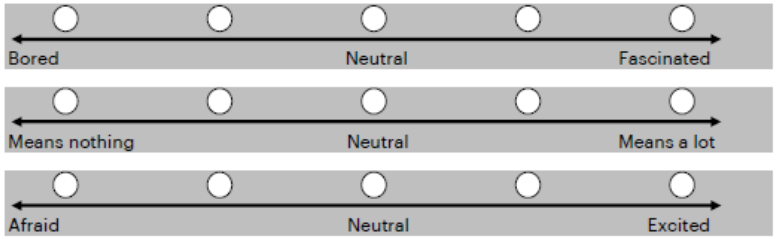
5. **Who encourages you to do the things you do?**

	I don't do this	A **parent** or guardian encourages me	A **sister** or **brother** encourages me	A **grand-parent** or **other relative** encourages me	A **teacher** encourages me	A **friend** encourages me	**I** motivate **myself**
Go to a science gallery, exhibition or museum	☐	☐	☐	☐	☐	☐	☐
Use a library	☐	☐	☐	☐	☐	☐	☐
Take part in sports	☐	☐	☐	☐	☐	☐	☐
Spend time outdoors	☐	☐	☐	☐	☐	☐	☐
Garden or grow plants at home	☐	☐	☐	☐	☐	☐	☐
Cook or bake	☐	☐	☐	☐	☐	☐	☐
Read a book or children's newspapers not for school	☐	☐	☐	☐	☐	☐	☐
Build or take things apart	☐	☐	☐	☐	☐	☐	☐
Take care of pets	☐	☐	☐	☐	☐	☐	☐

	I don't do this	A parent or guardian encourages me	A sister or brother encourages me	A grand-parent or other relative encourages me	A teacher encourages me	A friend encourages me	I motivate myself
Play a musical instrument or sing or hum	☐	☐	☐	☐	☐	☐	☐
Your favourite activity (the activity you have listed in the previous section): _____ _____ _____ _____	☐	☐	☐	☐	☐	☐	☐

QUESTIONS ABOUT SCIENCE

6. **How do you feel** when you think of '**SCIENCE**'? Please answer the following 3 questions and tick the circle on each of the three rows which best describes your feelings:



7. Are there **science topics** that you find **particularly interesting?** (To give you some examples: planets, mixing materials, the weather, plants, genetics, earthquakes, animals, hurricanes, building bridges, engines, GPS, ecology and food can all be science topics you are interested in.)	Yes	No
	○	○

8. If **yes, which ones**? Please list them in the box below!

Below you find a list of statements. Some people agree with them and others do not. **What do you think?** For each line, please only tick one circle.

9. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	Not applic-able
I enjoy learning science	o	o	o	o	o	o
Other people of my age find it easier to learn science topics than I do	o	o	o	o	o	o
My close friends like science	o	o	o	o	o	o
My mother talks to me about science	o	o	o	o	o	o
I find science to be really interesting	o	o	o	o	o	o
I think I would make a good scientist	o	o	o	o	o	o
I see how science relates to my life	o	o	o	o	o	o
My close friends enjoy science	o	o	o	o	o	o
My parents are interested in science	o	o	o	o	o	o
My father talks to me about science	o	o	o	o	o	o
I have no idea what my family thinks of science	o	o	o	o	o	o
My way of thinking and learning makes it hard to understand science	o	o	o	o	o	o
Science is not for me	o	o	o	o	o	o

QUESTIONS ABOUT SCHOOL

10. Please choose your **circumstances**: (More than one answer is possible)

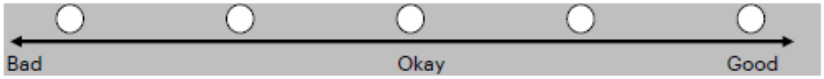
- ☐ Going to **school** or university
- ☐ **Apprenticeship** / vocational work
- ☐ Part time or full time **employed** or self-employed
- ☐ Undertaking **voluntary work**
- ☐ **Unemployed** and looking for a job
- ☐ **Unemployed** and **not looking** for a job
- ☐ **Carer** / homemaker
- ☐ **Military Service**
- ☐ Other: _____

The following questions deal with your **school-experiences**. If you are currently **not enrolled**, please answer them with regard to your **last school year**.

11. Which, if any of these, is your **favourite subject at school**? Tick the circle next to the category that contains your favourite. (Please choose only one answer)

- o **Natural Sciences** (Biology, Physics, Chemistry, Geology)
- o **Arts and humanities** (music, history, religious education, languages, art, geography, social sciences)
- o **Mathematics**
- o **Physical education**
- o **None** of these
- o I **like all** of them **equally**
- o Other:_____

12. In general, how do **your teachers** perceive **your achievement at school?**



Below you find two **some statements**. Some people agree with them and others do not. What do you think? For each statement, please choose and tick one circle that captures your opinion in the best possible way.

13. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	I don't have science in school
Science lessons are exciting.	○	○	○	○	○	○
I look forward to my science lessons.	○	○	○	○	○	○

ABOUT ME

The following questions want to get to know you better. Please help us with this!

14. How **old** are you? _____ years old

15. Which **gender** do you identify with? _____

16. **Where** do you **live**? (Please tick one!)

- ○ In the country side
- ○ In the outskirts of a city or close to a city
- ○ In the city

17. In which **country** were you **born**? I was born in _____

18. Have you ever lived in a different country?

- ○ Yes
- ○ No

19. Is English your **first language?**

- ○ Yes
- ○ No

If not, what is your first language?

_____

20. What **languages** do **adults in your home** use when talking to each other?

_____

21. What **languages** do **you speak at home?**

_____

22. **How many people** live in **your home** in total – **including yourself**?

_____

23. **Who** do you live **at home** with?

Your mother	☐
Your father	☐
Your guardians or foster parents	☐
Your grandparents	☐
Your sisters and brothers	☐
Other relatives	☐
Your child or children	☐
Someone else? Who? _____ _____	☐

24. Do you experience serious **difficulties** with hearing, seeing, speaking or moving?

- ○ Yes
- ○ No

25. Which of these **education levels** have you **completed fully**? (More than one answer is possible)

- ☐ Pre-school education
- ☐ Primary education
- ☐ Secondary education (Junior Certificate)
- ☐ Secondary education (Leaving Certificate)
- ☐ Third Level Education
- ☐ Other:_____

26. Have you any experience of working a job?

- ○ No
- ○ Yes

If **yes, WHAT** did you do? (More than one answer is possible)

- ☐ Summer job
- ☐ Internship
- ☐ Consultant or contractor
- ☐ Part time job
- ☐ Full time job

27. How many books can be found in your **home**? (Do not count newspapers or school books)

- ○ **None** or very **few** (0-10 books)
- ○ Enough to fill **one shelf** (11-25 books)
- ○ Enough to fill **one bookcase** (26-100 books)
- ○ Enough to fill **two bookcases** (101-200 books)
- ○ Enough to fill **three or more bookcases** (more than 200 books)

28. How many of the following **items** can be found in your **home**?

	None	1	2-4	More than 5
Cars, vans or trucks	○	○	○	○
Music instruments (e.g. a guitar or a piano)	○	○	○	○

THANK YOU FOR ANSWERING ALL THESE QUESTIONS!

9.4 Survey Versions Wave 2

9.4.1 English Standard Survey Wave 2

SCIENCE LEARNING OUTSIDE THECLASSROOM

QUESTIONNAIRE:

Things I Like To Do Both In and Out of School

Thank you for participating again in this survey! Our aim is to find out what young people between 9 and 20 years like to do and what they think about a range of issues related to science, their leisure activities or the groups they are part of.

Please read each question carefully and choose the answer that applies to you.

- With most questions you simply tick the circle "○"next to the answer that describes you best.
- When you see questions with boxes "☐"instead, you can select more than one answer.
- Whenever you find a line like this: "_____" you are asked to write something down.

Some of the questions specifically ask about your mother or your father – if this does not relate to your personal situation, please answer these questions in relation to people who are like a mother or a father to you, for example guardians, stepparents, foster parents...

This is not a test, there are no right or wrong answers - we are interested in your honest answers and opinions only!

➔ First, please tell us **YOUR NAME**:_____

THINGS I LIKE TO DO

1. **HOW OFTEN** do you do the following activities **outside of school hours**? Please tick the circle in the corresponding column.

Activity	Every day or almost every day	1-2 times a week	1-2 times a month	A few times a year	Hardly ever or never
Use a library	○	○	○	○	○
Visit a farm, a zoo or an aquarium	○	○	○	○	○
Visit a science gallery, exhibition or museum	○	○	○	○	○
Participate in an after-school activity (e.g. music or dance classes)	○	○	○	○	○
Cook or bake	○	○	○	○	○
Do sport in a team (e.g. soccer)	○	○	○	○	○
Do sport by yourself (e.g. running, dancing)	○	○	○	○	○
Spend time outdoors	○	○	○	○	○
Garden or grow plants at home	○	○	○	○	○
Do science experiments at home	○	○	○	○	○
Read a book or magazine not for school	○	○	○	○	○
Visit websites to learn about things you're interested in in out-of-school-hours	○	○	○	○	○
Use a computer, game console, pad or mobile phone to play games at home	○	○	○	○	○
Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter	○	○	○	○	○
Watch a video about science, maths, or technology in out-of-school-hours	○	○	○	○	○
Build or take things apart or repair things	○	○	○	○	○
Take care of pets	○	○	○	○	○
Play a musical instrument or sing or hum	○	○	○	○	○
Actively listen to music	○	○	○	○	○
Do you do an activity not listed? Tell us what it is: _____ _____ _____	○	○	○	○	○

2. If you had to **pick just one** of the activities from the list above (including the ones you added), **which ONE** do you **like most**?

_____

3. **WHO** do you usually do **this activity** with? (You can tick more than one answer)
   - ☐ A Parent or Guardian
   - ☐ A Sister or Brother
   - ☐ A Grandparent or other Relative
   - ☐ A Teacher
   - ☐ A Friend or Friends
   - ☐ I do this activity on my own
   - ☐ Someone else – who is it? _____

GROUPS I'M PART OF

What teams or groups are you a part of or have been a part of? Which groups would you like to join if you could?

- Tick the **first circle** if you already participate in such a group or have been part of.
- Tick the **second circle** if you don't participate in the group, but would like to if you could.
- Tick the **last circle**, if you are not in such a group, and also not interested in joining.

4. **Groups I'm part of or would like to join / Groups I have been part of for some time**

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
A sports club (such as soccer, tennis)	o	o	o
Scout troop	o	o	o
A choir, music or dance class	o	o	o
Drama or acting class	o	o	o
Cooking or sewing class	o	o	o

Group	I am already a **part** (or **have been part**) of such a group	I would like to **join** such a group	I am **not interested** in joining such a group
Religious youth group	o	o	o
Another group or club _____ _____ _____	o	o	o

WHO ENCOURAGES YOU TO DO THE THINGS YOU DO?

For each activity, **tick a box for each person who encourages you to do this**. You can put **more than one tick** in one row, if necessary.

For example, if your mother and sister encourage you to use the library, put a check by "A parent or guardian encourages me to do this" and by "A sister or brother encourages me to do this."

5. **Who encourages you to do the things you do?**

	I don't do this	A **parent** or guardian encourages me	A **sister** or **brother** encourages me	A **grand-parent** or **other relative** encourages me	A **teacher** encourages me	A **friend** encourages me	**I** motivate **myself**
Go to a science gallery, exhibition or museum	☐	☐	☐	☐	☐	☐	☐
Use a library	☐	☐	☐	☐	☐	☐	☐
Take part in sports	☐	☐	☐	☐	☐	☐	☐
Spend time outdoors	☐	☐	☐	☐	☐	☐	☐
Garden or grow plants at home	☐	☐	☐	☐	☐	☐	☐
Cook or bake	☐	☐	☐	☐	☐	☐	☐

	I don't do this	A parent or guardian encourages me	A sister or brother encourages me	A grand-parent or other relative encourages me	A teacher encourages me	A friend encourages me	I motivate myself
Read a book or magazine not for school	☐	☐	☐	☐	☐	☐	☐
Visit web-sites to learn about things you're interested in	☐	☐	☐	☐	☐	☐	☐
Watch a video about science, maths, or technology	☐	☐	☐	☐	☐	☐	☐
Build or take things apart	☐	☐	☐	☐	☐	☐	☐
Take care of pets	☐	☐	☐	☐	☐	☐	☐
Play a musical instrument or sing or hum	☐	☐	☐	☐	☐	☐	☐
Your favourite activity (the activity you have listed in the previous section in Question 2): _____ _____ _____ _____	☐	☐	☐	☐	☐	☐	☐

QUESTIONS ABOUT SCIENCE

6. **How do you feel** when you think of '**SCIENCE**'? Please answer the following 3 questions and tick the circle on each of the three rows which best describes your feelings:

○ Very bored	○ Rather bored	○ In between	○ Rather fascinated	○ Very fascinated
○ Means nothing	○ Means hardly anything	○ In between	○ Means quite a bit	○ Means a lot
○ Very afraid	○ A little afraid	○ In between	○ A little excited	○ Very excited

7. Are there **science topics** that you find **particularly interesting?** (To give you some examples: planets, mixing materials, computers, the weather, plants, the human body, genetics, earthquakes, animals, hurricanes, building bridges, engines, GPS, ecology and food can all be science topics you are interested in.)

Yes	No
○	○

8. If **yes, which ones**? Please list them in the box below!

Below you find a list of statements. Some people agree with them and others do not. **What do you think?** For each line, please only tick one circle.

9. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot
I enjoy learning science	○	○	○	○	○
Other people of my age find it easier to learn science topics than I do	○	○	○	○	○
My mother talks to me about science	○	○	○	○	○
I find science to be really interesting	○	○	○	○	○
I think I would make a good scientist	○	○	○	○	○
I see how science relates to my life	○	○	○	○	○
My close friends enjoy science	○	○	○	○	○
My parents are interested in science	○	○	○	○	○
Science is helpful in understanding today's world	○	○	○	○	○
My father talks to me about science	○	○	○	○	○
I have no idea what my family thinks of science	○	○	○	○	○
My way of thinking and learning makes it hard to understand science	○	○	○	○	○
Science is not for me	○	○	○	○	○

QUESTIONS ABOUT SCHOOL

10. Please choose your **circumstances**: (More than one answer is possible)

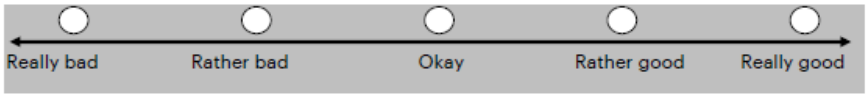
- ☐ Going to **school**
- ☐ Going to **university**
- ☐ **Apprenticeship** / vocational work
- ☐ Part time or full time **employed** or self-employed
- ☐ Undertaking **voluntary work**
- ☐ **Unemployed**
- ☐ Other: _____

The following questions deal with your **school-experiences**. If you are currently **not enrolled**, please answer them with regard to your **last school year**.

11. Which, if any of these, is your **favourite subject at school**? Tick the circle next to the category that contains your favourite. (Please choose only one answer)

- ○ **Natural Sciences** (Biology, Physics, Chemistry, Geology)
- ○ **Arts and humanities** (music, history, religious education, languages, art, geography, social sciences)
- ○ **Mathematics**
- ○ **Informatics** (Coding, Multimedia)
- ○ **Physical education**
- ○ **None** of these
- ○ I **like all** of them **equally**
- ○ Other:_____

12. In general, how do **your teachers** perceive **your achievement at school?**



Below you find **two statements**. Some people agree with them and others do not. What do you think? For each statement, please choose and tick one circle that captures your opinion in the best possible way.

13. What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	I don't have science in school
Science lessons are exciting.	O	O	O	O	O	O
I look forward to my science lessons.	O	O	O	O	O	O

ABOUT ME

The following questions want to get to know you better. Please help us with this!

14. How **old** are you? _____ years old

15. What **gender** do you identify with? _____

16. Where do you **live**? (Please tick one!)

- O In the country side
- O In the outskirts of a city or close to a city
- O In the city

17. In which **country** were you **born**? I was born in _____

18. Have you ever lived in a different country?

- O Yes
- O No

19. Is English your **first language?**

- O Yes
- O No

If not, what is your first language?

_____

20. What **languages** do **adults in your home** use when talking to each other?

_____

21. What **languages** do **you speak at home**?

_____

23. Who do you live **at home** with?

Your mother	☐
Your father	☐
Your guardians or foster parents	☐
Your grandparents	☐
Your sisters and brothers	☐
Other relatives	☐
Your child or children	☐
Someone else? Who? _____ _____	☐

24. Do you experience serious **difficulties** with hearing, seeing, speaking or moving?

- O Yes
- O No

25. Which of these **education levels** have you **completed fully**? (More than one answer is possible)

- ☐ Pre-school education
- ☐ Primary education
- ☐ Secondary education (Junior Certificate)
- ☐ Secondary education (Leaving Certificate)
- ☐ Third Level Education
- ☐ Other:_____

26. Have you any experience of working a job?

- ○ No
- ○ Yes

If yes, **WHAT** did you do? (More than one answer is possible)

- ☐ Summer job
- ☐ Internship
- ☐ Consultant or contractor
- ☐ Part time job
- ☐ Full time job

27. How many books can be found in your **home**? (Do not count magazines, newspapers or schoolbooks)

- ○ **None** or very **few** (0-10 books)
- ○ Enough to fill **one shelf** (11-25 books)
- ○ Enough to fill **one bookcase** (26-100 books)
- ○ Enough to fill **two bookcases** (101-200 books)
- ○ Enough to fill **three or more bookcases** (more than 200 books)

28. How many of the following **items** can be found in your **home**?

	None	1	2-4	5 or More
Televisions	○	○	○	○
Cars, vans or trucks	○	○	○	○
Smart phones in use	○	○	○	○
Computers and tablets	○	○	○	○
Music instruments (e.g. a guitar or a piano)	○	○	○	○

THANK YOU FOR ANSWERING ALL THESE QUESTIONS!

9.4.2 Online Survey Wave 2

SySTEM 2020 Questionnaire: Things I like to do both in and out of School

THANK YOU FOR PARTICIPATING IN THIS SURVEY AGAIN!

Our aim is to find out what young people between 9 and 20 years like to do and what they think about a range of issues related to science, their leisure activities or the groups they are part of.

Please read each question carefully and choose the answer that applies to you.

- With most questions you simply tick the circle "○" next to the answer that describes you best.
- When you see questions with boxes "☐" instead, you can select more than one answer.
- Whenever you find a line like this: "_____" you are asked to write something down.

Some of the questions specifically ask about your mother or your father – if this does not relate to your personal situation, please answer these questions in relation to people who are like a mother or a father to you, for example guardians, stepparents, foster parents…

This is not a test, there are no right or wrong answers - we are interested in your honest answers and opinions only!

Next

THINGS I LIKE TO DO

HOW OFTEN do you do the following activities **outside of school hours**? Please tick the circle in the corresponding column.

	Every day or **almost every day**	**1 - 2 times a week**	**1 - 2 times a month**	**A few times a year**	**Hardly ever** or **never**
Use a library	○	○	○	○	○
Visit a farm, a zoo or an aquarium	○	○	○	○	○
Visit a science gallery, exhibition or museum	○	○	○	○	○
Participate in an after-school activity (e.g. music or dance classes)	○	○	○	○	○
Cook or bake	○	○	○	○	○
Do sport in a team (e.g. soccer)	○	○	○	○	○
Do sport by yourself (e.g. running, dancing)	○	○	○	○	○
Spend time outdoors	○	○	○	○	○
Garden or grow plants at home	○	○	○	○	○
Do science experiments at home	○	○	○	○	○
	Every day or **almost every day**	**1 - 2 times a week**	**1 - 2 times a month**	**A few times a year**	**Hardly ever** or **never**
Read a book or magazine not for school	○	○	○	○	○
Visit websites during out-of-school-hours to learn about things you're interested in	○	○	○	○	○
Use a computer, game console, pad or mobile phone to play games at home	○	○	○	○	○
Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter	○	○	○	○	○
Watch a video about science, maths, or technology in out-of-school-hours	○	○	○	○	○
Build or take thinks apart or repair things	○	○	○	○	○
Take care of pets	○	○	○	○	○
Play a musical instrument or sing or hum	○	○	○	○	○
Actively listen to music	○	○	○	○	○
Do you do an activity not listed:	◉	○	○	○	○

✱ Do you do an activity not listed? Tell us WHAT it is:

✱ If you had to **pick just one** of the activities from the list above (including the ones you added), **which ONE** do you **like most**?

- ○ Use a library
- ○ Visit a farm, a zoo or an aquarium
- ○ Visit a science gallery, exhibition or museum
- ○ Participate in an after-school activity (e.g. music or dance classes)
- ○ Cook or bake
- ○ Do sport in a team (e.g. soccer)
- ○ Do sport by yourself (e.g. running, dancing)
- ○ Spend time outdoors
- ○ Garden or grow plants at home
- ○ Do science experiements at home
- ○ Read a book or magazine not for school
- ○ Visit websites during out-of-school-hours to learn about things you're interested in
- ○ Use a computer, game console, pad or mobile phone to play games at home
- ○ Use social media such as Instagram, YouTube, Snapchat, Facebook or Twitter
- ○ Watch a video about science, maths or technology in out-of-school-hours
- ○ Build or take things apart or repair things
- ○ Take care of pets
- ○ Play a musical instrument or sing or hum
- ○ Actively listen to music
- ○

✱ **WHO** do you usually do **this acitvity** with?

- ☐ A Parent or Guardian
- ☐ A Sister or Brother
- ☐ A Grandparent or other Relative
- ☐ A Teacher
- ☐ A Friend or Friends
- ☐ I do this activity on my own
- ☐ Someone else - WHO is it? [ ]

ⓘ You can tick more than one answer.

GROUPS I'M PART OF

What teams or groups are you a part of or have been a part of? Which groups would you like to join if you could?

- Tick the **first circle** if you already participate in such a group or have been part of one.
- Tick the **second circle** if you don't participate in the group, but would like to if you could.
- Tick the **last circle**, if you are not in such a group, and also not interested in joining.

	I am already a **part** (or **have been part**) of such a group	I would like to **join**	I am **not interested** in joining such a group
A sports club (such as soccer, tennis)	○	○	○
Scout troop	○	○	○
A choir, music or dance class	○	○	○
Drama or acting class	○	○	○
Cooking or sewing class	○	○	○
Religious youth group	○	○	○
Another group or club	◉	○	○

✱ Another group or club:

WHO ENCOURAGES YOU TO DO THE THINGS YOU DO?

For each activity, **tick a box for each person who encourages you to do this.** You can put more than one tick, if necessary.
For example, if your mother and sister encourage you to use the library, put a check by "A parent or guardian encourages me to do this" and by "A sister or brother encourages me to do this."

Go to a science gallery, exhibition or museum

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Use a library

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Take part in sports

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Spend time outdoors

Check all that apply

- [ ] I **don't do** this
- [ ] A **parent** or **guardian** encourages me
- [ ] A **sister** or **brother** encourages me
- [ ] A **grandparent** or **other relative** encourages me
- [ ] A **teacher** encourages me
- [ ] A **friend** encourages me
- [ ] I motivate **myself**

Garden or grow plants at home

Check all that apply

- [ ] I **don't do** this
- [ ] A **parent** or **guardian** encourages me
- [ ] A **sister** or **brother** encourages me
- [ ] A **grandparent** or **other relative** encourages me
- [ ] A **teacher** encourages me
- [ ] A **friend** encourages me
- [ ] I motivate **myself**

Cook or bake

Check all that apply

- [ ] I **don't do** this
- [ ] A **parent** or **guardian** encourages me
- [ ] A **sister** or **brother** encourages me
- [ ] A **grandparent** or **other relative** encourages me
- [ ] A **teacher** encourages me
- [ ] A **friend** encourages me
- [ ] I motivate **myself**

Read a book or magazine not for school

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Visit websites to learn about things you're interested in

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Watch a video about science, maths, or technology

Check all that apply

- [ ] **I don't do** this
- [ ] **A parent** or **guardian** encourages me
- [ ] **A sister** or **brother** encourages me
- [ ] **A grandparent** or **other relative** encourages me
- [ ] **A teacher** encourages me
- [ ] **A friend** encourages me
- [ ] I motivate **myself**

Build or take things apart

Check all that apply

- I don't do this
- A parent or guardian encourages me
- A sister or brother encourages me
- A grandparent or other relative encourages me
- A teacher encourages me
- A friend encourages me
- I motivate myself

Take care of pets

Check all that apply

- I don't do this
- A parent or guardian encourages me
- A sister or brother encourages me
- A grandparent or other relative encourages me
- A teacher encourages me
- A friend encourages me
- I motivate myself

Play a musical instrument or sing or hum

Check all that apply

- I don't do this
- A parent or guardian encourages me
- A sister or brother encourages me
- A grandparent or other relative encourages me
- A teacher encourages me
- A friend encourages me
- I motivate myself

QUESTIONS ABOUT SCIENCE

✱ **How do you feel** when you think of '**SCIENCE**'? Please answer the following 3 questions and tick the circle on each of the three rows which best describes your feelings:

Very bored	Rather bored	In between	Rather fascinated	Very fascinated
○	○	○	○	○

✱ **How do you feel** when you think of '**SCIENCE**'?

Means nothing at all to me	Means hardly anything to me	In between	Means quite a bit to me	Means a lot to me
○	○	○	○	○

✱ **How do you feel** when you think of '**SCIENCE**'?

Very afraid	A little afraid	In between	A little excited	Very excited
○	○	○	○	○

✱
Are there **science topics** that you find **particularly interesting?**

- ◉ Yes
- ○ No

ⓘ To give you some examples: planets, mixing materials, computers, the weather, plants, the human body, genetics, earthquakes, animals, hurricanes, building bridges, engines, GPS, ecology and food can all be science topics you are interested in.

✱
If **yes, which ones**? Please list them in the box below!

*

Below you find a list of statements. Some people agree with them and others do not. **What do you think?** For each line, please only tick one circle.

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot
I enjoy learning science	○	○	○	○	○
Other people of my age find it easier to learn science topics than I do	○	○	○	○	○
My mother talks to me about science	○	○	○	○	○
I find science to be really interesting	○	○	○	○	○
I think I would make a good scientist	○	○	○	○	○
I see how science relates to my life	○	○	○	○	○
My close friends enjoy science	○	○	○	○	○
My parents are interested in science	○	○	○	○	○
Science is helpful in understanding today's world	○	○	○	○	○
My father talks to me about science	○	○	○	○	○

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot
I have no idea what my family thinks of science	○	○	○	○	○
My way of thinking and learning makes it hard to understand science	○	○	○	○	○
Science is not for me	○	○	○	○	○

QUESTIONS ABOUT SCHOOL

The following questions deal with your **school-experiences**. If you are currently **not enrolled**, please answer them with regard to your **last school year**.

✱ Please choose your **circumstances**:

- ☐ Going to **school**
- ☐ Going to **university**
- ☐ **Apprenticeship** / vocational training
- ☐ Part time or full time **employed** or self-employed
- ☐ Undertaking **voluntary work**
- ☐ **Unemployed**
- ☐ Other:

More than one answer is possible

✱ **Which**, if any of these, is your **favourite subject at school**? Tick the circle next to the category that contains your favourite.

- ○ **Natural Sciences** (biology, physics, chemistry, geology)
- ○ **Arts and humanities** (music, history, religious education, languages, art, geography, social sciences)
- ○ **Mathematics**
- ○ **Informatics** (coding, multimedia)
- ○ **Physical education**
- ○ **None** of these
- ○ **I like** all of them **equally**
- ○ Other:

Please choose only one answer.

✱ In general, how do **your teachers** perceive **your achievement at school**?

Really bad	Rather bad	Okay	Rather good	Really good
○	○	○	○	○

✱ Below you find **two statements**. Some people agree with them and others do not.

What do you think? For each statement, please choose and tick one circle that captures your opinion in the best possible way.

What do you think?

	Agree a lot	Agree a little	Undecided	Disagree a little	Disagree a lot	I don't have science in school
Science lessons are exciting.	○	○	○	○	○	○
I look forward to my science lessons.	○	○	○	○	○	○

ABOUT ME

The following questions want to get to know you better. Please help us with this!

* How **old** are you?

years old

* What **gender** do you identify with?

* **Where** do you **live**?

- In the country side
- In the outskirts of a city or close to a city
- In the city

Please tick one.

* In which **country** do you **live**?

Please choose...

* In which **country** were you **born**?

Please choose...

*

Have you ever lived in a different country?

- Yes
- No

* What **languages** do **adults in your home** use when talking to each other?

* What **languages** do **you speak at home**?

*

Who do you live **at home** with?

- [ ] Your mother
- [ ] Your father
- [ ] Your guardians or foster parents
- [ ] Your grandparents
- [ ] Your sisters and brothers
- [ ] Other relatives
- [ ] Your child or children
- [ ] Someone else? Who?

*

Do you experience serious **difficulties** with hearing, seeing, speaking or moving?

- ( ) Yes
- ( ) No

*

Have you any **experience of working** a job?

- ( ) No
- (•) Yes

* If **yes**, **WHAT** did you do?

- [ ] Summer job
- [ ] Internship
- [ ] Consultant or contractor
- [ ] Part time job
- [ ] Full time job

More than one answer is possible.

How many books can be found in your **home**?

- **None** or very **few** (0-10 books)
- Enough to fill **one shelf** (11-25 books)
- Enough to fill **one bookcase** (26-100 books)
- Enough to fill **two bookcases** (101-200 books)
- Enough to fill **three or more bookcases** (more than 200 books)

Do not count magazines, newspapers or school books.

How many of the following **items** can be found in your **home**?

	None	1	2-4	5 or More
Televisions				
Cars, vans or trucks				
Smart phones in use				
Computers and tablets				
Music instruments (e.g. a guitar or a piano)				

THANK YOU FOR ANSWERING ALL THESE QUESTIONS!