Science Outside the Classroom

Research Paper 1

Children's Transversal Skills in Outdoor Learning Environments across four European countries: A participatory study

- Authors -

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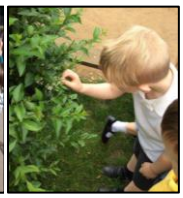


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ABSTRACT:

Transversal skills (TS) are regarded as important acquisitions for children's personal development and future employment and learning outdoors affords children agency and opportunities to succeed, including possibilities to acquire TS that can help them flourish in a mutable world. However, internationally children experience variable access to outdoor learning environments (OLEs). The Science Outside the Classroom project (2018-2021) focused on enhancing scientific enquiry skills and transversal skills among 711 children aged 3-11 years in the OLEs of five educational settings in four European countries. The project comprised an inclusive development programme (SOtC-DP) and a research study that investigated if and how the SOtC-DP supported the development of children's scientific enquiry skills and TS in OLEs. This paper reports on research findings concerning the study children's TS in OLEs. The study synthesised emotional intelligence theory with research associating non-cognitive skills with academic achievement. Located within the participatory inquiry paradigm, it was a multisite instrumental case study for which observations, scales, reviews, questionnaires and descriptive statistical analysis were adopted. Ethical considerations (BERA, 2018) were monitored by a university and participating teachers and primary carers gave voluntary informed consent, while participating children gave ongoing informed assent. Every measure was taken to ensure no harm was done. During the SOtC-DP, the quality of participating settings' outdoor learning environments increased by 39% and children's engagements in TS increased by 15.4% when learning outdoors. After the SOtC-DP, 14% more teachers believed that they had excellent or good expertise in helping children to develop TS outdoors in their settings. Study findings provide evidence that the SOtC-DP enhanced the well-being, motivation, social skills, creative skills and critical thinking skills of 711 children aged 3-11 years across four European countries. Findings also suggest that SOtC-DP outputs provide an evidence-based roadmap that any teacher with access to the worldwide web can use to support children aged 3-11 years to develop transversal skills regarded as valuable for personal development and future employment.

Keywords: Transversal Skills, Learning, Outdoors, Participation, Comparative Study

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Introduction

Science Outside the Classroom (SOtC) was an international project that took place in 2018-2021. The SOtC project team developed and implemented a development programme (SOtC-DP) for which the aim was to enhance children's scientific enquiry skills and transversal skills (TS) in outdoor learning environments (OLEs) across five educational settings in four European countries. A research study was conducted alongside the SOtC-DP to investigate if and how an outdoor science programme may support the development of children's scientific enquiry skills and TS in five European educational settings. This article reports on one strand of the SOtC study that measured and compared the study children's TS in OLEs. The section that follows outlines the SOtC project and sets out the research aim and objectives. Next there is a short review of extant literature, research and theory that informed the strand that is the focus of this article. An explication of the research design is provided, then findings are reported and discussed. In the final section of the article, evidence-based conclusions are presented.

Introduction to the Science Outside the Classroom (SOtC) Project

SOtC was an inclusive participatory international project, co-funded by European Union Erasmus+ program during 2018-2021 (Science Outside the Classroom (SOtC), 2021a). It comprised two principle elements: the SOtC-DP and the research study. The SOtC-DP engaged 711 children with diverse abilities aged 3-11 years and their teachers (n=32) in five educational settings in Croatia, England, Spain and Sweden, as well as a team of university academics comprising science educators and professional researchers.

The SOtC-DP focus was the development of children's scientific enquiry skills and TS outdoors with potential to help children 'to become creative, inventive and enterprising' (Science Outside the Classroom (SOtC), 2021b). Participating teachers and academics worked in partnership to share

expertise and exchange valued practices with the aim of promoting teachers' professional development and children's learning and skills development. Project outputs available in the public domain include the *Science Outside the Classroom Teaching Manual*, a *Science Pictionary* game, a photo book and additional SOtC teaching activities (Science Outside the Classroom (SOtC), 2021c). The partners made these resources available in the public domain as a legacy of the SOtC project, intending that they may inspire teachers to offer inclusive high-quality learning and teaching experiences in scientific enquiry skills and TS outdoors (SOtC, 2021b).

The SOtC research study was a participatory multisite instrumental case study (Heron and Reason, 1997; Creswell, 2013: 294-5). Academics and teachers worked as research partners across the five educational settings that partipated in the SOtC-DP. The aim of the study was **to investigate if and how an outdoor science programme may support the development of children's** scientific enquiry skills and **transversal skills in five European educational settings**. Four objectives acted as stepping stones to achieving the study aim. They were **to identify:**

- Scientific enquiry skills children aged 3-11 years may develop outdoors
- **Transversal skills children aged 3-11 years may develop through scientific enquiry outdoors**
- **Features of the physical environment that may enable children aged 3-11 years to develop** scientific enquiry skills and **transversal skills outdoors**
- **Pedagogical strategies that may enable teachers to support children aged 3-11 years to develop** scientific enquiry skills and **transversal skills outdoors.**

Findings concerning scientific enquiry skills are reported elsewhere; the scope of the present article is focus on the study findings concerning if and how an outdoor science programme may support the development of children's TS in five European educational settings. The elements of the study aim and objectives above that are relevant to this article are indicated in bold and underlining.

Brief Review of Literature: Transversal Skills, Outdoor Learning Environments and Pedagogical Strategies

The present study was informed by a synthesis of extant literature, research and theory focused on emotional intelligence theory (Goleman, 1995; Mayer and Salovey 1997), studies associating academic achievement with TS and pedagogical strategies (*i.a.* Agasisti and Longobardi 2016; Durlak et al., 2011; Murray and Garner, 2015; Pascal and Bertram, 1997; Perez-Gonzalez et al., 2014), biophilia hypothesis and outdoor learning (Cooper, 2016; Wilson, 1984). This section provides a brief review of literature that is germane to this theoretical framework.

Transversal Skills and Emotional Intelligence

TS are defined by (UNESCO International Bureau of Education (IBE) (2013) as *'Skills that are typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge and that can be used in a wide variety of situations and work settings'*, including *'1) critical and innovative thinking, 2) interpersonal skills, 3) intrapersonal skills, 4) global citizenship, 5) media and Information literacy, and 6) others'*. The European Commission (EC) (2020) regards TS as '*core skills… the cornerstone for the personal development of a person…the building blocks for the development of*

Table 1: Transversal Skills for the SOtC Project

Transversal Skills	Subsets of Transversal Skills
Wellbeing	Health and wellbeing
	Behaviour
	Confidence
	Enjoyment of learning
Motivation	Engagement with learning
	Attainment
	Resilience
	Determination
	Involvement
	Engagement with nature
Creativity	Creative
	Inventive
	Enterprising
	Imagination
	Inventiveness
	Resourcefulness
Social skills	Communication
	Team work
	Independence
Critical thinking	Reasoning
	Problem solving (generic)
	Answering questions
	Asking questions
	Understanding nature

the "hard" skills and competences required to succeed on the labour market'. According to the EC (2020), TS are *'Thinking, Language, Application of knowledge, Social Interaction, and Attitudes and Values'*. Emotional Intelligence (EI) is theorised as a cognitive ability linked to - but distinguishable from - general intelligence (Gardner 1983; Goleman 1995; Mayer and Salovey 1997). EI is defined as the ability to perceive, use, understand and manage emotions in oneself and others (Mayer and Salovey 1997). Goleman (1995, 2009) proposes five EI competences: motivation, self-awareness, self-regulation (resilience), empathy and social skills, each comprising sub-sets. These definitions indicate strong congruence between EI and TS, framed as a single entity for the present study (Table 1). Whilst EI theory has detractors (Brody 2004; Matthews, Zydner, and Roberts 2002, 15), it can provide 'a useful framework' for understanding how emotional information is processed (Salovey and Grewal 2005).

Transversal Skills and Academic Achievement

Globally, there is recognition that TS acquisition can support people to flourish in a mutable world (UNESCO (2014). EI theory has influenced practice in many schools (Murray and Cousens, 2020) and various studies evidence the association of academic achievement with EI domains that are congruent with TS (Agasisti and Longobardi 2016; Durlak et al., 2011; Murray and Garner, 2015; Perez-Gonzalez, Cejudo-Prado and Duran-Arias 2014). Perez-Gonzalez et al. (2014) identified correlations between emotional intelligence and academic performance (AP) in primary school students, though their findings varied according to subject. Agasisti and Longobardi 2016) found that students from homes characterised by low socio-economic status who presented with high academic results tended to attend schools where teachers and school leaders promote positive attitudes and offer a range of extracurricular activities. Murray and Garner (2015) identified that universal, integrated social and emotional learning (SEL) programmes can benefit the well-being and educational achievements of children and young people. Durlak et al. (2011) found that provision of SEL programs in schools leads to academic achievement, leveraged when SEL programs feature explicit learning goals, step-by-step training, active learning, and adequate time to develop TS. Furthermore, TS including motivation, well-being, creativity and critical thinking feature in excellence frameworks for early childhood provision (Laevers, 1994; 2000; Pascal, Bertram, Ramsden, Georgeson, Saunders, and Mould, 1996).

Outdoor Learning Environments (OLEs)

Facilitation of students' self-determination is another key element in excellence frameworks for early childhood provision (Laevers, 1994; 2000; Pascal et al., 1996). Children like to be outdoors (*inter alia*

Clark, 2007; Cousins, 1999; Moss and Petrie, 2002) and learning outdoors can afford students agency and opportunities to succeed (Marchant, Todd, Cooksey, Dredge, Jones, Reynolds…Brophy 2019; White, 2011; Moser and Martinsen, 2010). However, children's access to learning outdoors is variable (Waller, Ärlemalm-Hagsér, Sandseter, Lee-Hammond and Wyver, 2017; Maynard, Waters and Clement, 2013: 296). Cooper (2015) posits that outdoor learning environments support development of TS including self-regulation, involvement in learning, and confidence, alongside promoting cognitive development as well as academic achievement. The outdoors is described as 'an important pedagogical space' (Moser and Martinsen, 2010: 467) and there is recognition that a diverse and natural outdoor environment 'advances and enriches all of the domains relevant to the development, health, and wellbeing of young children' (Cooper, 2015:85). Benefits of learning outdoors are not limited to the youngest children: Marchant et al (2019) found that an outdoor learning programme for children aged 9-11 years improved engagement with learning, concentration, behaviour, health and wellbeing. Equally, White (2011: 64-65) observes that outdoor spaces offering *'…dynamic opportunities for journeying, place-making, dramatic story-telling, music-making and scientific explorations…enable children of different ages… to exercise agency… (They) support "possibility thinking" or creativity… (and) the development of dispositions for learning'* and social skills.

There is evidence that children flourish particularly in natural outdoor environments: outdoor space with woodland or forest features (i.a. Barrable and Arvanitis, 2019; Richardson and Murray, 2017; Rose and Kempton, 2014), according with the biophilia hypothesis that humans have a 'deep and intimate association with the natural environment' (Louv, 2005; Wilson, 1984; 1993: 31). The quality of the natural outdoor environment is linked to its potential to support learning especially the natural outdoor environment (Richardson and Murray, 2017). Cooper (2015: 86) proposes 'Minimum Standards to Promote Quality Natural Outdoor Learning Environments' (Figure 1).

However, quality indicators for outdoor learning environments have not been recognised widely among extant environment rating scales (i.a. Harms, Clifford and Cryer, 2014; Harms, Jacobs and White, 2013; Pianta, LaParo and Hamre, 2008).

Pedagogical Strategies

The SOtC-DP was designed to provide children aged 3-11 years with regular opportunities to learn by experiencing a number of pedagogic strategies, including problem-solving, working independently, communicating in different ways, high quality learning and teaching in science outdoors, a high quality

Figure 1: Minimum Standards to Promote Quality Natural Outdoor Learning Environments

- Formally designate the outdoor space an outdoor play and learning environment or similar
- The outdoor play and learning environment has at least two outdoor gross motor features (e.g., climbing features or looping pathways)
- The outdoor play and learning environment has at least two outdoor learning settings (e.g., gardening area, loose parts station, or dramatic play area)
- The outdoor play and learning environment includes a diverse selection of plants and habitats representative of local flora and fauna
- The outdoor play and learning environment includes natural features that enrich children's play and learning such as: non-toxic trees, shrubs, or vines; topographic variations (such as mounds, terraces, slopes); a variety of ground surfaces (mulch, grass, pebbles); smooth rocks, wood or logs; non-poisonous flowering plants or garden plants and vegetables; birdfeeders, bird baths and birdhouses
- An outdoor water source for irrigation is available
- The outdoor play and learning environment has a looping pathway and wheeled toys
- At least 30 minutes of outdoor time is offered per three hours at the center.
- Consumption of fruits and vegetables grown on site is expressly allowed
- A nature supplement for early learning guidelines is adopted
- Professional development for enhancing and utilizing the outdoor play and learning environment is provided
- Each center has outdoor space of at least 75 sq. ft. per child, with exemptions granted only if daily walking outings to nearby parks or public spaces are provided

outdoor environment, physical activity, freedom and movement, inclusion, and active, experiential learning (SOtC, 2021b). Pascal and Bertram (1997) propose that interactions between the educator and the learner underpin pedagogy and, aligning with Rogers 'core conditions for facilitative practice' (1967), they identify three principle factors in teaching approach that affect the quality of such interactions: sensitivity (to the learner), stimulation and the affordance of autonomy (to the learner). These three factors may be considered pedagogical strategies. MacNaugton and Williams (2009) also identify 'a broad and diverse range of teaching techniques to support children's learning' (p.xii) – or pedagogical strategies.

Table 2: Teaching techniques to support children's learning' (MacNaughton and Williams, 2009)

Demonstrating	Questioning	Deconstructing
Describing	Reading	Democratising
Encouraging, praising, helping	Recalling	Documenting
Facilitating	Singing	Empowering
Feedback	Suggesting	Philosophising
Grouping	Telling and instructing	Problem-solving
Listening	Co-constructing	Reinforcing
Modeling	Community building	Scaffolding
Positioning people	Decolonising	Task analysis

The Research Design

An explication of the research design is provided in this section. Focus is given to the paradigm and methodology that were selected for the research, the study's ethical considerations and participants, the roles of academics and teachers as co-researchers in the study and the research instruments used to co-construct data concerning transversal skills.

Paradigm and Methodology

The SOtC research study was a participatory multisite instrumental case study. It was conducted within the participatory inquiry paradigm: an objective-subjective ontology within which what can be known objectively about the world is relative to how it is subjectively shaped and articulated by the knower and those with whom the knower interacts (Heron and Reason, 1997). For SOtC, children's acquisition of objective knowledge about science enquiry skills was reified through their subjective-objective knowledge acquisition of transversal skills in diverse contexts outdoors. The participatory inquiry paradigm incorporates multiple ways of knowing, including experiential and practical knowledge relative to the knower: co-construction and co-operation are valorised as means to achieve knowledge (Heron and Reason, 1997). Throughout the SOtC project, teachers, children and academics co-operated to share and co-construct knowledge, aligning with Heron's descriptor of the participatory inquiry paradigm (1996:11): 'Worlds and people are what we meet, but the meeting is shaped by our own terms of reference'. The study was, therefore, interpretive.

As a multisite instrumental case study, the research focused on an issue within 'real world, contemporary' educational settings in 'different geographical locations' (Creswell, 2013: 294-5). Academics and teachers worked in partnership as researchers to investigate the issue: **if and how an outdoor science programme may support the development of children's** scientific enquiry skills and **transversal skills in five European educational settings**. The cases in the study were the five educational settings that participated in the SOtC-DP, comprising their children and teachers (Table 3).

Ethical Considerations

Ethical considerations were guided by the British Educational Research Association guidelines (BERA) (2018) and ethical protocols were agreed and monitored by the participating university's Research Ethics Committee. In addition, each partner was responsible for identifying and following additional ethical codes and procedures that were required in their respective partner countries. In accordance with BERA (2018) and individual countries' required protocols, ahead of data co-construction each

partner ensured that information was provided to teachers and consent forms were completed by teachers, and that information was provided to parents and consent forms were completed by parents of participating children. Additionally, participating children gave ongoing informed voluntary assent to participate in the study. No harm was done and the option to withdraw was offered to all participants until analysis began. Anonymity of participating individuals is protected: no individual subject is named in the research reporting and apart from the sampling frame, only aggregated data are presented.

Participants

A purposive sampling strategy was adopted for the study. In accordance with the study aim, participants were selected because they were teachers or children at the project settings who participated in the SOtC-DP. Only individuals for whom informed consent had been provided took part in the research study. Table 3 shows the sampling frame.

Table 3: Sampling Frame

Settings in SoTC-DP *(pseudonyms)*	Teachers in SOtC-DP	All Children in Setting	Information about Socio-Economic Status (SES): all children in setting	Children in SOtC-DP	
				Number in SotC-DP	Aged
Rowan School	7	467	8% Free School Meals / 20% Special Educational Needs / 28% non-indigenous	256	6-11 yrs
Modrova Kindergarten	6	134	19.2% High SES / 34.8% medium SES / 44.5% Low SES / 0.5 Poverty	75	3-5 yrs
Juno Kindergarten	12	80	Middle and upper class with good economic conditions	37	3-7 yrs
Feliz School	4	421	13% Special Educational Needs / 43% non-indigenous	223	6-11 yrs
Jubilee School	4	420	9.66% of children are eligible for additional funding for children with low SES / 5.8% are eligible for free school meals	120	4-5 yrs 9-10 yrs

Before the data co-construction began, teachers selected ten children in each setting whom they identified as diverse in respect of gender, age, academic ability and ethnicity (n=50). Although all children who participated in the SOtC-DP were invited to take part in at least one research instrument (Table 4), this subset of 50 children was invited to take part in all the research instruments requiring student data. This model made data co-construction manageable for the teacher-researchers and the children in their busy setting contexts. All teachers who took part in the SOtC-DP were also invited to complete teachers' questionnaires before and after the programme. The three participating academics did not contribute data to the research study.

Academics and Teachers as Co-Researchers

Participating teachers (n=32) and academics (n=3) worked as co-researchers in the study, though their functions were not always the same. The three academics who took part in the SOtC Research Study also took part in the SOtC-DP, to a greater or lesser extent. They all visited SOtC settings which participated in both the SOtC-DP and the Research Study. Two of the academics were also science

educators with science degrees and for the SOtC-DP, they worked with the teachers on creating pedagogical materials that were informed by objective knowledge about science enquiry skills considered accurate at the time of the study. All three academics had teaching qualifications and had previously been school teachers, so could be considered 'insiders', in that they had substantive experience of teaching in schools and/or early childhood settings. However, they were not employed by the participating schools or kindergartens: they worked in higher education and had higher qualifications as researchers. The academics were therefore distanced from the schools that were the study locations, so they were 'relative insiders', rather than 'insiders' (Griffiths, 1998). As the term 'academic' suggests, this group had assumed the academy's 'values, attitudes and beliefs to the extent that they (were) no longer true insiders' in schools (Griffiths, 1998: 137). Moreover, although teachers and academics discussed and agreed the study aim and objectives together, the academic team's 'values, attitudes and beliefs', influenced by research 'norms and forms', were powerful drivers for the study (Griffiths, 1998: 137-9), since the university led the research, designed research instruments and analysed the data.

Teachers who took part in the SOtC-DP also participated as Teacher-Researchers (TRs) in the SOtC Research Study. However, because they also worked as busy teachers throughout the project, ethically and practically their work as researchers was necessarily limited. One TR Co-ordinator in each setting translated materials from English into their setting's home language, then collated their setting's data and translated it from their setting's home language into English before uploading to the project's secure shared space. Other participating TRs co-constructed data with children in their settings, as well as data about their settings' physical environments. Whilst the teachers' full participation as researchers would have been ideal, and translation may have included a few infelicities, the adopted model had advantages. For example, minimal research training was required, in comparison with what would have been needed had the teachers undertaken the full gamut of research activity. Equally, this model allowed for the co-construction of data from geographically – and linguistically - disparate locations across Europe at minimal cost, and as the teachers already knew their settings and the children in them, they did not need to spend time becoming familiar with the research contexts before beginning to co-construct authentic data. In this study, the teachers were 'insiders' (Griffiths, 1998), in the sense that their primary cultural contexts were the schools where they worked as teachers whilst also gathering and collating data about their settings. However, the teachers were also 'relative insiders' in that they collected and collated data from children, and as they were not children themselves, they were distanced from that community of children (Griffiths, 1998).

Research Instruments concerning Transversal Skills

In order to co-construct high quality, robust data over the course of the SOtC-DP, a multi-method model was used (Table 4). Use of several methods secured the trustworthiness of the findings (Denzin, 1970; Guba, 1981) and repeating methods before and after the programme allowed comparison of findings. TS data were co-constructed using five research instruments administered before and after the SOtC-DP was implemented, indicated in bold in Table 4. All research instruments were used to co-construct data concerning science enquiry skills, except the documentary evidence. Data collected at the end of the SOtC-DP followed an extended period of COVID-19 lockdown in all participating countries.

Table 4: Research Instruments

<table>
<tr><th colspan="2">Before the Development Programme
(n= number of participants)</th><th colspan="2">After the Development Programme
(n= number of participants)</th></tr>
<tr><td rowspan="4">Documentary Evidence: settings' demographic data, location and mission and values (5 settings)</td><td>Teacher-Researchers' observations: Students' Transversal Skills Outdoors (n=50)</td><td>Teacher-Researchers' observations: Students' Transversal Skills Outdoors (n=48)</td><td>Post-Box: Students' Knowledge of Science Topics (n=399)</td></tr>
<tr><td>Teacher-Researchers' observations: Setting Outdoor Learning Environments (5 settings)</td><td>Teacher-Researchers' observations: Setting Outdoor Learning Environments (5 settings)</td><td>Adapted PhotoVoice: Students' Knowledge of Science Topics (n=48)</td></tr>
<tr><td>Students' Beliefs and Attitudes Questionnaire (n=49)</td><td>Students' Beliefs and Attitudes Questionnaire (n=47)</td><td rowspan="2">Documentary Evidence: Review of SOtC-DP intellectual outputs</td></tr>
<tr><td>Teachers' Beliefs and Attitudes Questionnaire (n=32)</td><td>Teachers' Beliefs and Attitudes Questionnaire (n=31)</td></tr>
</table>

Teacher-Researcher (TR) Assessments of Students' Transversal Skills Outdoors (ATSLO)

TRs conducted observations of students' TS when learning outdoors in their settings. They conducted the same observations with the same students before and after the SOtC-DP, except with two students who were not included in the final assessments (n=50/n=48). TRs then used these observations as evidence to assess each student's TS subset (Table 1) as 'emerging', 'expected' or 'exceeding', attributing numerical values to descriptors for each TS subset (3, 2 or 1 respectively) to complete the *Assessment of Transversal Skills when Learning Outdoors (ATSLO)* Scale for each child. The ATSLO scale was synthesised from relevant research and literature (Department for Education and Skills (DfES), 2005; Goleman, 1995; 2009; Harms, Clifford and Cryer, 2014; Laevers, 2000; Louv, 2005; Murray, 2017; Murray and Cousens, 2020; Murray and Garner, 2015; Pascal et al., 1996; Standards and Testing Agency, 2017). Figure 2 shows the first page of the ATSLO scale (an adapted version of the ATSLO scale is available for wider use - see appendix 1):

Figure 2: Example from Assessment of Transversal Skills when Learning Outdoors (ATSLO) Scale

(i) TRANSVERSAL SKILLS GRID: WELL-BEING	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child… A	B	C	D	E	F	G	H	I	J
Health and physical well-being	Always lively, active and full of energy when outdoors.	Usually active and energetic when outdoors.	Often lethargic when outdoors.										
Behaviour	Contributes to making the rules and follows the rules when outdoors Always open and accessible to what is happening outdoors	Understands and usually follows rules when outdoors Usually open and accessible to what is happening outdoors	Does not always follow rules when outdoors Is sometimes withdrawn or aggressive when outdoors										
Confidence	Always likes to engage with new activities outdoors	Usually likes to engage with new activities outdoors	Does not like engaging with new experiences outdoors										
Enjoyment of learning	Always looks happy when learning outdoors	Usually looks happy and cheerful when learning outdoors	Rarely or never looks happy when learning outdoors										
Emotional well being	Always appears relaxed and comfortable outdoors.	Usually appears relaxed and happy outdoors. Rarely shows any signs of stress or tension outdoors.	Often shows signs of discomfort outdoors, including signs of stress or tension										
Sub-totals for each child's well-being outdoors:													

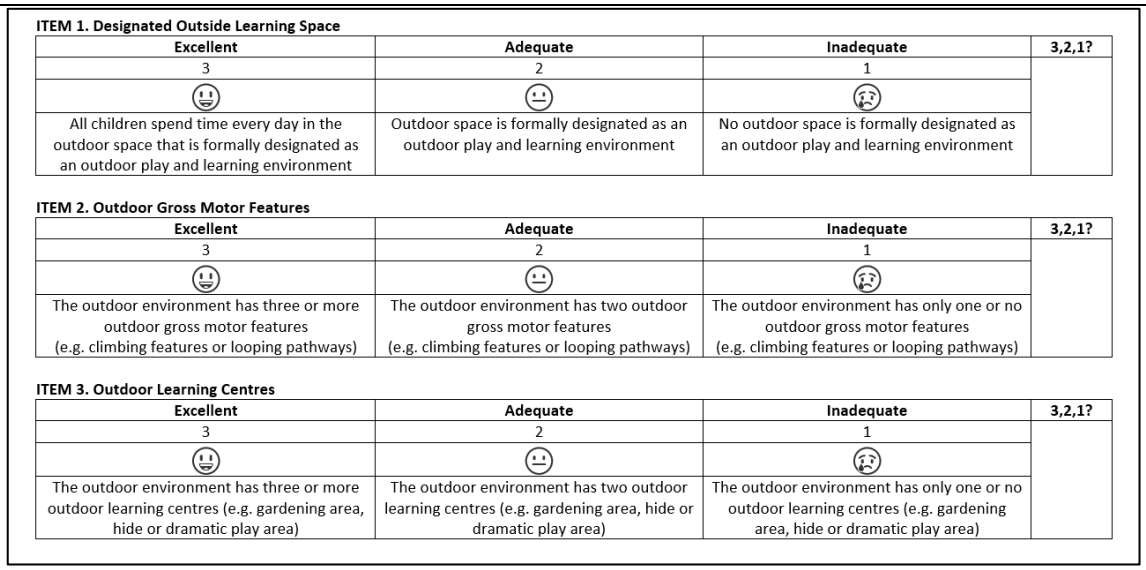
TRs in each setting tallied the scores for all their students who had participated in the ATSLO scale in their setting. They then contributed their setting's ATSLO data to the overall project data. The full data sets were then aggregated to elicit scores for children's transversal skills when learning outside before and after the programme; this process allowed for comparison of data before and after the programme.

Teacher-Researcher (TR) Observations of Outdoor Setting Environments (OOSE)

The Observation of Outdoor Setting Environment (OOSE) was also completed by TRs in their settings. OOSE was developed for the study as a tool for co-constructing data about the quality of the study settings' physical outdoor learning environments. The OOSE scale drew on Cooper's (2015) *Proposed Minimum Standards to Promote Quality Natural Outdoor Learning Environments* (Figure 1), and ECERS-E3 (Harms, Clifford and Cryer, 2014). It featured three options for each criterion: 'excellent', 'adequate', or 'inadequate' and each option carried a numerical value (3, 2 or 1 respectively). Before and after the SOtC-DP was implemented, TRs conducted observations of their settings' outdoor learning environments (n=5/n=5) and completed the (OOSE) Scale. Figure 3 shows the first page of the OOSE scale (an adapted version of the OOSE scale is available for wider use - see appendix 2).

TRs in each setting tallied the scores for their own setting before and after the SOtC-DP. Next, they contributed their setting's data to the overall project data by uploading to the project's secure data space. The full data sets were then aggregated and analysed to elicit scores for the quality of the

Figure 3: Example from Observations of Outdoor Setting Environment (OOSE) Scale



ITEM 1. Designated Outside Learning Space

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
All children spend time every day in the outdoor space that is formally designated as an outdoor play and learning environment	Outdoor space is formally designated as an outdoor play and learning environment	No outdoor space is formally designated as an outdoor play and learning environment	

ITEM 2. Outdoor Gross Motor Features

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
The outdoor environment has three or more outdoor gross motor features (e.g. climbing features or looping pathways)	The outdoor environment has two outdoor gross motor features (e.g. climbing features or looping pathways)	The outdoor environment has only one or no outdoor gross motor features (e.g. climbing features or looping pathways)	

ITEM 3. Outdoor Learning Centres

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
The outdoor environment has three or more outdoor learning centres (e.g. gardening area, hide or dramatic play area)	The outdoor environment has two outdoor learning centres (e.g. gardening area, hide or dramatic play area)	The outdoor environment has only one or no outdoor learning centres (e.g. gardening area, hide or dramatic play area)	

outdoor setting environments before and after the programme. Again, this process allowed for comparison of data before and after the programme.

Students' Questionnaires

Students' questionnaires were concerned predominantly with the SOtC students' attitudes and beliefs, enabling each participating student to express 'a point of view, a belief, a preference, a judgement, an emotional feeling, a position' concerning statements about their science enquiry skills and TS and their own learning in relation to these (Oppenheimer, 1992: 174). Students' questionnaires had two main sections - (1) 'About the child' and (2) 'About learning' and featured 17 demographic, multiple choice, scaled and open questions.

Students' questionnaires were completed before and after the SOtC-DP to ascertain any changes in their attitudes and beliefs concerning science enquiry skills and TS, and their own learning in relation to these over the course of the SOtC-DP. Following a pilot, the students' questionnaires were translated by TR Co-ordinators into the home languages of their settings. The design of the student questionnaires featured language that could be understood easily by children aged 3-11 years and relevant pictures to support children's access and understanding. To secure validity and reliability, the students' questionnaires were administered 1:1 with up to ten participating children in each setting by TRs who were also their teachers. TR Co-ordinators then translated students' responses into English, before collating them for each setting and uploading the collated responses to the secure data space.

The five students' questions (SQ) in their questionnaires that were relevant to this article are those concerned with their learning and TS acquisition: SQ7, SQ8, SQ9, SQ10 and SQ11.

For SQ7, teachers asked children to share their beliefs about their own TS development by responding on a 3-point Likert scale to simple statements concerning well-being, motivation, creativity, social skills and critical thinking (Figure 4)

Figure 4: SQ7 – Children's Beliefs about their Transversal Skills Development

7. <u>All about you.</u> When your Teacher reads each line to you, tell your Teacher if you agree, if you are not sure or if you disagree.

(Teachers, this is about <u>children's beliefs about their transversal skills development</u>. Read each line to the child, ask the child which option fits best and tick one box, as indicated by the child.)

	3 I agree	2 I am not sure	1 I do not agree
I feel good	3	2	1
I want to learn	3	2	1
I think of useful new ideas	3	2	1
I work well with my friends	3	2	1
I find ways to work things out for myself	3	2	1

For the next question (SQ8), students stated where they prefer to learn - indoors, outdoors or both - by responding to simple statements on a 3-point Likert scale (Figure 5).

Figure 5: SQ8 – Students' preferences regarding where they prefer to learn

8. These pictures are about <u>where you like to learn.</u> For each picture, say if you like to learn in the place, are not sure if you like to learn in the place, or do not like to learn in the place.

(Teachers, for each picture, please read the words to the child, ask the child which option fits best and tick one box, as indicated by the child. You can give the child an example if the child is not sure what the picture is about)

		3 Like	2 Not sure	1 Don't like
I like to learn indoors		3	2	1
I like to learn outdoors		3	2	1
I like to learn both indoors and outdoors		3	2	1

Next, students shared their beliefs regarding where they were good at learning - indoors, outdoors or both. Again, they responded on a 3-point Likert scale to simple statements (SQ9) (Figure 6).

Figure 6: SQ9: Where students believed they are good at learning

9. These pictures are about <u>where you are good at learning.</u> For each picture, say if you are good at learning there, are not sure if you are good or bad at learning there, or bad at learning there.

(Teachers, for each picture, please read the words to the child, ask the child which option fits best and tick one box, as indicated by the child. You can give the child an example if the child is not sure what the picture is about)

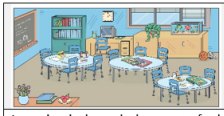
		3 Good	2 Not sure	1 Bad
Learning indoors		3	2	1
Learning outdoors		3	2	1
Learning both indoors and outdoors		3	2	1

For SQ10, teachers asked the students 'How does learning indoors make you feel?' Students shared their beliefs about learning indoors and their own TS by responding to simple statements on a 3-point Likert scale concerning well-being, motivation, creativity, social skills and critical thinking (Figure 7).

Figure 7: SQ10 – Students' beliefs about their transversal skills and learning indoors

10. <u>How does learning indoors make you feel</u>?

(Teachers, this is about <u>children learning indoors and their transversal skills development</u>. Read these statements to the child, ask the child if she or he agrees disagrees or is not sure. Tick one box, as indicated by the child.)

	3 I agree	2 I am not sure	1 I do not agree
Learning indoors helps me to feel good	3	2	1
Learning indoors helps me want to learn	3	2	1
Learning indoors helps me think of useful new ideas	3	2	1
Learning indoors helps me to work well with my friends	3	2	1
Learning indoors helps me to find ways to work things out for myself	3	2	1

Finally, when teachers asked the students 'How does learning outdoors make you feel?' (SQ11), students shared their beliefs about learning outdoors and their own TS. Again, they responded to simple statements on a 3-point Likert scale concerning well-being, motivation, creativity, social skills and critical thinking, but this time they focused on learning outdoors (Figure 8).

Figure 8: SQ11 – Students' beliefs about their transversal skills and learning outdoors

11. How does learning outdoors make you feel?

(Teachers, this is about children learning outdoors and their transversal skills development. Read these statements to the child, ask the child if she or he agrees disagrees or is not sure. Tick one box, as indicated by the child.)

	3 I agree	2 I am not sure	1 I do not agree
Learning outdoors helps me to feel good	3	2	1
Learning outdoors helps me want to learn	3	2	1
Learning outdoors helps me think of useful new ideas	3	2	1
Learning outdoors helps me to work well with my friends	3	2	1
Learning outdoors helps me to find ways to work things out for myself	3	2	1

The students' questionnaire responses were analysed using descriptive statistical analysis, then data sets were aggregated and compared to elicit findings concerning students' views about their acquisition of TS when learning indoors and outdoors, before and after the SOtC-DP.

Teachers' Questionnaires

The teachers' questionnaires were also concerned predominantly with attitudes and beliefs, designed to faciliate each participating teacher to express 'a point of view, a belief, a preference, a judgement, an emotional feeling, a position' concerning statements about children's science enquiry skills and TS and their own teaching in relation to these (Oppenheimer, 1992: 174). Teachers' questionnaires had three sections - (1) 'About you', (2) 'About your science teaching until now', and (3) 'About your teaching' and featured 33 demographic, dichotomous, multiple choice, scaled and open questions. Following a pilot, the teachers' questionnaires were translated by TR Co-ordinators into the home languages of their settings. The teachers' questionnaires were then administered to teachers who were only respondents - not TRs - for this research instrument. Teachers completed their questionnaires before and after the SOtC-DP to ascertain any changes in their attitudes and beliefs concerning children's science enquiry skills and TS and their own teaching in relation to these over the course of the SOtC-DP. Coordinating TRs then translated teachers' responses into English, before collating them for each setting and uploading the collated responses to the secure shared data space.

This article focuses on the nine teachers' questions (TQ) in their questionnaires that were concerned with their teaching and children's TS acquisition indoors and outdoors (TQ22-TQ30). Teachers rated

their own expertise, confidence, enjoyment and levels of challenge in helping children to gain TS (Table 1) indoors and outdoors on 5-point Likert scales (e.g. Figure 9).

Figure 9: Example of question for teachers regarding their expertise and children's TS outdoors

26. Rate your expertise in helping children to gain these skills and attributes when you teach outdoors (Tick one number in each row)

		5 Excellent	4 Good	3 OK	2 Poor	1 Bad
Wellbeing	Health and wellbeing	5	4	3	2	1
	Behaviour	5	4	3	2	1
	Confidence	5	4	3	2	1
	Enjoyment of learning	5	4	3	2	1
Motivation	Engagement with learning	5	4	3	2	1
	Attainment	5	4	3	2	1
	Resilience	5	4	3	2	1
	Determination	5	4	3	2	1
	Involvement	5	4	3	2	1
	Engagement with nature	5	4	3	2	1
Creativity	Creative	5	4	3	2	1
	Inventive	5	4	3	2	1
	Enterprising	5	4	3	2	1
	Imagination	5	4	3	2	1
	Inventiveness	5	4	3	2	1
	Resourcefulness	5	4	3	2	1
Social skills	Communication	5	4	3	2	1
	Team work	5	4	3	2	1
	Independence	5	4	3	2	1
Critical thinking	Reasoning	5	4	3	2	1
	Problem solving (generic)	5	4	3	2	1
	Answering questions	5	4	3	2	1
	Asking questions	5	4	3	2	1
	Understanding nature	5	4	3	2	1

Teachers' questionnaire responses were also subjected to descriptive statistical analysis, then data were aggregated and compared to elicit findings concerning participating teachers' views about their expertise, confidence, enjoyment, and levels of challenge they experienced in helping children to gain TS (Table 1) indoors and outdoors, before and after the SOtC-DP.

Documentary Evidence: Review of SOtC-DP Intellectual Outputs

The development of the *Science Outside the Classroom Teaching Manual*, *Science Pictionary* game, *SOtC Photo Book* and additional SOtC teaching activities were a major feature of the SOtC-DP (SOtC, 2021c). These intellectual outputs (IOs) feature curriculum content and pedagogical strategies that are intended to support teachers to help children aged 3-11 years to develop science enquiry skills and transversal skills outdoors. They were co-constructed by the SOtC teachers and academics and trialled by SOtC teachers in their settings with their children aged 3-11 years within the SOtC-DP. At the end of the project, the IOs were upoaded to the SOtC project website for public access (SOtC, 2021c).

To establish whether these IOs offer pedagogical strategies that may enable teachers to support children aged 3-11 years to develop transversal skills outdoors, activities proposed within them were subjected to two critical reviews to identify (i) if the IOs feature pedagogical strategies (MacNaughton and Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b) and (ii) which pedagogical strategies proposed within the IOs afforded children opportunities to practise transversal skills during the SOtC-DP.

Presentation of Findings

In this section, data are presented according to the five research instruments that are relevant to the focus of this article: an investigation into if and how the SOtC-DP supported the development of children's TS outdoors in five European educational settings.

Findings: Teacher-Researcher (TR) Assessments of Students' Transversal Skills Outdoors (ATSLO)

TRs observed and assessed the TS children presented when learning outdoors in their settings and recorded their findings on the ATSLO scale designed for the present study. Before the SOtC-DP, TRs observed and assessed 50 children (27 boys/23 girls) aged 3-11 years characterised by diverse gender, age, academic ability and ethnicity and after the SOtC-DP, TRs observed and assessed 48 of the same children (25 boys/23 girls) (Table 5). Mean figures for each TS across all five participating settings were calculated, then combined to show the mean figures for all TS presented by children before and after the SOtC-DP (Table 5).

Table 5: Assessments of students' Transversal Skills when Learning Outdoors (ATSLO)

	No. of children assessed	# Gender		Mean Figures: Transversal Skills					Combined Mean Total
		Male	Female	Well-Being	Motivation	Creativity	Social Skills	Critical Thinking	
Pre-SOtC-DP	50	27	23	12.1	14.2	9.04	6.6	9.92	51.86
Post-SOtC-DP	48	25	23	13.96	15.58	10.8	7.62	11.62	59.58

Figures recorded before and after the SOtC-DP (Figure 10) were compared (Figs. 10, 11).

Figure 10: Pre-SOtC-DP /Post-SOtC-DP Assessments of students' Transversal Skills when Learning Outdoors (ATSLO)

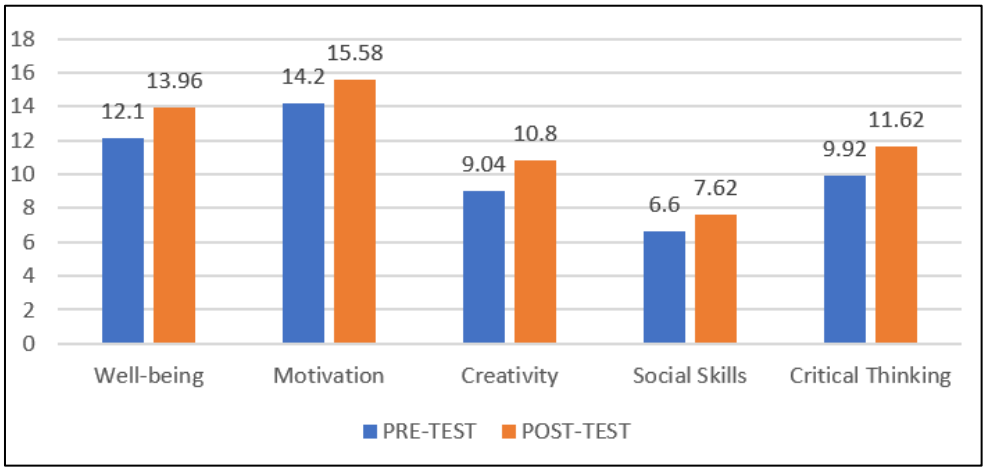
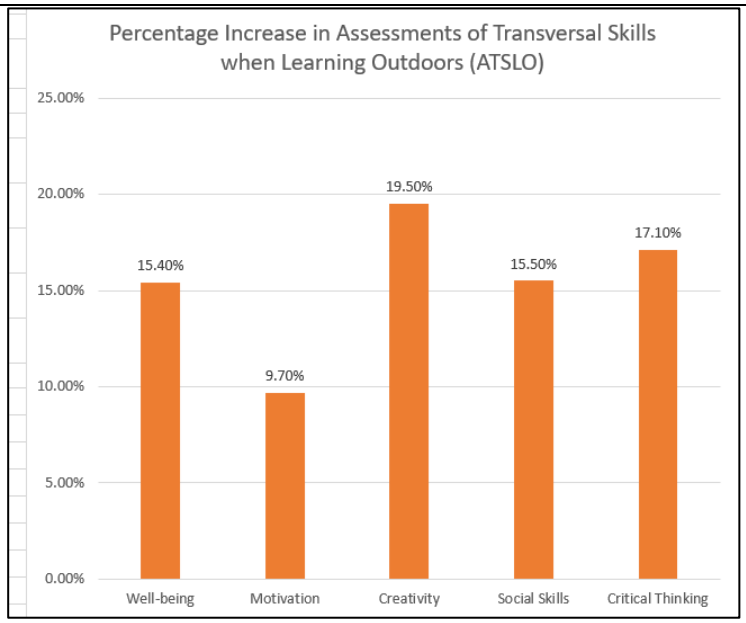


Figure 11: Percentage Increase in Assessments of students' Transversal Skills when Learning Outdoors (ATSLO)



Comparison of these findings revealed that TRs observed an increase of 15.4% in children's TS when learning outdoors in their settings.

Findings: Teacher-Researcher (TR) Observations of Outdoor Setting Environments (OOSE)

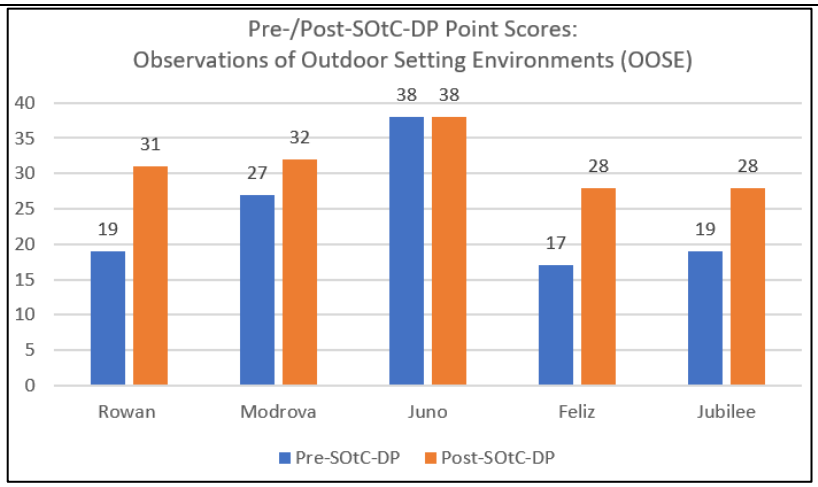
Observations that TRs conducted of their settings' outdoor environments (OOSE) before and after the SOtC-DP revealed increased scores for twelve of the fourteen items observed. Only the scores for Item 5 (Natural Features) and Item 11 (Outdoor Space) remained unchanged (Table 6).

Table 6: Observations of Outdoor Setting Environments (OOSE)

ITEMS	Pre- SOTC-DP	Post- SOTC-DP	Pre/Post Score Comparison
ITEM 1. Designated Outside Learning Space	10	14	+4
ITEM 2. Outdoor Gross Motor Features	10	12	+2
ITEM 3. Outdoor Learning Centres	10	14	+4
ITEM 4. Plants and Habitats	7	10	+3
ITEM 5. Natural Features	9	9	=
ITEM 6. Outdoor Water Source	8	11	+3
ITEM 7. Wheeled Toys	8	11	+3
ITEM 8. Time	10	12	+2
ITEM 9. Fruits and Vegetables	7	9	+2
ITEM 10. Professional Development	8	12	+4
ITEM 11. Outdoor Space	10	10	=
ITEM 12. Science Resources	6	9	+3
ITEM 13. Science processes: Non-living	8	11	+3
ITEM 14. Science processes: Living processes	9	13	+4
SCORE FOR ALL ITEMS ACROSS 5 SETTINGS	**120**	**157**	**+37**
MEAN TOTAL	**24**	**31.4**	**7.4**

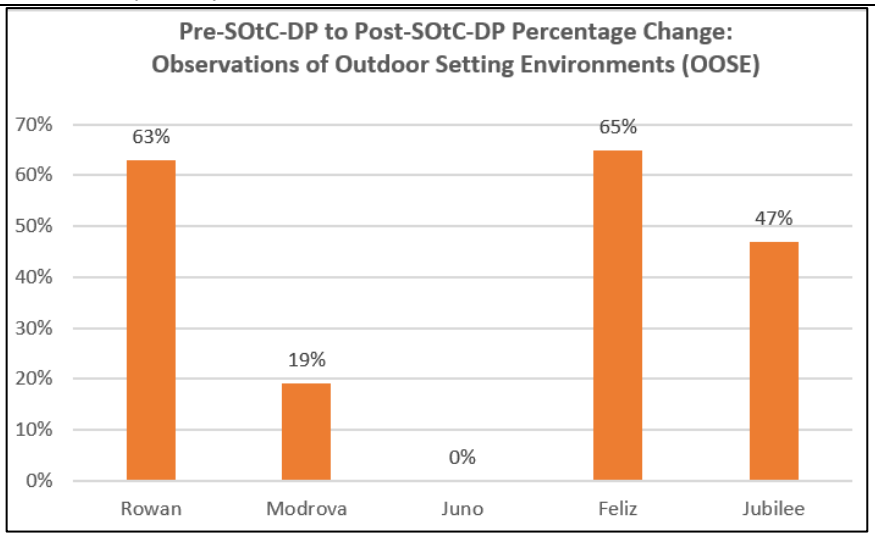
As indicated in Figure 12, four partner settings showed increased scores in their observations of outdoor setting environments (OOSE) after the SOtC-DP. Juno setting scores remained the same.

Figure 12: Pre-SOtC-DP /Post-SOtC-DP Observations of Setting Outdoor Environments (OOSE)



For each setting, percentages were calculated for the differences between OOSE scores before and after the SOtC-DP (Figure 13). Overall, these revealed a percentage increase of 39% (rounded) across all settings' OOSE scores.

Figure 13: Percentage increases: Pre-SOtC-DP /Post-SOtC-DP Observations of Setting Outdoor Environments (OOSE) Scores



Findings: Students' Questionnaires

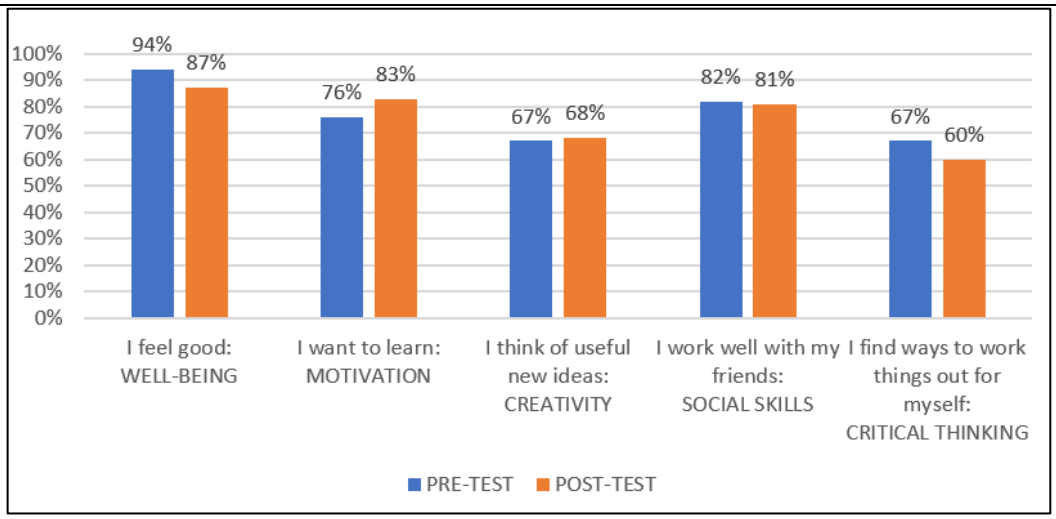
49 children aged 3-11 years responded to the students' questionnaire before the SOtC-DP, and 47 of the same children responded afterwards. Findings presented in this section relate to five questions in

the student questionnaires concerned with development of children's TS outdoors in the five European educational settings: SQ7-SQ11.

SQ7 Responses

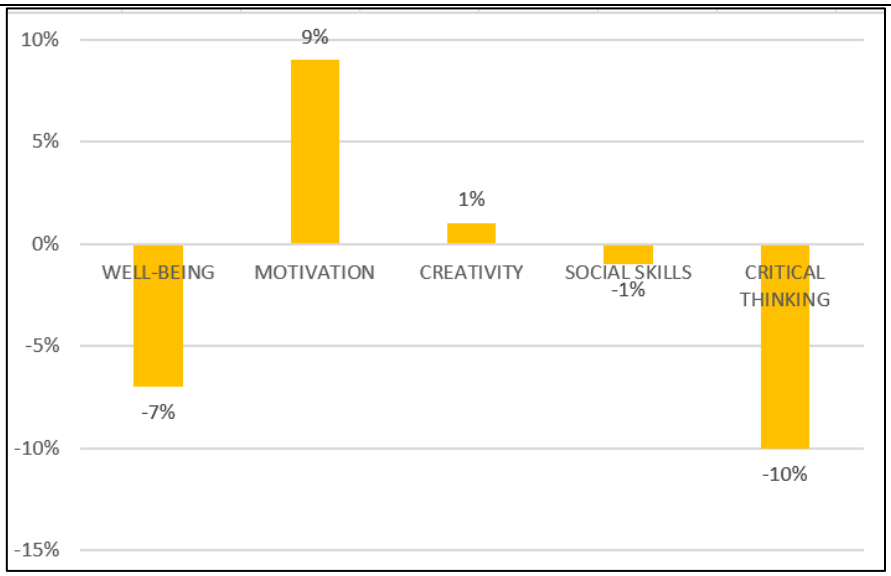
As indicated in Figure 4, for SQ7, students responded to statements regarding their own TS, according to a 3-point Likert scale (Figure 4). SQ7 data gathered before and after the SOtC-DP were compared (Figure 14).

Figure 14: SQ7 - Pre-SOtC-DP /Post-SOtC-DP comparison of students' responses to positive statements about their TS



Having experienced the SOtC-DP, more students shared positive beliefs about their motivation (+9%) and creativity (+1%), whereas fewer children were positive about their well-being (-7%), social skills (-1%) and critical thinking (-10%) (Figure 15). Overall, after the SOtC-DP, 2% fewer students (-2%) agreed with positive statements about their own TS.

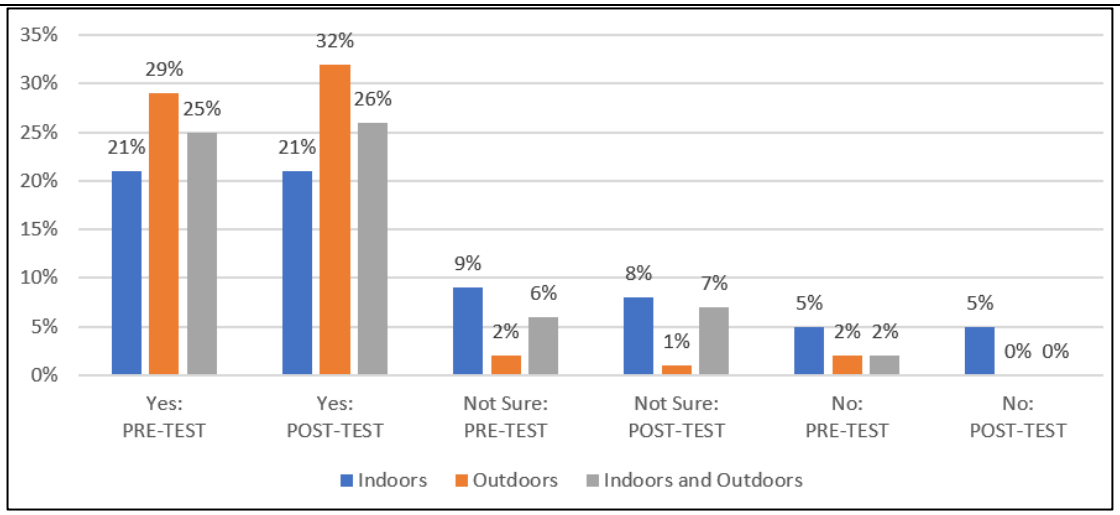
Figure 15: SQ7 - Pre-SOtC-DP/Post-SOtC-DP percentage differences in students' responses to positive statements about their TS



SQ8 Responses

In their responses to SQ8**,** students stated where they preferred to learn: indoors, outdoors or indoors and outdoors (Figure 16). Before the SOtC-DP, 38% more students said they preferred to learn outdoors than those who said they preferred to learn indoors, whereas after the SOtC-DP, 52% more students said they preferred to learn outdoors than those who said they preferred to learn indoors. Overall, therefore, following the project, although there was no change in children's stated preference for learning indoors, 14% more children said they prefer to learn outdoors than those who said they prefer to learn indoors *[(21:29=38%) / (21:32=52%): (52%-38%=14%)]* (Fig.16).

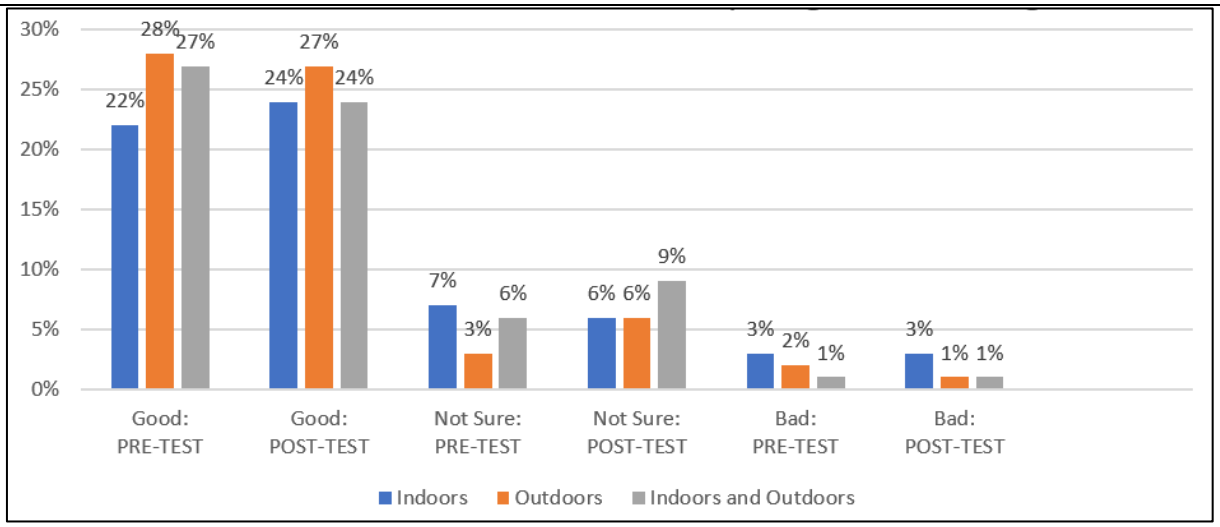
Figure 16: SQ8 – Pre-SOtC-DP/Post-SOtC-DP, where do children prefer to learn?



SQ9 Responses

SQ9 asked students to say ***where*** they believed they were good at learning: indoors, outdoors or indoors and outdoors (Figure 17). Before the SOtC-DP, 27% more children said they were good at learning **outdoors** than those who said they were good at learning indoors. Afterwards, 13% more children said they were good at learning **outdoors** than those who said they were good at learning indoors. Therefore, after the project, 14% fewer children thought they were good at learning **outdoors** than those who said they were good at learning indoors.

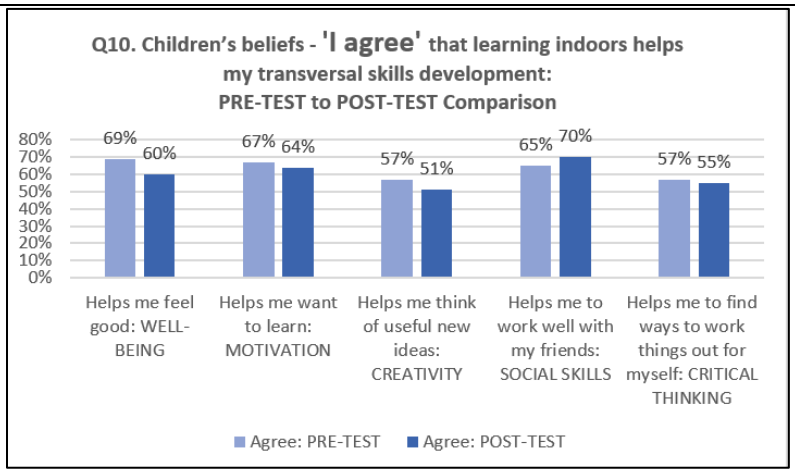
Figure 17: SQ9 – Pre-SOtC-DP/Post-SOtC-DP where did children believe they were good at learning?

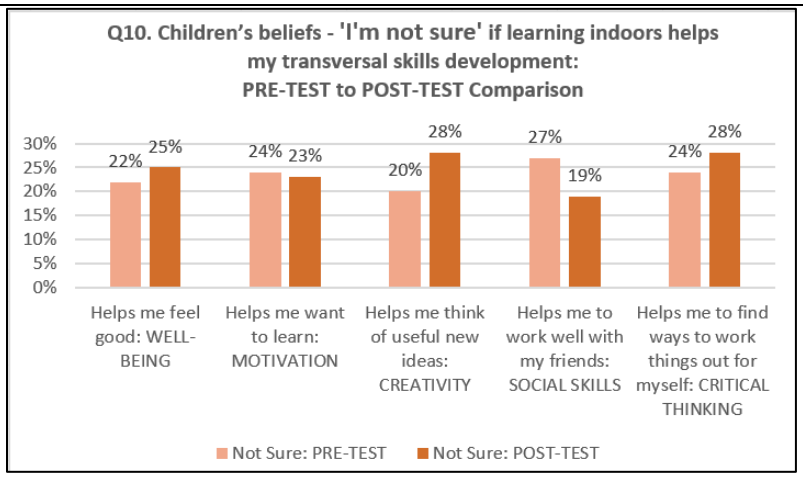


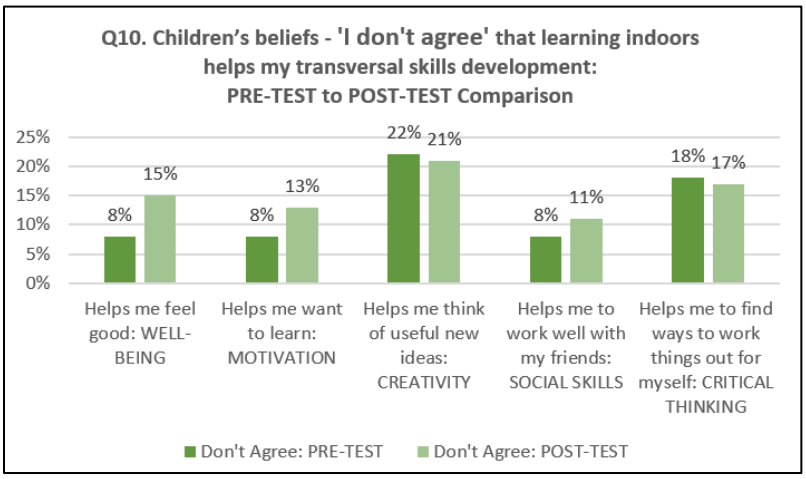
SQ10 Responses

For SQ10, teachers asked children to share their beliefs about their own transversal skills acquisition when learning indoors by selecting a Likert scale option for each statement provided (Figs 7, 18).

Figure 18: SQ10 – Pre-SOtC-DP/Post-SOtC-DP, children's beliefs about their TS acquisition when learning indoors

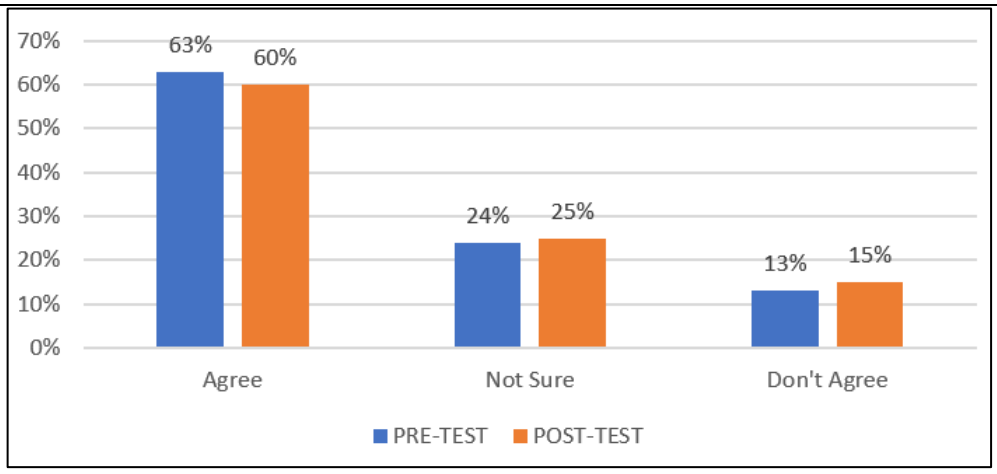






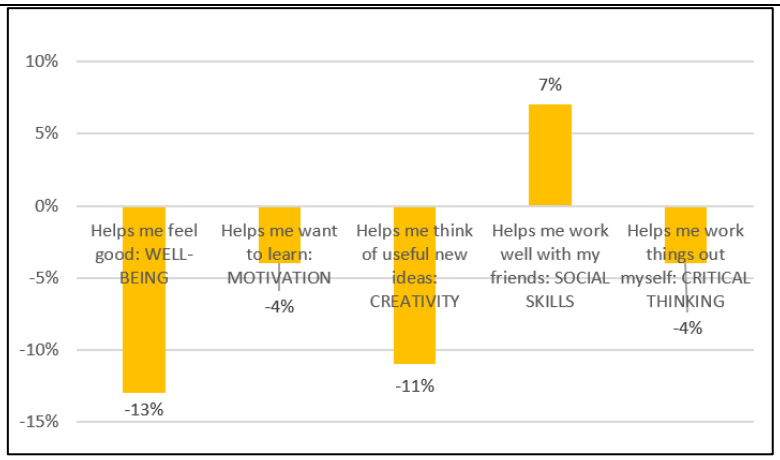
When responding to SQ10 before the SOtC-DP, 79% more children agreed than disagreed that learning ***indoors*** helped them to acquire TS (Figs 18,19), whereas after the SOtC-DP, 75% more children agreed than disagreed that learning ***indoors*** helped them to acquire TS (Figs 18,19). Having experienced the SOtC-DP, overall 4% fewer children (-4%) thought learning indoors helped them to acquire TS (Figs. 18, 19).

Figure 19: SQ10 – Aggregated Data: children's beliefs pre-SOtC-DP/post-SOtC-DP about their TS aqcuisition when learning indoors



Having experienced the SOtC-DP, although more children thought learning ***indoors*** leveraged their social skills (+7%) after the SOtC-DP, fewer children thought learning ***indoors*** enhanced their well-being (-13%), motivation (-4%), creativity (-11%) and critical thinking (-4%). Overall, by the end of the SOtC-DP, 5% fewer children (-5%) agreed that learning indoors helped them to acquire TS (Fig.20).

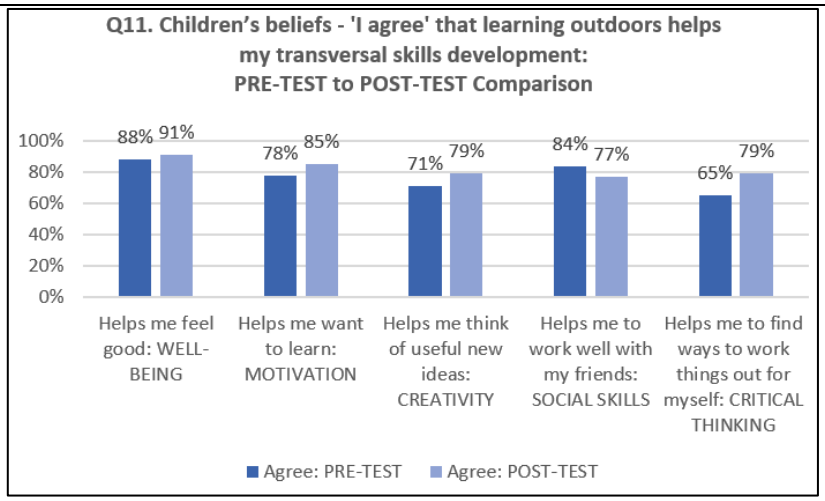
Figure 20: SQ10 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Children's agreement that learning indoors helped them acquire TS

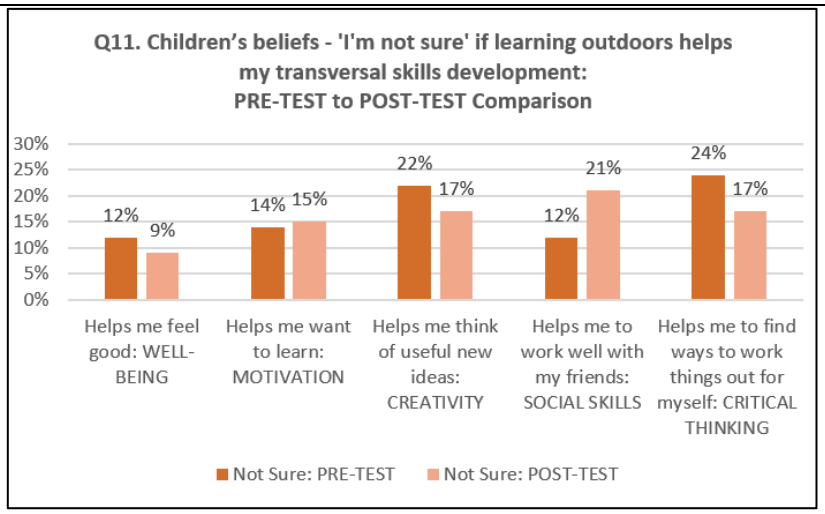


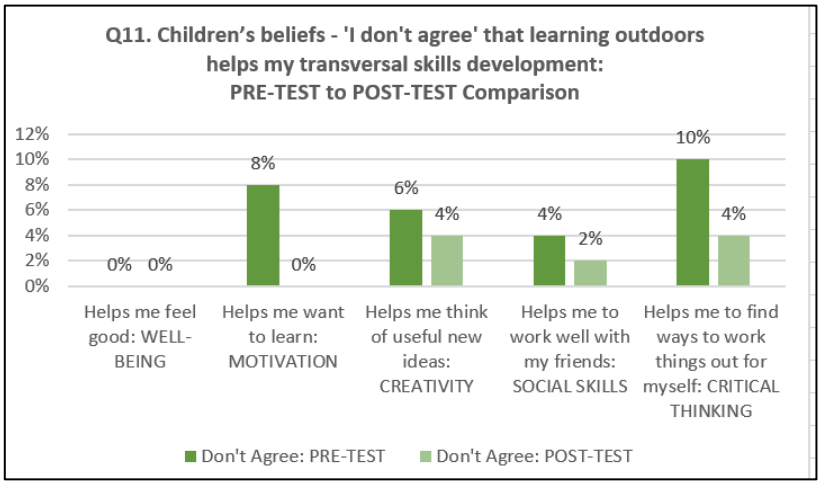
SQ11 Responses

SQ11 required children to share their beliefs about their own TS acquisition when learning outdoors by selecting a Likert scale option for each statement provided (Figs 8, 21).

Figure 21: SQ11 – Pre-SOtC-DP/Post-SOtC-DP, children's beliefs about their TS acquisition when learning outdoors

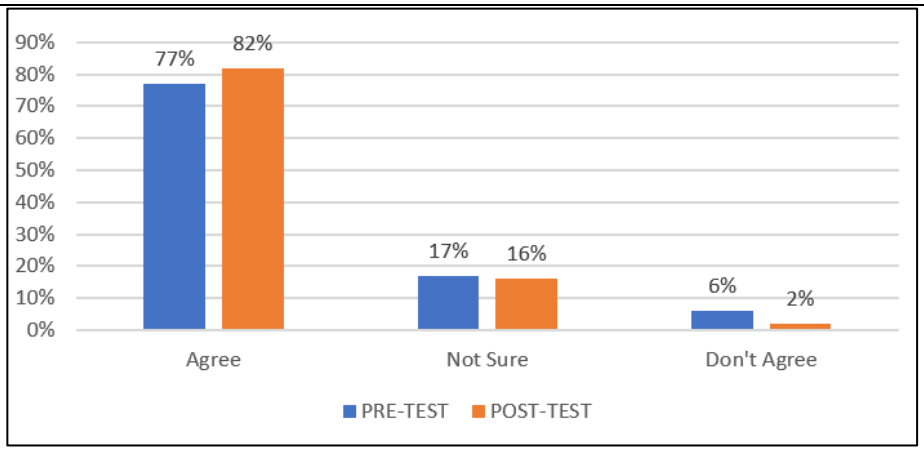






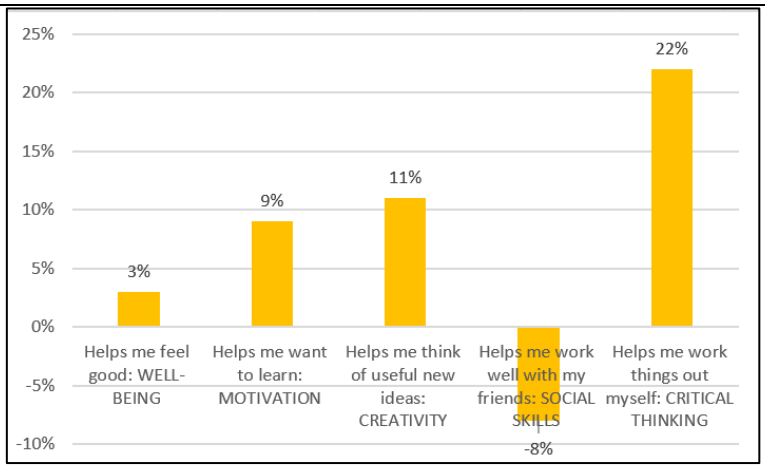
When responding to SQ11 before the SOtC-DP, 92% more children agreed than disagreed that learning **outdoors** helped them to acquire TS (Figs 18,19), whereas after the SOtC-DP, 97% more children agreed than disagreed that learning **outdoors** helped them to acquire TS (Figs 21,22).

Figure 22: SQ11 – Aggregated Data: children's beliefs pre-SOtC-DP/post-SOtC-DP about their TS aqcuisition when learning outdoors



Having experienced the SOtC-DP, more children thought learning outdoors enhanced their well-being (+3%), motivation (+9%), creativity (+11%) and critical thinking (+22%), though fewer children thought learning outdoors enhanced their social skills (-8%) (Fig. 23): almost the opposite of the children's views regarding learning indoors and their TS acquisition (Fig.20). Overall, by the end of the SOtC-DP, 7.4% more children agreed that learning outdoors helped them to acquire TS (Fig.23).

Figure 23: SQ11 - *Pre-SOtC-DP/Post-SOtC-DP Comparison: Children's agreement that learning outdoors helped them acquire TS*



Comparing children's responses for indoors with their responses for outdoors, 12.4% more children agreed that learning **outdoors** (7.4%) enhanced their TS acquisition than those who agreed that learning **indoors** (-5%) enhanced their TS acquisition (Figs. 20, 23).

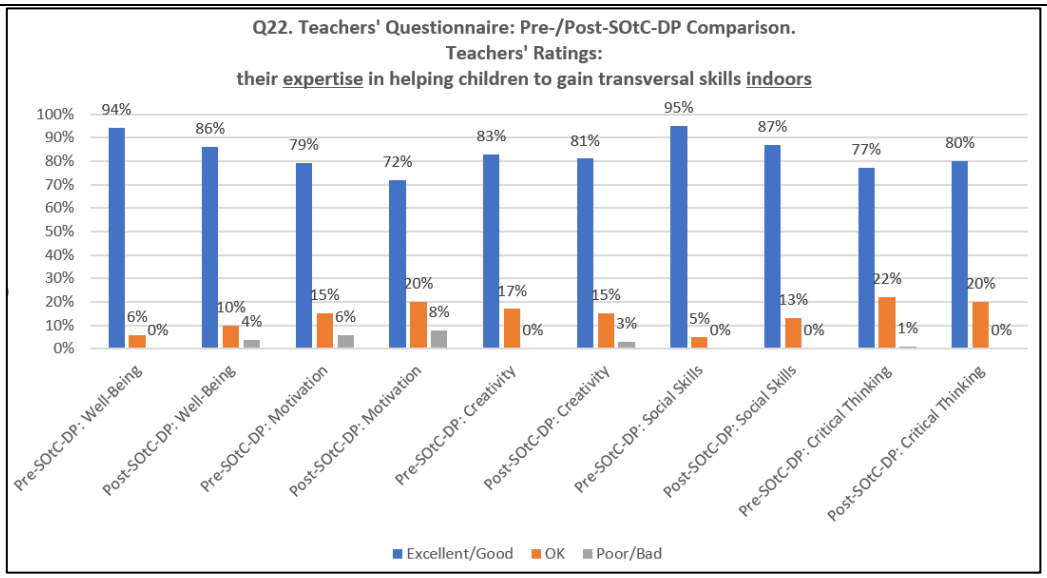
Findings: Teachers' Questionnaires

Findings presented in this section relate to nine questions in the teachers' questionnaires that are concerned with their teaching and children's TS acquisition indoors and outdoors (TQ22-TQ30). For these questions, teachers were invited to rate their own expertise, confidence, enjoyment and levels of challenge they experienced in helping children they taught aged 3-11 years to gain TS (Table 1) indoors and outdoors on Likert scales (e.g. Fig. 9). 32 teachers completed their questionnaires before the SOtC-DP, and 31 teachers did so afterwards.

TQ22/ *Teachers' Expertise: Helping children gain TS indoors*

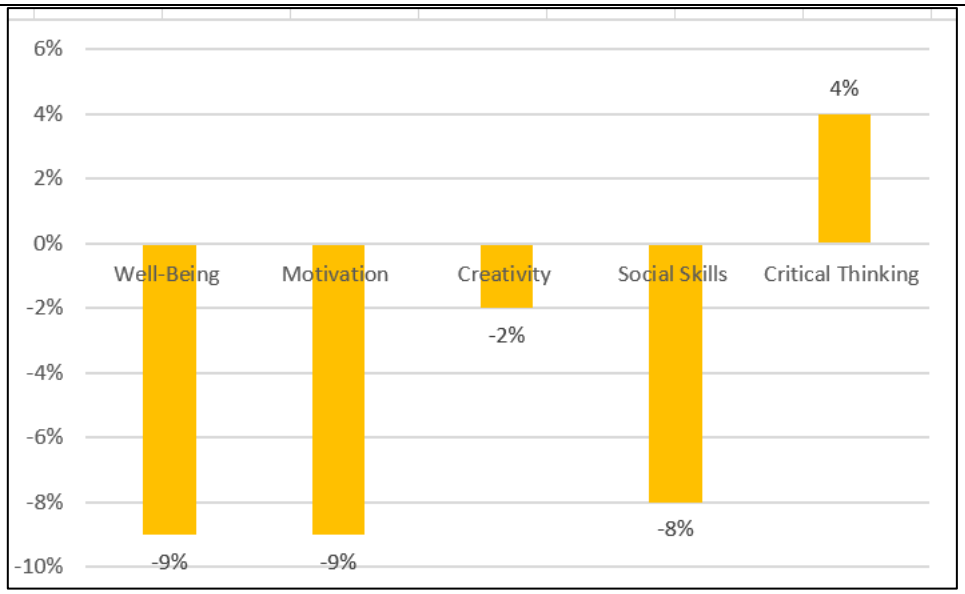
TQ22 asked teachers to rate their **expertise** in helping children they taught aged 3-11 years to gain TS indoors. Before and after the SOtC-DP, most teachers (72% to 95%) rated their expertise as 'Excellent' or 'Good' regarding helping children to gain TS indoors (Fig. 24).

Figure 24: TQ22 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own expertise in helping children gain TS indoors



However, as Figure 25 shows, whilst teachers believed their **expertise** in helping children to gain specific TS **indoors** had increased for critical thinking (+4%) by the end of the SOtC-DP, it had decreased for well-being (-9%), motivation (-9%), creativity (-2%) and social skills (-8%). Overall, by the end of the programme, 5% fewer teachers rated their **expertise** as 'Excellent' or 'Good' regarding helping children to gain TS **indoors**, compared with before (-5%).

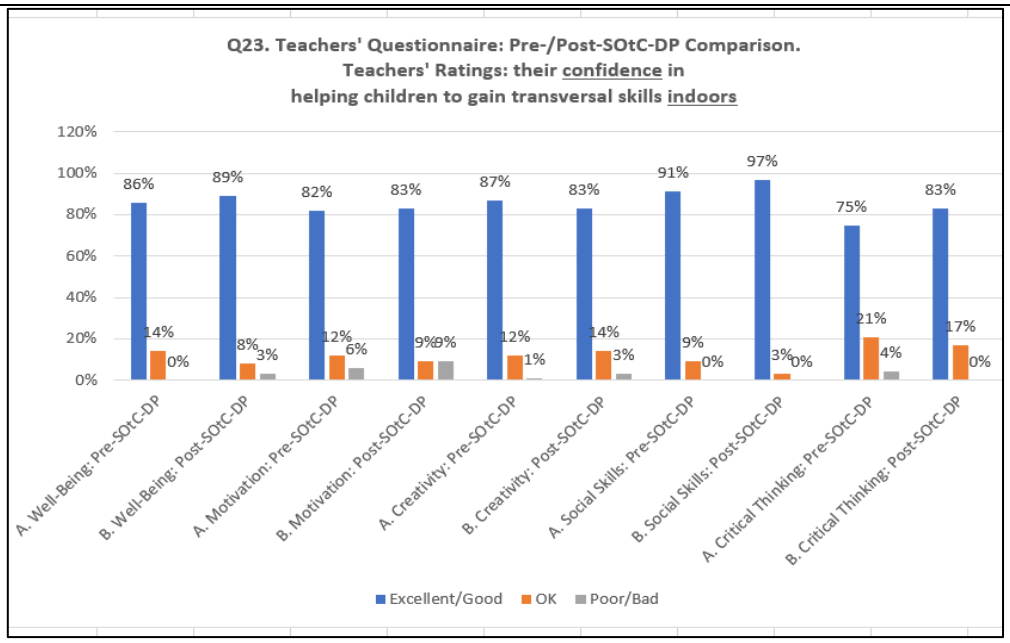
*Figure 25: TQ22 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **expertise** in helping children gain TS **indoors***



TQ23/ Teachers' Confidence: Helping children gain TS indoors

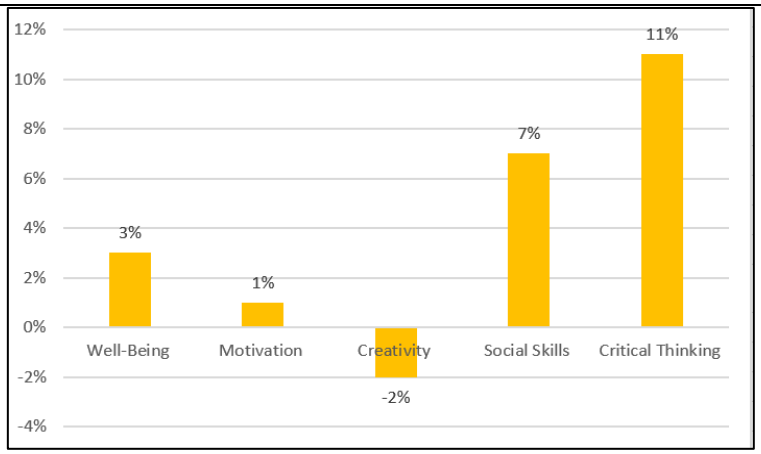
In response to TQ23, teachers rated their **confidence** in helping children they taught aged 3-11 years to gain TS indoors. Before and after the SOtC-DP, most teachers (range 75%-97%) rated their own confidence as 'Excellent' or 'Good' regarding helping children to gain TS indoors (Fig. 26).

Figure 26: TQ23 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own confidence in helping children gain TS indoors



As shown in Figure 27, teachers believed their confidence in helping children to gain specific TS **indoors** increased during the SOtC-DP for well-being (+3%), motivation (+1%), social skills (+7%), and critical thinking (+11%) but decreased for creativity (-2%). Overall, after the SOtC-DP, 4% more teachers rated their confidence as 'Excellent' or 'Good' for helping children to gain TS **indoors,** compared with before the programme.

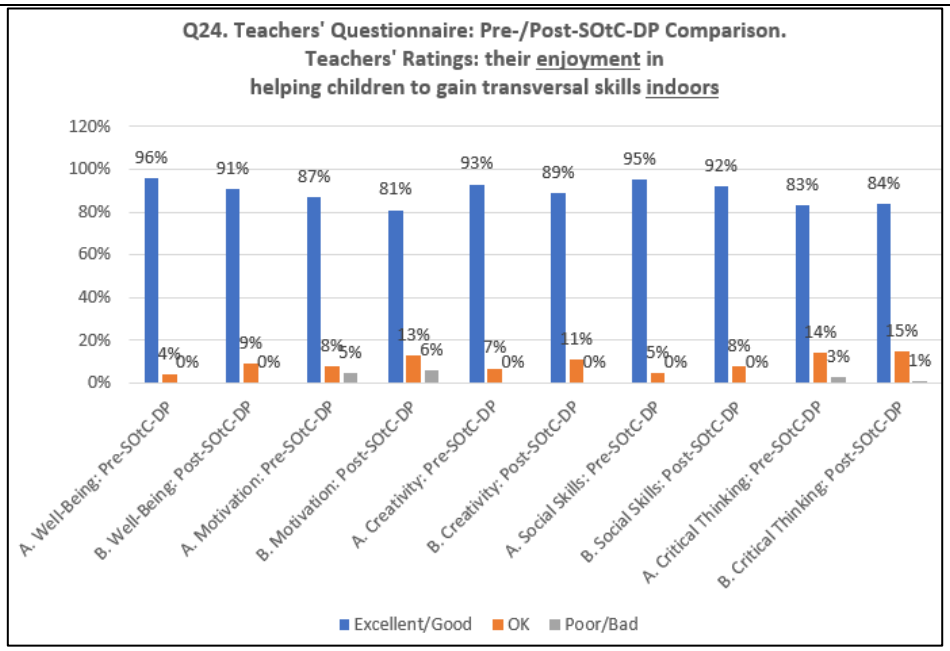
*Figure 27: TQ23 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **confidence** in helping children gain TS **indoors.***



TQ24/ Teachers' Enjoyment: Helping children gain TS indoors

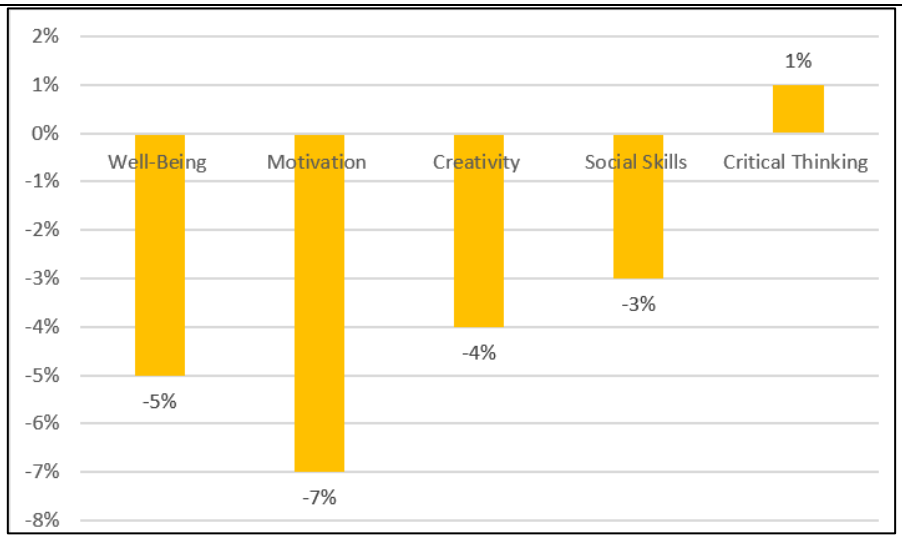
In response to TQ24, teachers rated their **enjoyment** in helping children they taught aged 3-11 years to gain TS indoors. Before and after the SOtC-DP, most teachers (range 81% to 96%) rated their own enjoyment as 'Excellent' or 'Good' regarding helping children to gain TS indoors (Figure 28).

Figure 28: TQ24 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own enjoyment in helping children gain TS indoors



Nevertheless, after the SOtC-DP, overall, 4% fewer teachers rated their **confidence** as 'Excellent' or 'Good' in respect of helping children to gain TS **indoors,** compared with before the SOtC-DP**.** Figure 29 shows that teachers believed their enjoyment in helping children to gain specific TS **indoors** decreased during the SOtC-DP for well-being (-5%), motivation (-7%), creativity (-4%) and social skills (-3%), though increased slightly for critical thinking (+1%).

*Figure 29: TQ24 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **enjoyment** in helping children gain TS **indoors.***



TQ25/ Teachers' Levels of Challenge: Helping children gain TS while teaching science indoors

In response to TQ25, teachers rated their perceived levels of challenge in helping children they taught aged 3-11 years to gain TS, while teaching science **indoors**. This question was included because the other main strand in the SOtC focused on science enquiry skills. Before *and* after the SOtC-DP, most teachers (range 52% to 76%) rated their own perceived level of ease as 'Excellent' or 'Good' in helping children to gain TS when teaching science **indoors** (Figure 30). However, overall, teachers' ratings for this question were lower than their responses for other questions focused on helping children acquire TS **indoors**.

Figure 30: TQ25 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their perceived ease or difficulty in helping children gain TS, while teaching science indoors

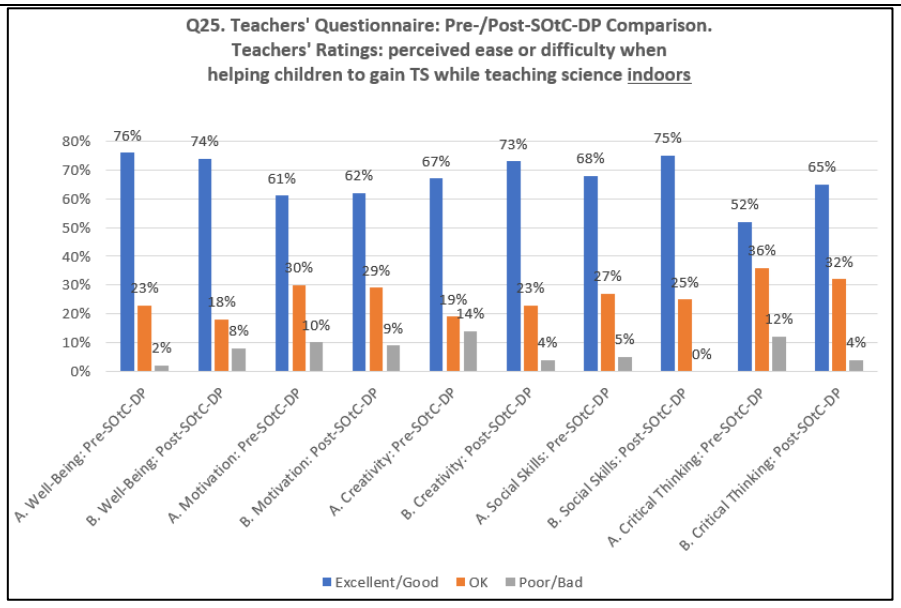
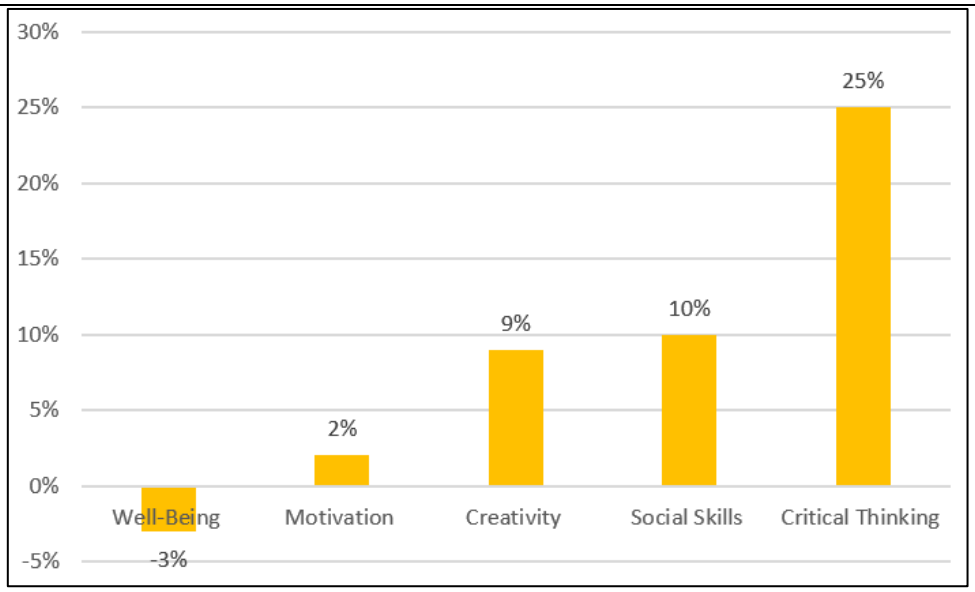


Figure 31 shows the differences between teacher's pre-test to post-test responses in respect of *their perceived ease or difficulty in helping children gain TS, while teaching science indoors.* By the end of the SOtC-DP, teachers said they were finding it less easy to support children's well-being while teaching science **indoors** (-3%). However, they were finding it easier to support children to acquire motivation (+2%), creativity (+9%), social skills (+10%), and especially critical thinking (+25%). Overall, **9%** more teachers rated as 'Excellent' or 'Good' their ease in helping children to gain TS while teaching science **indoors**, compared with before the SOtC-DP.

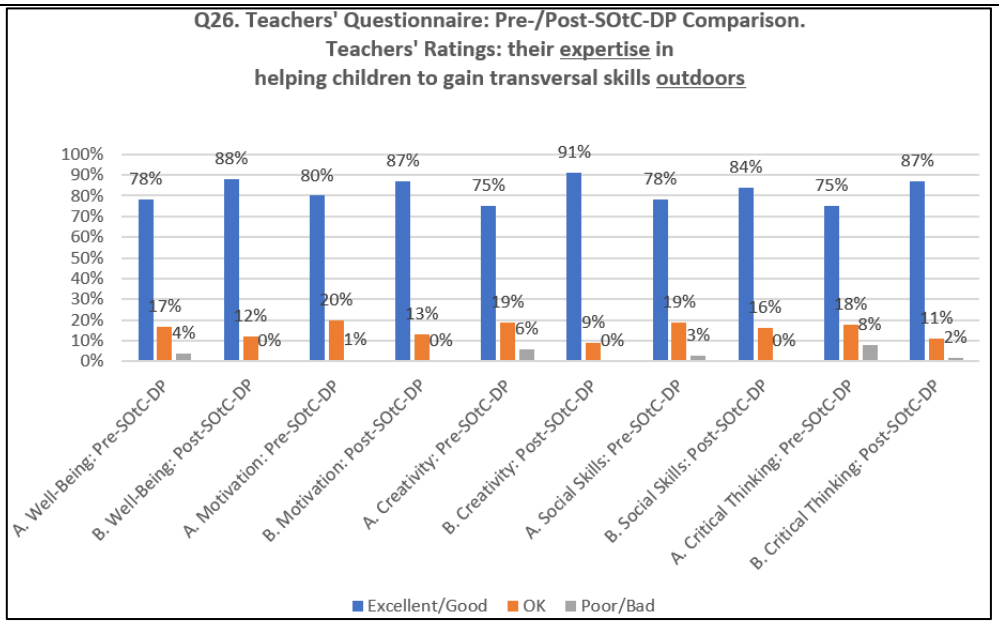
*Figure 31: TQ25 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their **perceived ease or difficulty** in helping children gain TS, while teaching science **indoors***



TQ26/ Teachers' Expertise: Helping children gain TS outdoors

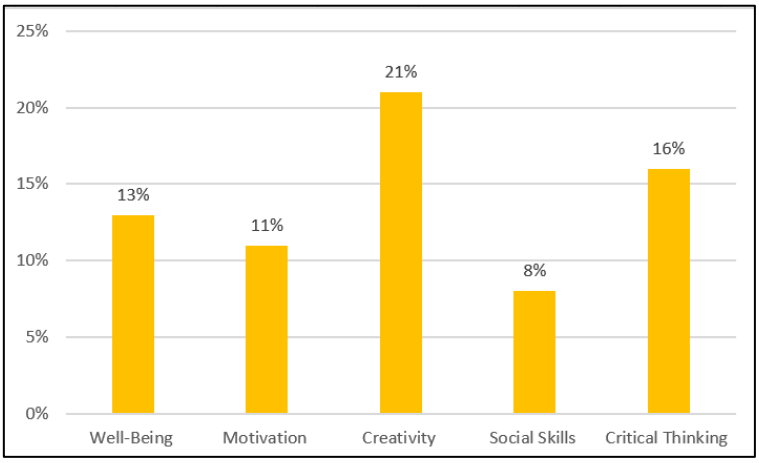
TQ26 asked teachers to rate their **expertise** in helping children they taught aged 3-11 years to gain TS **outdoors**. Before and after the SOtC-DP, most teachers (75% to 91%) rated their expertise as 'Excellent' or 'Good' regarding helping children to gain TS outdoors (Figure 32).

Figure 32: TQ26 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own expertise in helping children gain TS outdoors



After the SOtC-DP, overall, **14%** more teachers rated their **expertise** as 'Excellent' or 'Good' regarding helping children to gain TS **outdoors**, compared with previously. Figure 33 displays these data for each TS and shows that teachers believed their expertise in helping children to gain specific TS **outdoors** increased during the SOtC-DP for all TS: well-being (13%), motivation (+11%), creativity (+21%), social skills (8%), and critical thinking (+16%).

*Figure 33: TQ26 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **expertise** in helping children gain TS **outdoors***



TQ27/ Teachers' Confidence: Helping children gain TS outdoors

In response to TQ27, teachers rated their **confidence** in helping children they taught aged 3-11 years to gain TS **outdoors**. Before and after the SOtC-DP, most teachers (74% to 95%) rated their own **confidence** as 'Excellent' or 'Good' in helping children to gain TS **outdoors** (Fig. 34).

*Figure 34: TQ27 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own **confidence** in helping children gain TS **outdoors***

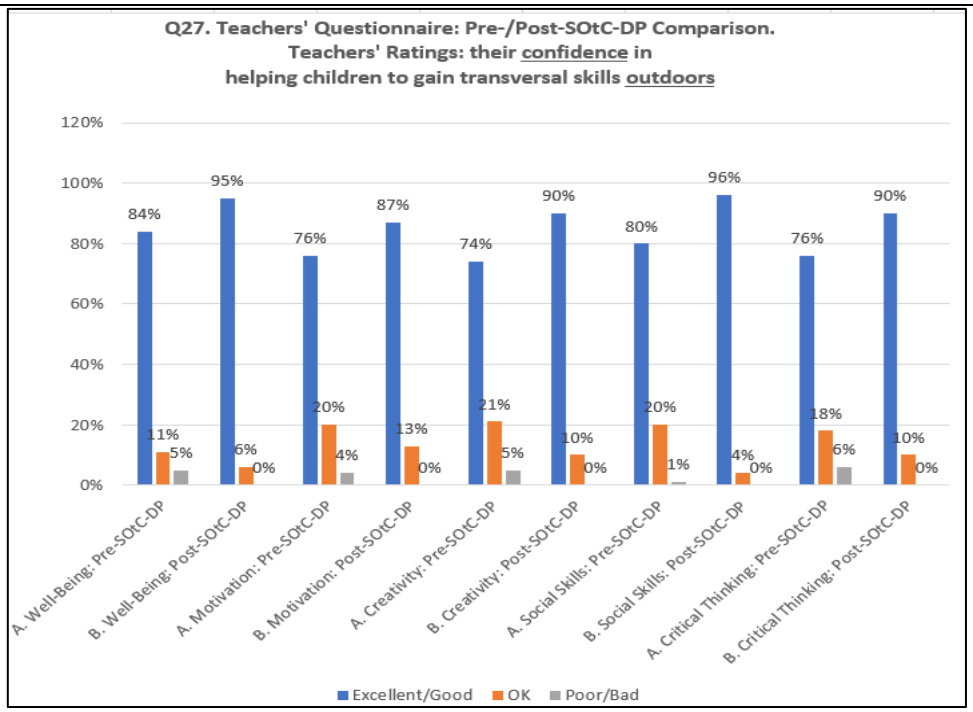
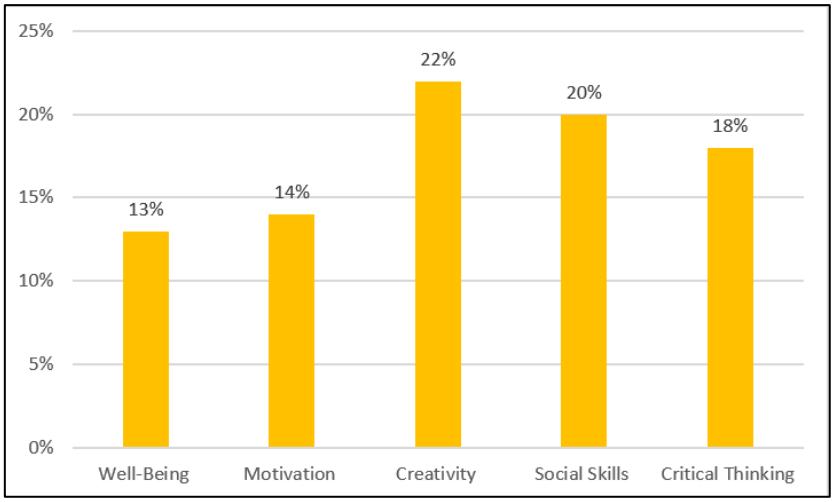


Figure 35 indicates that teachers believed their **confidence** in helping children to gain specific TS **outdoors** increased during the SOtC-DP for all TS: well-being (+13%), motivation (+14%), creativity (+22%), social skills (+20%), and critical thinking (+18%). After the programme, overall **17% more** teachers rated their **confidence** as 'Excellent' or 'Good' regarding helping children to gain TS **outdoors,** compared with beforehand.

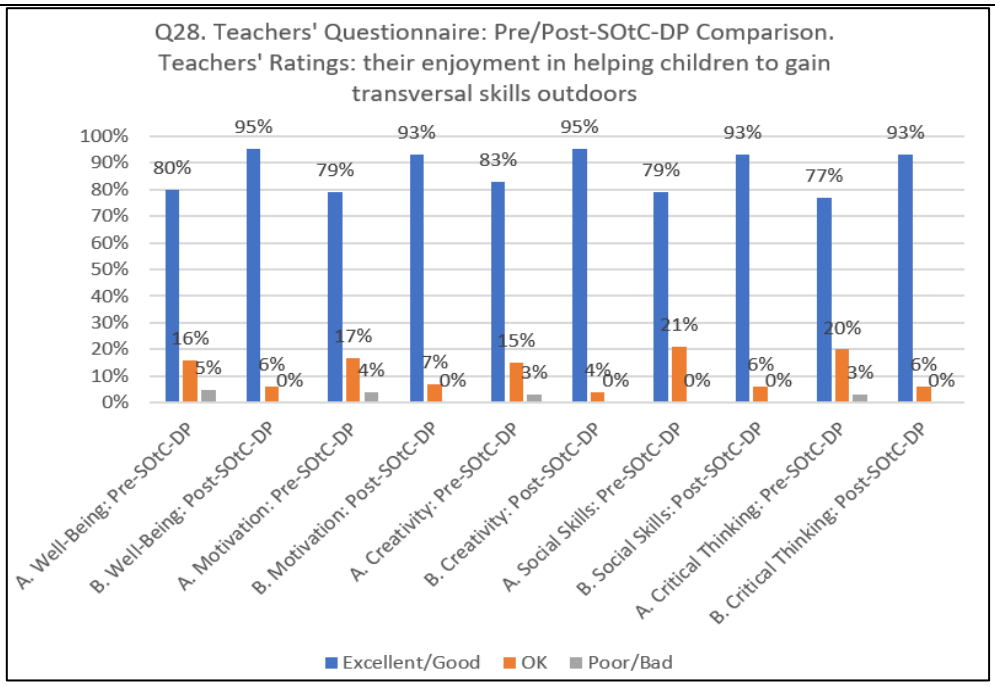
*Figure 35: TQ27 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **confidence** in helping children gain TS **outdoors**.*



TQ28/ Teachers' Enjoyment: Helping children gain TS outdoors

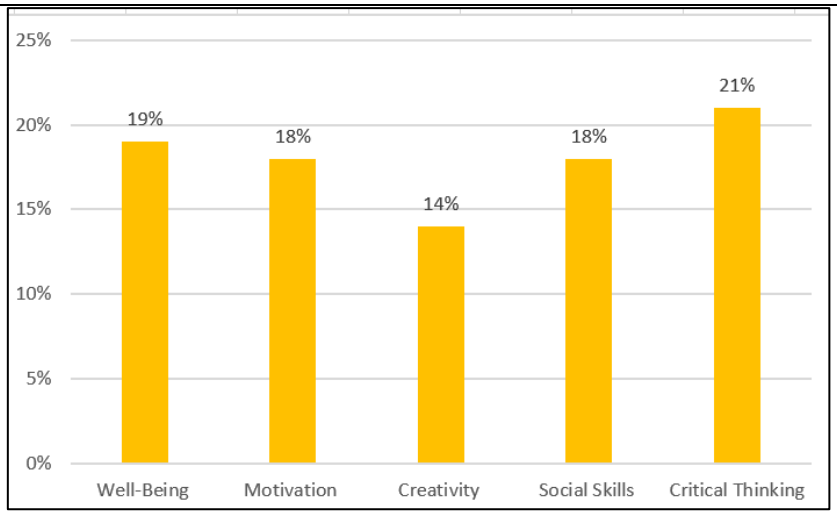
In response to TQ28, teachers rated their **enjoyment** in helping children they taught aged 3-11 years to gain TS **outdoors**. Before and after the SOtC-DP, most teachers (77% to 95%) rated their own enjoyment as 'Excellent' or 'Good' regarding helping children to gain TS **outdoors** (Fig. 36).

*Figure 36: TQ28 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their own **enjoyment** in helping children gain TS **outdoors***



Equally, as indicated in Figure 37, teachers own **enjoyment** in helping children to gain each specific TS **outdoors** increased during the SOtC-DP: well-being (+19%), motivation (+18%), creativity (+14%), social skills (+18%), and critical thinking (+21%). **Overall 18% more** teachers rated their **enjoyment** as 'Excellent' or 'Good' in respect of helping children to gain TS **outdoors**, compared with before the SOtC-DP.

*Figure 37: TQ28 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their own **enjoyment** in helping children gain TS **outdoors**.*



TQ29/ Teachers' Levels of Challenge: Helping children gain TS while teaching science outdoors

In response to TQ29, teachers rated their perceived levels of challenge in helping children they taught aged 3-11 years to gain TS, while teaching science outdoors. As for TQ25, this question was included because the other main strand of the SOtC project focused on science enquiry skills. Before and after the SOtC-DP, most teachers (range 69%-86%) rated their own perceived level of ease as 'Excellent' or 'Good' in helping children to gain TS when teaching science outdoors (Fig. 38).

Figure 38: TQ29 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' ratings of their perceived ease or difficulty in helping children gain TS, while teaching science outdoors

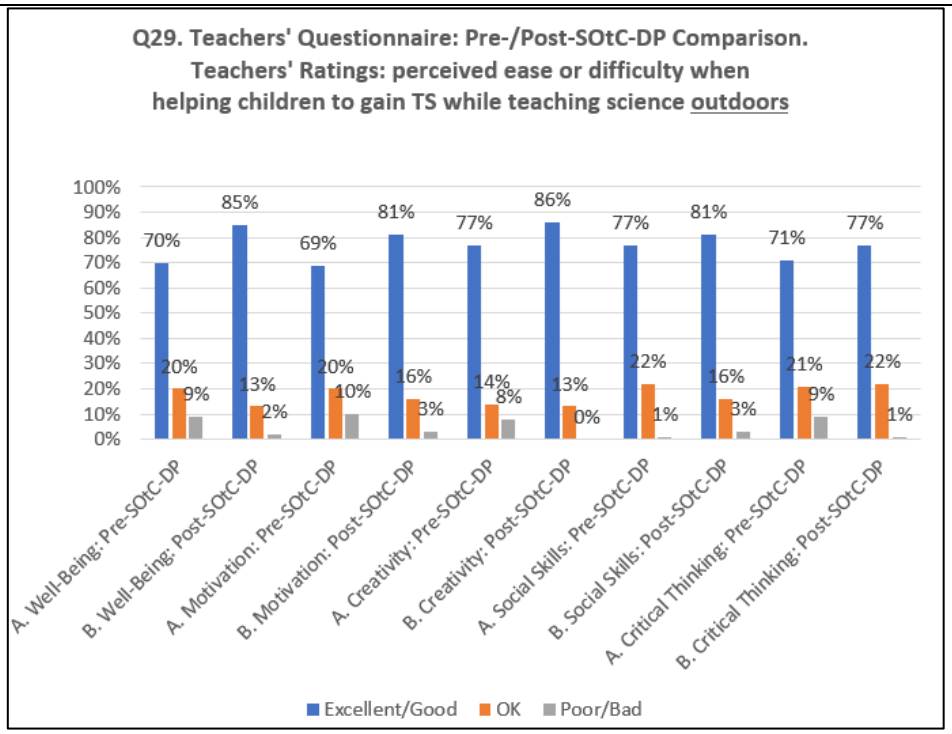
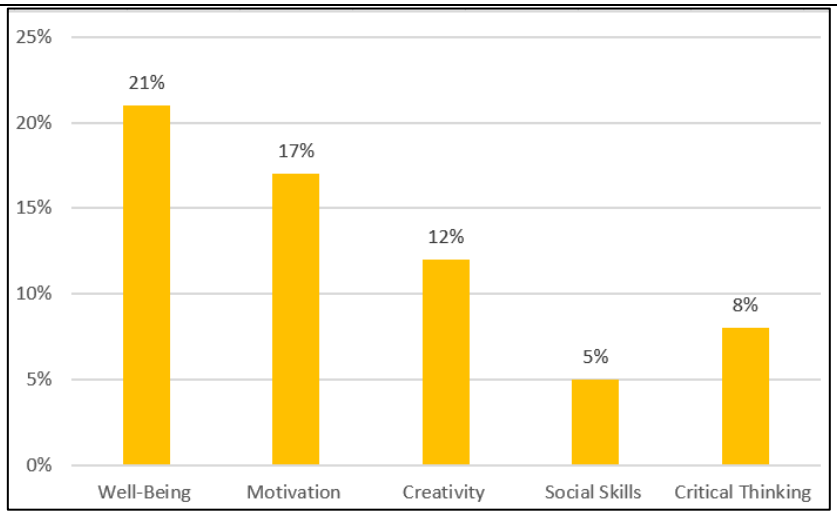


Figure 39 indicates that teachers believed their ease in helping children to gain each specific TS while teaching science outdoors increased during the SOtC-DP: well-being (+21%), motivation (+17%), creativity (+12%), social skills (+5%), and critical thinking (+8%). Overall, after the SOtC-DP, 13% more teachers rated as 'Excellent' or 'Good' their ease in helping children to gain TS while teaching science outdoors, compared with before.

Figure 39: TQ29 – Pre-SOtC-DP/Post-SOtC-DP Comparison: Teachers' 'Excellent' & 'Good' ratings of their perceived ease or difficulty in helping children gain TS, while teaching science outdoors

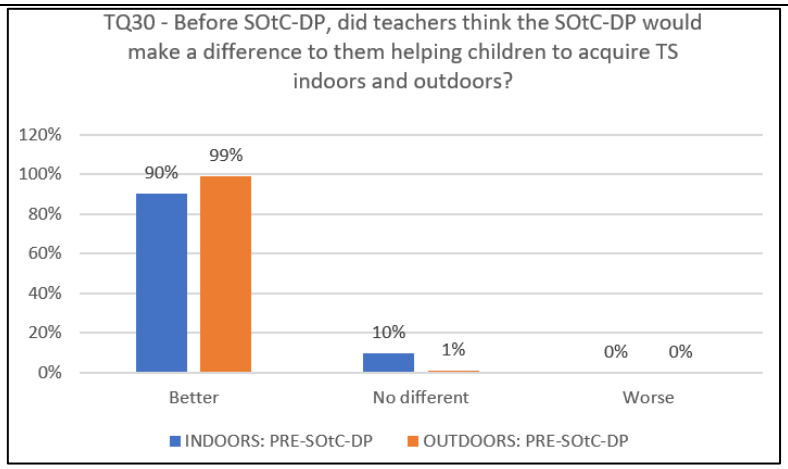


TQ30/ Teachers' Views: will – and did - the SOtC-DP make a difference to how teachers could support children's TS acquisition?

In their responses to TQ30 before the SOtC-DP, teachers rated their beliefs regarding any difference they thought SOtC-DP would make to their expertise, confidence and enjoyment when helping children to acquire TS, indoors and outdoors. Following the SOtC-DP, teachers rated their beliefs regarding any difference they believed the SOtC-DP had made to their expertise, confidence and enjoyment when helping children to acquire TS, indoors and outdoors.

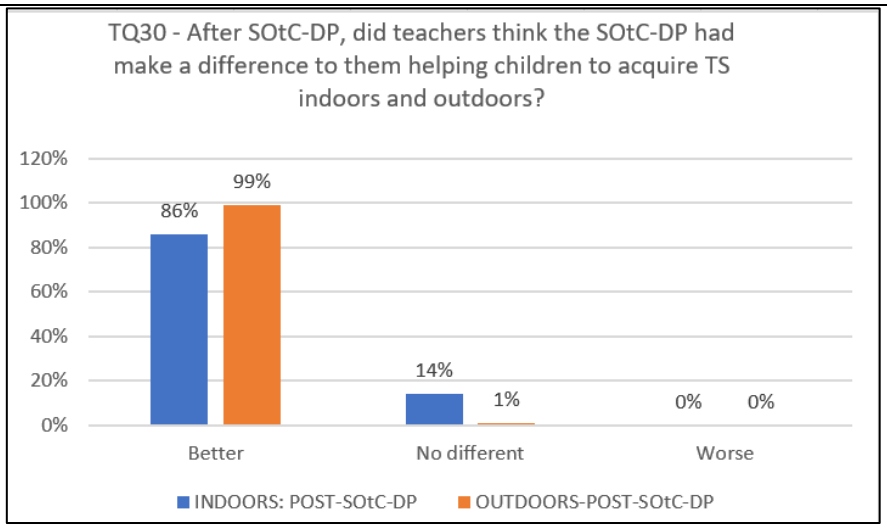
Before the SOtC-DP, most teachers' responses (90%-99%) indicated that they believed the SOtC-DP would improve their expertise, confidence and enjoyment for supporting children's TS acquisition indoors (90%) and outdoors (99%) (Fig. 40).

Figure 40: TQ30 – Pre-SOtC-DP: Did teachers think the SOtC would make a difference to how they could support children's TS acquisition?



After the SOtC-DP, most teachers' responses (range 86%-99%) indicated that they believed the SOtC-DP had improved their expertise, confidence and enjoyment for supporting children's TS acquisition indoors (86%) and outdoors (99%) (Fig. 41).

Figure 41: TQ30 – Post-SOtC-DP - Did teachers think the SOtC had made a difference to how they could support children's TS acquisition?



The teachers' responses to TQ30 suggest that although they believed the SoTC-DP had not quite fulfilled their expectations regarding helping them to improve their expertise, confidence and enjoyment for supporting children's TS acquisition indoors (90%:86%) **(-4%), the SoTC-DP had met their expectations fully in terms of enhancing their expertise, confidence and enjoyment for supporting children's TS acquisition outdoors (99%:99%).**

Comparing Teachers' Expertise, Confidence and Enjoyment for supporting Children's TS Acquisition Indoors and Outdoors (TQ22, TQ23, TQ24, TQ26, TQ27, TQ28)

Nothwithstanding the teachers' responses to TQ30, as shown in Figure 42, teachers' responses before and after the SOtC-DP, to questions about their own expertise, confidence and enjoyment for supporting children to gain TS **indoors** and **outdoors** were compared. By the end of the SOtC-DP programme, 14% more teachers rated their expertise in helping children gain TS **outdoors** as 'Excellent' or 'Good', 17% more teachers did so in respect of both their confidence and 18% did so for their enjoyment in helping children gain TS **outdoors**. (TQ26, TQ27, TQ28: Fig. 42). Conversely, 5% fewer (-5%) teachers rated their expertise in helping children gain TS **indoors** as 'Excellent' or 'Good', while only 4% more teachers did so in respect of their confidence and 4% fewer (-4%) did so for their enjoyment in helping children gain TS **indoors**. (TQ26, TQ27, TQ28: Fig. 42).

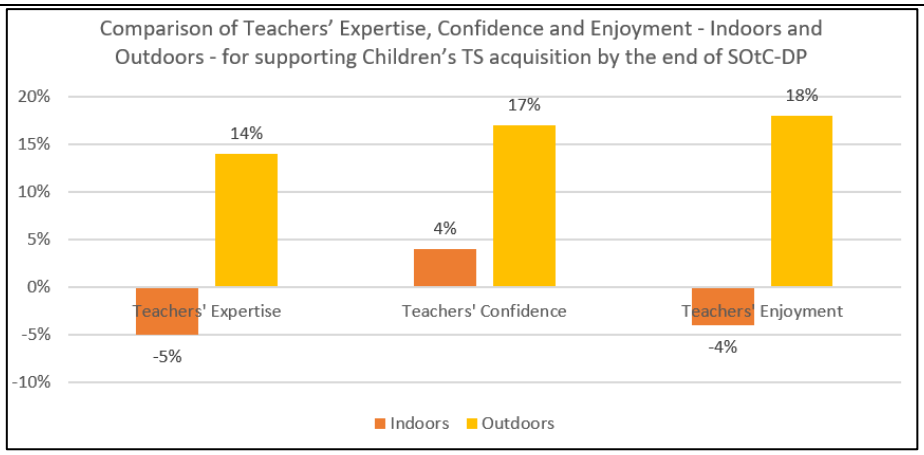
Direct comparisons of teachers' responses concerning indoors and outdoors reveals:

- Teachers' 'Excellent' or 'Good' ratings of their own **expertise** were **19% higher for outdoors** (14%), than indoors (-5%) (TQ22/TQ26)

- Teachers' 'Excellent' or 'Good' ratings of their own **confidence** were **13% higher for outdoors** (17%) than indoors (4%) (TQ23/TQ27)
- Teachers' 'Excellent' or 'Good' ratings of their own **enjoyment** were **22% higher for outdoors** (18%) than indoors (-4%). (TQ24/TQ28).

Overall, in their responses to TQ22, TQ23, TQ24, TQ26, TQ27, TQ28, teachers rated their expertise, confidence and enjoyment as 18% higher by the end of the SOtC-DP in respect of supporting children to gain TS outdoors, compared with indoors.

Figure 42: Comparing Teachers' Expertise, Confidence and Enjoyment for supporting Children's TS Acquisition Indoors and Outdoors (TQ22, TQ23, TQ24, TQ26, TQ27, TQ28)



Findings: Documentary Evidence - Review of SOtC-DP Intellectual Outputs (IOs)

The data presented in this section emerged from two reviews of IOs that were created for the SOtC-DP (SOtC, 2021c). The purpose of the reviews was to identify if the SOtC-DP featured pedagogical strategies (MacNaughton and Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b) with potential to enable teachers to support children aged 3-11 years to develop transversal skills outdoors.

The first review identified evidence of pedagogical strategies in the IOs. The second review identified pedagogical strategies in the IOs that afforded children opportunities to practise and so develop transversal skills: well-being (WB), motivation (M), creativity (Cr), social skills (SS) and critical thinking (CT) as part of the SOtC-DP. Findings from both reviews are presented in Table 7.

Table 7: Pedagogical strategies (PS) featured in SOtC-DP IOs (SOtC, 2021c)

PEDAGOGICAL STRATEGIES (MacNaughton & Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b)	**(i) Pedagogical Strategies in SOtC-DP resources**	**(ii) SOtC-DP Pedagogical Strategies to develop TS**					**PEDAGOGICAL STRATEGIES** (MacNaughton & Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b)	**(i) Pedagogical Strategies in SOtC-DP resources**	**(ii) SOtC-DP Pedagogical Strategies to develop TS**				
		WB	M	Cr	SS	CT			WB	M	Cr	SS	CT
Sensitivity to the learner	√	√			√		Telling and instructing	√		√		√	
Stimulation	√		√	√		√	Co-constructing	√	√	√	√	√	√
Affordance of autonomy	√	√		√		√	Community building	√	√	√		√	
Demonstrating	√		√				Decolonising						
Describing	√	√			√		Deconstructing	√	√				
Encouraging, praising, helping	√	√	√		√		Democratising	√	√	√	√	√	√
Facilitating	√	√	√	√			Documenting	√		√		√	√
Feedback	√		√			√	Empowering	√	√	√	√	√	√
Grouping	√	√			√		Philosophising	√					√
Listening	√	√			√	√	Problem-solving	√		√	√		√
Modeling	√	√	√		√		Reinforcing	√				√	
Positioning people	√				√		Scaffolding	√	√	√		√	
Questioning	√		√		√	√	Task analysis	√					√
Reading	√					√	Diverse communication	√	√	√	√	√	√
Recalling	√	√	√			√	Physical activity, movement	√	√	√	√		
Singing	√	√			√		Inclusion	√	√	√		√	
Suggesting	√		√				Active, experiential learning	√	√	√	√	√	√

Discussion

The Discussion is structured according to the three study objectives that align with the focus of this paper, so the sections focus on:

(a) Transversal skills children aged 3-11 years developed through scientific enquiry outdoors

(b) Features of the physical environment that enabled children aged 3-11 years to develop transversal skills outdoors

(c) Pedagogical strategies that enabled teachers to support children aged 3-11 years to develop transversal skills outdoors.

(a) Transversal skills children aged 3-11 years developed through scientific enquiry outdoors

As the subject emphasis of the SOtC-DP was on science, specifically children's development of scientific enquiry skills outdoors (SOtC, 2021b), focus on TS was reified through children learning scientific enquiry skills outdoors during the programme. TS are recognised widely as generic skills with potential to leverage personal development, academic achievement and employability (Durlak et al., 2011; EC, 2020; UNESCO IBE, 2013). Definitions in the extant literature of TS and related topics, including EI (i.a. Goleman, 1995; Mayer and Salovey 1997; UNESCO IBE, 2013), informed a TS framework for the present study (Table 1). The study's TS framework was further synthesised with literature from the fields of education and biophilia hypothesis (*i.a.* Harms et al., 2014; Louv, 2005; Murray and Garner, 2015; Pascal et al., 1996; STA, 2017; Wilson, 1984) to create the study's ATSLO Scale (*Assessment of TS when Learning Outdoors*). TRs engaged in naturalistic observation of children aged 3-11 years in their own educational settings before and after the SOtC-DP and recorded information from each observation on an ATSLO scale for each participating child (n=98). Additionally, children's responses to the student questionnaires (n=96) provided further intelligence regarding their beliefs about their TS; for example, Compared with their responses before the SOtC-DP, afterwards 5% more children agreed that learning outdoors enhanced their TS acquisition (Fig.22). Overall, findings indicate that children's well-being, motivation, creativity, social skills and critical thinking were enhanced during the SOtC-DP: all main categories in the study's TS framework (Table 1), suggesting that children aged 3-11 years developed TS through engaging in scientific enquiry **outdoors**. However, while data showed clearly that children's well-being, motivation and creativity were enhanced after their experiences of engaging in scientific enquiry **outdoors** during the SOtC, results for children's development of social skills and critical thinking were less definitive. Data for each TS are discussed below.

Well-Being

By the end of the SOtC-DP, participating children's well-being had strengthened by 15.4% on the ATSLO scale, suggesting that the children had become happier and healthier, were enjoying learning as well as better relationships, were better problem-solvers and were more confident, resilient, autonomous and engaged following the project (Blank et al., 2009). In their responses to the student questionnaires, having experienced the SOtC-DP, more children (+3%) thought learning **outdoors** enhanced their well-being than before (SQ11: Figs. 8, 23), whereas fewer children (-13%) thought learning **indoors** enhanced their well-being (SQ10: Figs. 7, 20): a difference of +16% overall in children's views that learning **outdoors** enhanced their well-being over the course of the programme.

Fewer children (-7%) were positive about their well-being generally by the end of the SOtC-DP than before the project began (SQ7: Figs. 4, 14, 15). The reasons for this are not clear, although the COViD pandemic during the last few months of the SOtC-DP may have affected children's well-being negatively (Hoffman and Miller, 2020). Nevertheless, by the end of the SOtC-DP, whereas teachers said they were finding it less easy to support children's well-being while teaching science **indoors** (-3%) (TQ25: Fig.31), they found it easier **outdoors** (+21%) (TQ29: Fig.39): a difference of +24% overall in teachers saying they found it easier to support children's well-being **outdoors** compared with **indoors**, while teaching science.

Motivation

The increase in participating children's motivation by 9.7% on the ATSLO scale suggests that by the end the SOtC-DP, children were finding their learning tasks more meaningful, their engagement and interest in learning had increased, especially outdoors, they had become more resilient with greater determination to achieve, and their belief in their own abilities had grown (Lingard, Nixon and Ranson, 2008; Murray and Cousens, 2020; Pintrich, 1999; Ryan and Deci, 2000). Equally, more children were positive about their motivation by the end of the SOtC-DP (+9%) compared with before (SQ7: Figs. 4, 14, 15), and afterwards, although fewer children believed learning **indoors** enhanced their motivation to learn (-4%) (SQ10, Figs 18, 19, 20), more children thought learning **outdoors** enhanced their motivation for learning (+9%) (SQ11: Figs. 8, 21, 22, 23). Moreover, 17% more teachers said they were finding it easier to leverage children's motivation while teaching science **outdoors** by the end of the SOtC-DP (TQ29: Fig.39), compared with only a 2% increase **indoors** (Q25: Fig.31).

Creativity

Children's creativity rose by 19.5% on the ATSLO scale during the SOtC-DP period, and was the category of the study's TS framework that showed the greatest increase. While creativity has been defined as 'imaginative activity fashioned so as to produce outcomes that are both original and of value' (National Advisory Committee on Creative and Cultural Education, 1999: 29), Craft (2000) proposes that creativity goes beyond this definition to encompass a broader set of skills. The present study's findings concerning creativity provide evidence that during the time the children engaged with the SOtC-DP, they became more resourceful, inventive, enterprising, questioning, imaginative, and better able to solve problems (Craft, 2000; Murray and Garner, 2015). By the end of the SOtC-DP, although fewer children believed learning **indoors** enhanced their creativity than at the beginning (-11%) (SQ10, Figs 18, 19, 20), more children afterwards thought learning **outdoors** had increased their creativity (+11%) (SQ11: Figs. 8, 21, 22, 23): children believed their creativity was +22% more likely to increase when they learned **outdoors,** compared with **indoors.** Additionally, by the end of the SOtC-DP, whilst 9% of teachers reported high levels of ease in supporting children's creativity while teaching science **indoors** (Q25: Fig.31). this figure was 12% for **outdoors** (TQ29: Fig.39). 3% of teachers reported greater ease in supporting children's creativity while teaching science **outdoors,** compared with indoors.

Social Skills

Participating children's social skills increased by 15.5% on the ATSLO scale during the SOtC-DP implementation. This finding indicates that during the SOtC-DP, the children's capacities increased for building relationships, collaboration, communication, and working both autonomously and as part of a team (Goleman, 1995; 2009). However, after the SOtC-DP, fewer children (-8%) thought their social skills were enhanced by learning **outdoors** (SQ11: Fig. 23), while more children (+7%) were inclined to believe that learning **indoors** enhanced their social skills (SQ10, Fig. 20): having experienced the SOtC-DP, children were therefore 15% more likely to believe that learning **indoors** rather than **outdoors**, enhanced their social skills. Equally, whereas teachers rated their own ease in supporting children's social skills while teaching science **indoors** increased by 10% during the SOtC-DP (Q25: Fig.31), only 5% of teachers found this easier **outdoors** (TQ29: Fig.39), a reduction of 5%. Therefore, whereas teacher assessments indicated that children's social skills increased (ATSLO), children believed their social skills increased more when learning **indoors** and teachers said they found it easier to support children to gain social skills when learning **indoors.**

Critical Thinking

Children's critical thinking skills improved by 17.1% on the ATSLO scale during the time they engaged with the SOtC-DP, suggesting that participating children developed enhanced abilities to question, interpret, analyse and evaluate and use information logically to reason, problem solve and understand (Facione, 1990; Moon, 2008; Murray, 2013). The ability to think critically is associated with motivation to learn (Hu, Jia, Plucker and Shan, 2016) and having experienced the SOtC-DP, many more children (+22%) thought that learning **outdoors** enhanced their critical thinking (SQ11: Fig. 23), whereas after the project, 4% fewer children (-4%) believed learning **indoors** enhanced their critical thinking (SQ10, Fig. 20). Altogether, 26% more children said they believed learning **outdoors** enhanced their critical thinking, compared with learning **indoors**. However, compared with before the SOtC-DP, afterwards, 10% fewer children (-10%) responded positively to the SQ7 statement concerning critical thinking in the student questionnaire: 'I find ways to work things out for myself' (Fig. 15). Equally, after the SOtC-DP, 17% more teachers said they they found it easier to support children's critical thinking when teaching science **indoors** rather than **outdoors**. After the programme, while 8% more teachers reported finding it easier to support children's critical thinking when teaching science **outdoors** (TQ29: Fig.39), 25% of teachers said they found it easier to support children's critical thinking when teaching science **indoors** (TQ25: Fig.31).

Overall, therefore, results concerning children's development of critical thinking outdoors over the course of the SOtC-DP were mixed. Whereas teachers' assessments showed that children's critical thinking skills improved by 17.1% outdoors and 22% more children thought learning **outdoors** enhanced their critical thinking, 17% more teachers thought teaching children critical thinking skills was easier **indoors** than **outdoors** while 10% fewer children agreed that that '(they found) ways to work things out for (themselves)' after the programme: a question on critical thinking in the student questionnaire (SQ7).

(b) Features of the physical environment that may enable children aged 3-11 years to develop transversal skills outdoors

Data from the observations of outdoor setting environments (OOSE) and relevant data from the students' and teachers' questionnaires are considered in this section.

OOSE: Physical Environment Findings

To provide evidence of the features of the physical environment in each study setting, observations (n=10) of their outdoor setting environments (OOSE), were undertaken, recorded and measured by TRs using the OOSE scale that was developed for the SOtC research study, based on Cooper's 'Benefits and Standards for an outdoor learning environment' (2015), and ECERS-E3 (Harms et al., 2014) (Fig. 3, Table 6).

For each setting, percentages were calculated for the differences between OOSE scores before and after the SOtC-DP (Fig. 13). By the end of the SOtC-DP, OOSE data showed increased scores for twelve of the fourteen items TRs observed in their settings' outdoor environments (Table 6), with only the scores for Item 5 (Natural Features) and Item 11 (Outdoor Space) remaining unchanged (Table 6). OOSE data also revealed that four of the five study settings showed increased scores after the SOtC-DP, when compared with data collected before the SOtC-DP (Fig. 12). Juno setting was the exception: its scores remained the same. One reason may have been that Juno setting was a kindergarten in a Nordic country, and early childhood settings in Nordic countries have a strong tradition of learning outside, regarding 'nature as an important place for play and learning' (Sandseter and Lysklett, 2016: 115). Overall, however, there was a percentage increase of 39% across all settings' OOSE scores.

The shift in OOSE data in four of the five settings by the end of the SOtC-DP programme suggests that these settings had developed their outdoor learning environments during the programme. Extant literature suggests that these changes are likely to have enhanced students' well-being, intrinsic motivation, creativity, social skills and critical thinking - all five TS - as well as their physical and mental health, development, learning, behaviour, and self-regulation (Cooper, 2015; Louv, 2005; Marchant et al., 2019; White, 2011; Wilson, 1984).

Student Questionnaires: Physical Environment Findings

In the student questionnaire responses to SQ8, participating children stated whether they preferred to learn indoors, outdoors or indoors and outdoors. After they had experienced the SOtC-DP, 14% more children said they prefer to learn **outdoors** than those who preferred to learn **indoors** (Fig.16). This finding is congruent with extant literature positing that children like being outdoors (*i.a.* Clark, 2007; Cousins, 1999; Moss and Petrie, 2002). However, whilst 27% more children said they were good at learning **outdoors** than those who said they were good at learning **indoors** *before* the project, this reduced to 13% following the project. This was a reduction of 14% of children believing they were good

at learning **outdoors,** compared with indoors during the project (SQ9: Fig.17). The reason for the lower figure after the children had experienced the SOtC-DP is not altogether clear but given that children value agency and self-determination (Marchant et al., 2019; Pascal et al., 1996; White, 2011), it may be attributable to a reduction in opportunities for children's free play and agency outdoors, as structured activities to build their science enquiry skills outdoors were implemented by their teachers over the course of the SOtC-DP (SOtC, 2021c).

Teachers' Questionnaires: Physical Environment Findings

In their questionnaire responses, teachers rated their beliefs regarding any differences they thought SOtC-DP would make - then *did* make - to their expertise, confidence and enjoyment when helping children to acquire TS, **indoors** and **outdoors** (TQ30: Figs 40, 41, 42). The teachers had high expectations before the project: 90% of them thought the project would improve their expertise, confidence and enjoyment better **indoors** and 99% believed it would improve them **outdoors**. After the project, a 4% reduction (-4%) in teachers' positive responses about **indoors** indicated that they believed the SoTC-DP had not quite fulfilled their expectations regarding helping them to improve their expertise, confidence and enjoyment for supporting children's TS acquisition **indoors** (90%:86%). However, by the end of the SOtC-DP, the teachers believed the programme had met their expectations fully in terms them supporting children's TS acquisition **outdoors,** as their responses after the project matched those provided before the project (99%:99%) (TQ30: Figs. 40,41). Moreover, teachers rated their own expertise, confidence and enjoyment as 18% higher by the end of the SOtC-DP in respect of supporting children to gain TS outdoors, compared with indoors (TQ22, TQ23, TQ24, TQ26, TQ27, TQ28: Fig 42). These findings suggest that the SOtC-DP helped teachers to become more skilled, knowledgeable and confident in supporting children's TS acquisition outdoors, and to enjoy doing so more.

(c) Pedagogical strategies that may enable teachers to support children aged 3-11 years to develop transversal skills outdoors

This section discusses two elements: (i) pedagogical strategies present in IOs that emerged from the SOtC-DP (SOtC, 2021c) and (ii) teachers' questionnaire responses focused on their expertise, confidence and enjoyment in helping children gain TS outdoors, before and after the SOtC-DP.

Pedagogical Strategies in SOtC-DP Intellectual Outputs (IOs)

The SOtC-DP partners produced IOs including the *Science Outside the Classroom Teaching Manual*, *Science Pictionary* game, *SOtC Photo Book* and additional SOtC teaching activities and these entered the

public domain at the end of the project (SOtC, 2021c). The curriculum content and pedagogical strategies set out in the IOs were intended to support teachers to help children aged 3-11 years to develop science enquiry skills and transversal skills outdoors (SOtC, 2021b).

As Table 7 shows, following two reviews of the IOs, evidence was identified of (i) pedagogical strategies in the IOs and (ii) the transversal skills that children were able to practise through the pedagogical strategies they experienced during the SOtC-DP. 34 pedagogical strategies were included in the review (MacNaughton and Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b), and from this comprehensive list, only one - 'decolonisation' - was not represented in the SOtC-DP IOs. Definitions of decolonisation vary (Stein, Andreotti, Suša, Amsler, Hunt, Ahenakew… and Okano, 2020), but Battiste (2013:107) defines it as:

> *'…a process of unpacking the keeper current in education: its powerful Eurocentric assumptions of education, its narratives of race and difference in curriculum and pedagogy, its establishing culturalism or cultural racism as a justification for the status quo, and the advocacy for Indigenous knowledge as a legitimate education topic.'*

The omission of decolonisation from the SOtC-DP may therefore be considered a weakness of the programme. However, the reviews provide evidence that the SOtC-DP IOs are replete with a rich seam of pedagogical strategies that enabled teachers during the SOtC-DP to support children aged 3-11 years to develop transversal skills outdoors. Their availability in the public domain from the end of the project (SOtC, 2021c) means that any teacher with access to the worldwide web can draw on the pedagogic strategies set out in the SOtC-DP IOs to support children aged 3-11 years to develop transversal skills outdoors in their own practice.

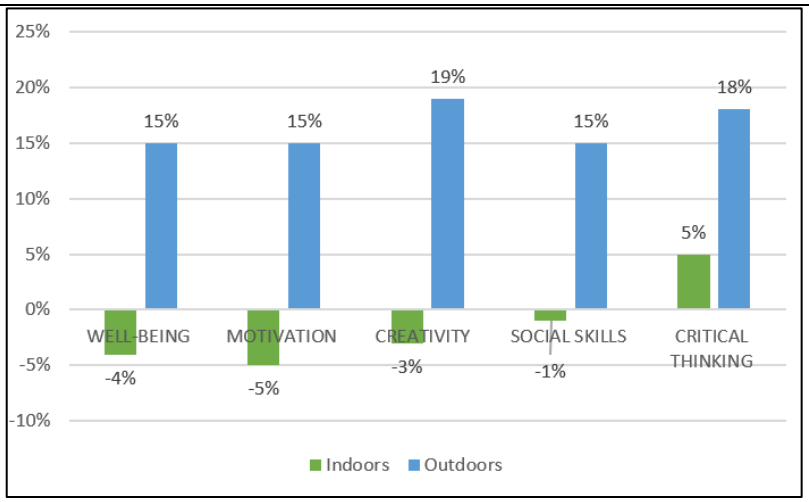
Teachers' Questionnaires: Teachers helped children gain TS Outdoors

SOtC teachers' questionnaire responses to TQ26, TQ27 and TQ29 indicate that they believed the pedagogical strategies they adopted enabled them to support children aged 3-11 years to develop transversal skills outdoors. The teachers' responses to these questions focused on their expertise, confidence and enjoyment in helping children gain TS outdoors, before and after the SOtC-DP (including comparison with indoors). When comparing their responses at the end of the SOtC-DP with those before the programme began, 14% more teachers rated their expertise in helping children gain TS **outdoors** as 'Excellent' or 'Good', 17% more teachers did so in respect of both their confidence and 18% did so for their enjoyment in helping children gain TS **outdoors** (TQ26, TQ27, TQ28: Figs. 33, 35, 37, 43).

Over the course of the SOtC-DP, teachers believed their combined expertise, confidence and enjoyment increased for helping children gain every TS **outdoors**: well-being (+15%), motivation (+15%), creativity (+19%), social skills (+15%) and critical thinking (+18%).

This compared with many fewer gains in the SOtC teachers' responses concerning their expertise, confidence and enjoyment in helping children gain TS **indoors** (Fig. 43). After the SOtC-DP, 5% fewer teachers (-5%) rated their expertise as 'Excellent' or 'Good' regarding helping children to gain TS **indoors**, compared with beforehand, with 4% more teachers doing so in respect of their confidence and and 2% fewer teachers (-2%) rating their enjoyment as 'Excellent' or 'Good' (TQ22, TQ23, TQ24; Figs. 25, 27, 29). Over the course of the SOtC-DP, teachers believed their combined (mean) expertise, confidence and enjoyment increased only for helping children gain one TS **indoors**: critical thinking (+5%), while decreasing in respect of well-being (-4%), motivation (-5%), creativity (-3%) and social skills (-1%).

Figure 43: Indoors/Outdoors Comparison: Teachers' 'Excellent/Good' ratings regarding their expertise, confidence and enjoyment in helping children gain TS



These findings provide new empirical evidence that use of the outdoors is a highly effective pedagogic overall strategy for children's transversal skills acquisition and is particularly effective for children's development of critical thinking and creativity. Whilst these findings resonate with extant literature (i.a. Cooper, 2015; White, 2011), many children do not have opportunities to learn outdoors (Cooper, 2015; Waller et al., 2017).

Conclusions, Strengths, Limitations and Recommendations

This section draws conclusions from the evidence produced by conducting this participatory multisite instrumental case study conducted within the participatory inquiry paradigm (Creswell, 2013; Heron, 1996; Heron and Reason, 1997). Findings are summarised that address the strand of the SOtC research aim that is in line with the scope of the present article: to investigate if and how the SOtC-DP supported the development of children's TS in five European educational settings. A consideration of the study limitations is then followed by recommendations based on the study findings.

Conclusions

This section summarises findings presented and discussed in previous sections. To produce those findings, germane data were co-constructed by academics and TRs working with children aged 3-11 years, using five research methods. Four methods were administered before and after the SOtC-DP: observations informing the ATSLO scale (n=98) and the OOSE scale (n=10), as well as beliefs and attitudes questionnaires completed by participating teachers (n=63) and students (n=96) that were analysed using descriptive statistics. The fifth method was review of intellectual outputs created as part of the SOtC-DP.

Because the study objectives provided incremental steps towards achieving the study aim, this section is structured according to the three research objectives relevant to the research strand that is the focus of this article.

(a) Summary: Transversal skills children aged 3-11 years developed through scientific enquiry outdoors

Findings relating to the first study objective indicate that children's TS were leveraged during the SOtC-DP, suggesting that children aged 3-11 years developed TS through their engagements in scientific enquiry outdoors. Evidence for this claim includes an overall boost of 15.4% on the ATSLO scale in children's TS when learning outdoors, and questionnaire data indicating overall that students and teachers believed children's TS had developed during the course of the SOtC-DP: a programme primarily focused on supporting children's scientific enquiry outdoors. While questionnaire data indicated that children and teachers were more positive about children's development of well-being, motivation and creativity when learning science **outdoors,** rather than indoors, they were more positive about children's acquisition of social skills when learning science **indoors**, rather than outdoors. Questionnaire data were mixed in respect of critical thinking skills. By the end of the project, although 22% more children thought learning **outdoors** enhanced their critical thinking, 10% fewer children agreed that

'(they found) ways to work things out for (themselves)' (SQ7) and 17% more teachers thought teaching children critical thinking skills was easier **indoors** than outdoors**.**

(b) Summary: Features of the physical environment that may enable children aged 3-11 years to develop transversal skills outdoors

OOSE data gathered by TRs showed that outdoor physical environments had improved in all the SOtC settings except the only Nordic SOtC setting where the score did not change: there is a well-established tradition of outdoor learning in Nordic settings (Sandseter and Lysklett, 2016). Overall, however, over the course of the SOtC-DP, the SOtC settings had improved their outdoor environments in respect of twelve of the fourteen items listed in the OOSE scale (Table 6): changes likely to have enhanced students' TS, as well as their physical and mental health, development, learning, behaviour, and self-regulation (Cooper, 2015; Louv, 2005; Marchant et al., 2019; White, 2011; Wilson, 1984). Indeed, having experienced the SOtC-DP, 14% more children said they preferred learning **outdoors** compared with children who said they preferred to learn **indoors** (Fig.16). Equally, by the end of the SOtC-DP, all responding teachers believed the programme had met their expectations fully in enhancing their expertise, confidence and enjoyment for supporting children's TS acquisition **outdoors**.

(c) Summary: Pedagogical strategies that may enable teachers to support children aged 3-11 years to develop transversal skills outdoors

Reviews of the SOtC-DP IOs revealed that SOtC-DP offered 33 (from a total of 34) pedagogical strategies that enabled teachers to support children aged 3-11 years to develop transversal skills outdoors (Table 7). SOtC teachers' questionnaire responses endorsed this finding (Fig. 41). These findings suggest that use of the outdoors is a highly effective pedagogic overall strategy for children's transversal skills acquisition, particularly effective for children's development of critical thinking and creativity. Although these findings resonate with extant literature (i.a. Cooper, 2015; White, 2011), many children do not have opportunities to learn outdoors (Cooper, 2015; Waller et al., 2017). However, the availability of the SOtC-DP IOs in the public domain from the end of the project, including the *Science Outside the Classroom Teaching Manual*, *Science Pictionary* game, *SOtC Photo Book* and additional SOtC teaching activities, (SOtC, 2021c) means that any teacher with access to the worldwide web can draw on the pedagogic strategies set out in the SOtC-DP IOs to support children aged 3-11 years to develop transversal skills **outdoors** in their own practice.

Final Summary: Conclusions

The study findings indicate that in the SOtC project, acquisition of objective knowledge about science enquiry skills was reified through subjective-objective knowledge acquisition of transversal skills in diverse contexts outdoors (Heron, 1996; Heron and Reason, 1997). Findings support the proposition that children's well-being, motivation, creativity, social skills and critical thinking were enhanced during the SOtC-DP: all main categories in the study's TS framework (Table 1). These findings provide evidence that children aged 3-11 years developed TS through engaging in scientific enquiry outdoors. The section of the study aim that is relevant to this paper - to investigate if and how the SOtC-DP supported the development of children's TS in five European educational settings – was therefore achieved.

Strengths and Limitations of Research

All research projects have strengths and limitations and this study was no exception.

Strengths of the research study included its participatory design. This enabled teachers and children in the study to be valued as experts in their own lives (Langsted 1994: 29; Yandell, 2019). It afforded outsiders access to insider perspectives in each setting that resulted in the co-construction of the authentic meanings an external researcher could not have elicited as quickly or easily, if at all. The participatory design also enhanced the inclusion that which was a major ambition for the SOtC project: academics, teachers and children were all included in the research in some capacity, as co-researchers (Fielding, 2001). For example, effective teachers are already expert observers in educational settings (Murray, 2018; Wragg, 2011) so they were well placed to conduct the ATSLO and OOSE observations. The SOtC teachers also had opportunities to gain new research skills when they administered the students' questionnaires and conducted PhotoVoice with the children in their settings. Moreover, the Post-Box research instrument (Table 4) gave all children in the SOtC project the option to collect their own data (the post-box focused on science enquiry skills so is reported elsewhere). The negotiation, discussion and agreement that was necessary to arrive at the research aim and objectives resulted in a research experience which had intrinsic value for the academics, practitioners and children who were part of the SOtC. Equally, on a practical note, devolving aspects of the research process to those already located in the settings was efficient: it meant that a large amount of data could be collected at low-cost from settings across a wide geographical area where different languages were spoken.

Conversely, the study had some limitations. Firstly, the cultural differences are not examined in this study. Whilst they would have been a useful and interesting addition to the research, the scope of the

study did not allow for such an examination. Secondly, the findings from this study cannot be assumed to be generalisable, though given the diverse nature of the study settings, the findings may be argued to be indicative and are likely to be of interest to many educational settings. Furthermore, the elements of the research design set out in this study could be used by others wishing to investigate if and how an outdoor science programme may support the development of children's TS. Third, there was a risk that each of the numerous teacher-researchers who collected data may do so differently, thereby affecting the outcomes; precise instructions and some research training was provided to mitigate this risk but it could not be eliminated fully. Another limitation was the reliance of the study on TR-Coordinators translating research instruments from English into the languages used in their settings, then translating the data from their settings' languages into English. Translating research instruments and data can create methodological challenges (Temple and Young, 2008). However, this limitation was mitigated to some extent at least in this study because teachers and academics agreed the research aim and objectives together, and the research was based in educational practice with which the teachers and academics all had some familiarity. Precision in sampling was also a limitation. Although purposive sampling was planned and enacted – such that only teachers and children in the SOtC-DP were participants - the decisions to participate (or not) in the research were theirs, and the parents' in respect of the children. This removed the facility to select equal participant groups for each setting. For example, different numbers of teachers in each setting participated. To some extent this limitation was mitigated by converting data into percentages and the TRs selection of the same ten children in each setting who were diverse in terms of gender, age, academic ability and ethnicity for the students' questionnaires, ATSLO and PhotoVoice (see Table 4). The COVID pandemic presented further limitations to the study. It began eight months into the project which was originally planned ot last for 24 months. All the settings experienced lockdowns which meant the SOtC-DP was interrupted, which delayed data collection. Equally, the pandemic meant that participating children had extraordinary experiences which may have affected their responses and behaviours, particularly in respect of their transversal skills development (Hoffman and Miller, 2020).

Recommendations

Based on the evidence of the study findings, it is possible to identify several recommendations. These are listed below; each is linked to the study objective for which evidence was provided and suggests the key people most likely to be in the positions to enact the recommendation.

Based on evidence from this study, it is recommended that all education policy-makers, setting leaders and teachers of children aged 3-11…

- recognise the value of children aged 3-11 years acquiring transversal skills (Objective (O)/ a)
- recognise the value of high quality outdoor learning environments* for promoting children's transversal skills (O/a)
- recognise that children may acquire valuable transversal skills while learning science enquiry skills outdoors (O/a)
- create, regularly use and maintain high quality outdoor learning environments* in all educational settings (O/b)
- offer children aged 3-11 years opportunities to learn through the pedagogical strategies set out in Table 8 (O/c)

Table 8: Pedagogical Strategies to support Children's Transversal Skills Development

PEDAGOGICAL STRATEGIES TO SUPPORT CHILDREN'S TRANSVERSAL SKILLS DEVELOPMENT (MacNaughton & Williams, 2009; Pascal and Bertram, 1997; SOtC, 2021b)			
Sensitivity to the learner	Listening	Telling and instructing	Philosophising
Stimulation	Modeling	Co-constructing	Problem-solving
Affordance of autonomy	Positioning people	Community building	Reinforcing
Demonstrating	Questioning	Decolonising	Scaffolding
Describing	Reading	Deconstructing	Task analysis
Encouraging, praising, helping	Recalling	Democratising	Diverse communication
Facilitating	Singing	Documenting	Physical activity, movement
Feedback	Suggesting	Empowering	Inclusion
Grouping			Active, experiential learning

Based on evidence from this study, it is recommended that teachers in the SOtC settings:

- further support the development of children's social skills and critical thinking when they are learning outdoors (O/a)

Based on evidence from this study, it is recommended that SOtC partners…

- Share widely, in different forms for different audiences - including education policy-makers, setting leaders and teachers of children aged 3-11 **-** the SOtC intellectual outputs and research evidence to inform effective pedagogy for children to learn transversal skills. This is likely to be especially important in the aftermath of the COVID pandemic (O/a, O/b, O/c)
- Share widely with teachers the ATSLO scale (Murray, 2021) for assessing children's transversal skills and the OOSE scale (Murray, 2021) for evaluating outdoor environments in educational settings, for further use in primary schools and early childhood settings (see appendices 1,2) (O/a, O/b)

Based on evidence from this study, it is recommended that teachers and academics working in the field of education…

- Consider the benefits of participatory research and where feasible, share research tasks (O/a, O/b, O/c)

*In the context of this study, 'High quality outdoor learning environments' are outdoor learning environments for children aged 3-11 years that score highly on the OOSE scale (Murray 2021) (appendix 2) and that also offer the majority of '*Pedagogical Strategies that support Children's Transversal Skills Development' (Table 8)* most of the time.

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APPENDICES

Appendix 1: ATSLO-2 - Assessment of Transversal Skills when Learning Outdoors 2

Appendix 2: OOSE-2 - Observation of Outdoor Setting Environment 2

APPENDIX 1

SCIENCE OUTSIDE THE CLASSROOM

Assessment of Transversal Skills when Learning Outdoors 2 (ATSLO-2)

(Initial and Final Assessments)

This assessment is an amended version of the ATSLO based on transversal skills identified in the original 'Science Outside the Classroom' Erasmus+ bid and draws on research and literature including 'Social and Emotional Aspects of Learning' (SEAL) (DfES, 2005), the EXE and EEL programmes (Laevers, 2000; Pascal et al., 1996), 'Young Children As Researchers' (Murray, 2017), 'Social and Emotional Learning Policies and Practices: a literature review' (Murray and Garner, 2015), 'Primary school children's beliefs associating extra-curricular provision with non-cognitive skills and academic achievement' (Murray and Cousens, 2020), 'Lost Child in the Woods' (Louv, 2005), and the Standards and Testing Agency (2016).

GUIDANCE FOR TEACHERS:

1. For each child, identify the period of time you would like to measure then complete this assessment at the beginning and the end of that period.

2. For each row, identify which description best applies to the child learning outdoors and put the number matching the best description in the right-hand column (3, 2, or 1). Apply a 'best fit' judgement to each box. Where there are two descriptors in one box and you deem that only one descriptor applies to a child, the child has not reached that level, so grade them at the lower judgement.

3. On each of the 5 TRANSVERSAL SKILLS GRIDS, assess each child's 'best fit' judgements for each skill (1,2, or 3). For each child, add the numbers on each grid to create a sub-total and insert each child's sub-total at the bottom of each TRANSVERSAL SKILLS GRID.

4. When you have completed all 5 TRANSVERSAL SKILLS GRIDS, transfer the subtotal information to the SUMMATIVE GRID below - add lines if neccessary

5. Complete the overall TOTAL for all the children you wish to assess in the SUMMATIVE GRID below.

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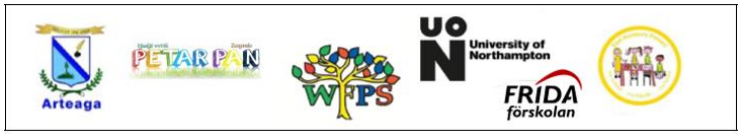

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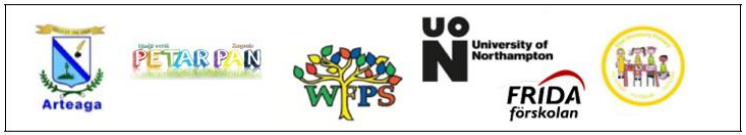


SCIENCE OUTSIDE THE CLASSROOM

Assessment of Transversal Skills when Learning Outdoors 2 (ATSLO-2)

(Initial and Final Assessments)

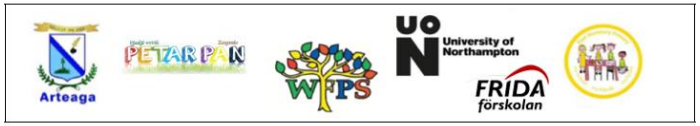
SUMMATIVE GRID

AFTER you have completed the 5 transversal skills grids, please insert the subtotals and totals for your children HERE:

√ Tick the right-hand box if this is the INITIAL ASSESSMENT		√ Tick the right-hand box if this is the FINAL ASSESSMENT	
Your School / Kindergarten:		**Assessing Teacher's name:**	

CHILDREN'S NAMES	Gender √		Age		SUB-TOTALS for each child:					TOTAL FOR EACH CHILD
	Male	Female	Years	Months	Well-Being	Motivation	Creativity	Social Skills	Critical Thinking	

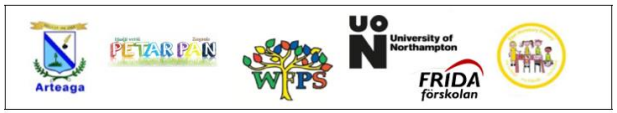
Add more lines as required…



SCIENCE OUTSIDE THE CLASSROOM

Transversal Skills Grid 1: Well-Being

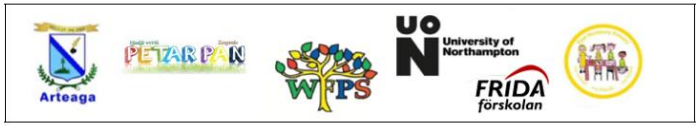
(i) TRANSVERSAL SKILLS GRID 1: WELL-BEING	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child…									
				A	B	C	D	E	F	G	H	I	J
Health and physical well-being	Always lively, active and full of energy when outdoors.	Usually active and energetic when outdoors.	Often lethargic when outdoors.										
Behaviour	Contributes to making the rules and follows the rules when outdoors Always open and accessible to what is happening outdoors	Understands and usually follows rules when outdoors Usually open and accessible to what is happening outdoors	Does not always follow rules when outdoors Is sometimes withdrawn or aggressive when outdoors										
Confidence	Always likes to engage with new activities outdoors	Usually likes to engage with new activities outdoors	Does not like engaging with new experiences outdoors										
Enjoyment of learning	Always looks happy when learning outdoors	Usually looks happy and cheerful when learning outdoors	Rarely or never looks happy when learning outdoors										
Emotional well being	Always appears relaxed and comfortable outdoors.	Usually appears relaxed and happy outdoors. Rarely shows any signs of stress or tension outdoors.	Often shows signs of discomfort outdoors, including signs of stress or tension										
			Sub-totals for each child's well-being outdoors:										



SCIENCE OUTSIDE THE CLASSROOM

Transversal Skills Grid 2: Motivation

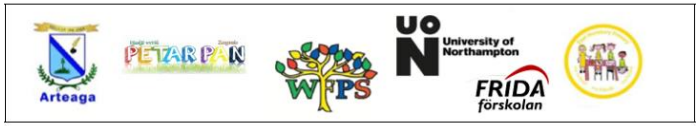
(ii)TRANSVERSAL SKILLS GRID 2: MOTIVATION	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child…									
				A	B	C	D	E	F	G	H	I	J
Engagement with learning	Always engages actively with new learning activities outdoors.	Usually engages actively with new learning activities outdoors	Rarely or never engages actively with new learning activities outdoors.										
Attainment	Often exceeds what is expected academically	Usually achieves as expected academically.	Often does not achieve as expected academically.										
Resilience	Always perseveres to get the job done outdoors.	Usually tries again when things do not go according to plan outdoors.	Easily becomes distressed outdoors. Usually gives up when things do not go according to plan outdoors										
Determination	Always works hard to achieve goals outdoors. Sets goals and works hard to achieve them outdoors.	Usually tries hard to achieve goals outdoors.	Rarely or never tries hard to achieve a goal outdoors.										
Involvement	Consistently and continuously concentrates deeply on activities outdoors.	When outdoors, usually focuses well on activities. May sometimes be distracted but resumes activity after interruption.	Is usually passive outdoors. Tends to flit from one activity to another outdoors										
Engagement with nature	Usually prefers to be outdoors than indoors. Is fascinated by plants and animals outdoors.	Sometimes likes to go outside. Usually shows interest in plants and animals outdoors.	Usually prefers to be indoors than outdoors. Shows no interest in plants or animals outdoors.										
Sub-totals for each child's motivation outdoors:													



SCIENCE OUTSIDE THE CLASSROOM

Transversal Skills Grid 3: Creativity

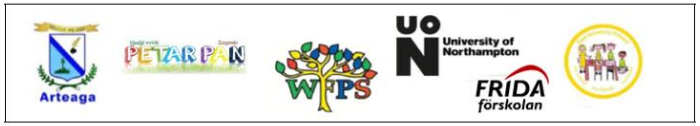
(iii) TRANSVERSAL SKILLS GRID 3: CREATIVITY	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child…									
				A	B	C	D	E	F	G	H	I	J
Creative	When outdoors, frequently creates new artefacts that may be valued.	When outdoors, sometimes creates new artefacts that may be valued.	When outdoors, rarely or never creates new artefacts that may be valued.										
Inventive	Frequently has original ideas outdoors.	Sometimes has original ideas outdoors.	Rarely or never has original ideas outdoors.										
Enterprising	Frequently shows initiative outdoors.	Sometimes shows initiative outdoors.	Rarely or never shows initiative outdoors.										
Imagination	Frequently produces novel images, objects or concepts outdoors without immediate input from sight, hearing, touch, taste or smell.	Sometimes produces novel images, objects or concepts outdoors without immediate input from sight, hearing, touch, taste or smell.	Rarely or never produces novel images, objects or concepts outdoors without immediate input from sight, hearing, touch, taste or smell.										
Resourcefulness	Frequently finds quick or clever ways to overcome difficulties.	Sometimes finds quick or clever ways to overcome difficulties.	Rarely or never finds quick or clever ways to overcome difficulties.										
			Sub-totals for each child's creativity outdoors:										



SCIENCE OUTSIDE THE CLASSROOM

Transversal Skills Grid 4: Social Skills

(iv) TRANSVERSAL SKILLS GRID 4: SOCIAL SKILLS	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child…									
				A	B	C	D	E	F	G	H	I	J
Communication	Constantly expresses ideas, feelings or thoughts outdoors. Constantly listens on others' ideas, feelings or thoughts.	Often expresses ideas, feelings or thoughts outdoors. Often listens to others' ideas, feelings or thoughts.	Rarely or never expresses ideas, feelings or thoughts when outdoors. Rarely or never listens to others' ideas, feelings or thoughts.										
Team work	Always interacts positively with peers when outdoors. Often acts in response to peers' needs, ideas, feelings or thoughts.	Usually interacts positively with peers when outdoors Sometimes acts in response to peers' needs, ideas, feelings or thoughts.	Finds it difficult to interact positively with peers when outdoors. Rarely or never acts on peers' needs, ideas, feelings or thoughts when outdoors.										
Independence	When outdoors, often makes decisions that lead to useful outcomes. When outdoors, often leads activities without adult support.	When outdoors, sometimes makes decisions that lead to useful outcomes. When outdoors, often engages in activities without adult support.	When outdoors, finds it difficult to make decisions. When outdoors, rarely or never engages in activities without adult support.										
Sub-totals for each child's social skills outdoors:													



SCIENCE OUTSIDE THE CLASSROOM

Transversal Skills Grid 5: Critical Thinking

(v) TRANSVERSAL SKILLS GRID 5: CRITICAL THINKING	Exceeding (3)	Expected (2)	Emerging (1)	3, 2, 1? Child…									
				A	B	C	D	E	F	G	H	I	J
Reasoning	When outdoors, always demonstrates sensible judgements based on evidence. When asked, can always provide logical reasons for own actions taken outdoors.	When outdoors, usually demonstrates sensible judgements based on evidence When asked, can usually provide logical reasons for own actions taken outdoors.	When outdoors, rarely or never uses evidence as a basis for making sensible decisions. When asked, cannot usually provide logical reasons for own actions taken outdoors.										
Problem solving (generic)	Often devises and applies practical methods to create solutions outdoors.	Sometimes devises and applies practical methods to create solutions outdoors.	Rarely or never devises and applies practical methods to create solutions outdoors.										
Answering open questions	Devises several logical solutions to respond to an open question concerning outdoor activity.	Devises a logical solution to respond to an open question concerning outdoor activity.	Is unable to devise a logical solution to respond to an open question concerning outdoor activity.										
Asking questions	Often asks questions about ‘why’ and ‘how’ outdoors.	Sometimes asks questions about ‘why’ and ‘how’ outdoors.	Rarely or never asks questions about ‘why’ and ‘how’ outdoors.										
Understanding nature	Usually uses all five senses to explore features of nature outdoors.	Sometimes uses all five senses to explore features of nature outdoors.	Rarely or never uses all five senses to explore features of nature outdoors.										
Sub-totals for each child’s critical thinking outdoors:													

APPENDIX 2

SCIENCE OUTSIDE THE CLASSROOM
Observation of the Outdoor Setting Environment 2 (OOSE-2)

This observation framework is based on Cooper's 'Benefits and Standards for an outdoor learning environment' (2015) and ECERS-E3 (Harms, Clifford and Cryer, 2014).

GUIDANCE FOR TEACHERS:

1. Complete this observation to measure the quality of your school / kindergarten outdoor area.

2. For each item row below, identify which description best applies to your school / kindergarten outdoor environment and put the number matching that best description in the right-hand column (3,2, or 1). Please apply a 'best fit' judgement to each item.

3 At the end your observation, transfer the Observation of the Outdoor Science Environment (OOSE) scores to the **OOSE-2 SUMMATIVE GRID.**

4. If you are planning to develop your outdoor area, make one observation before you develop, then again afterwards to measure the development.
Complete the TOTAL of your Observation of the Outdoor Science Environment 2 (OOSE-2) scores in the OOSE-2 SUMMATIVE GRID on the next page.

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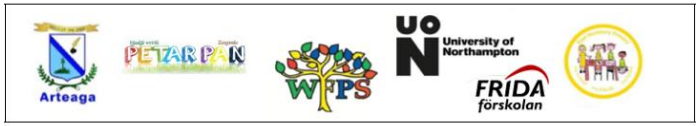
SCIENCE OUTSIDE THE CLASSROOM

Observation of the Outdoor Science Environment 2 (OOSE-2)

SUMMATIVE GRID: Observation of the Outdoor Science Environment (OOSE-2)			
√ Tick the box on the right if this is the <u>Initial Observation of your School/Kindergarten</u> <u>outdoor area</u>		**√ COPY THIS FORM and Tick the box on the right if this is the <u>2nd Observation of your School/Kindergarten outdoor area</u>**	
Your School / Kindergarten:		**Assessing Teacher's name:**	
ITEMS			**3,2,1?**
ITEM 1. Designated Outside Learning Space			
ITEM 2. Outdoor Gross Motor Features			
ITEM 3. Outdoor Learning Centres			
ITEM 4. Plants and Habitats			
ITEM 5. Natural Features			
ITEM 6. Outdoor Water Source			
ITEM 7. Wheeled Toys			
ITEM 8. Time			
ITEM 9. Fruits and Vegetables			
ITEM 10. Professional Development			
ITEM 11. Outdoor Space			
ITEM 12. Science Resources			
ITEM 13. Science processes: Non-living			
ITEM 14. Science processes: Living processes			
TOTAL SCORE FOR ALL ITEMS:			



ITEM 1. Designated Outside Learning Space

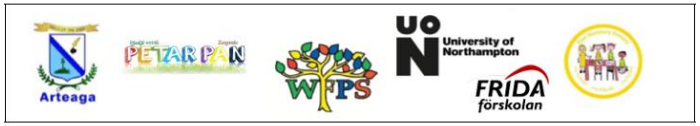
Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😀	😐	😢	
All children spend time every day in the outdoor space that is formally designated as an outdoor play and learning environment	Outdoor space is formally designated as an outdoor play and learning environment	No outdoor space is formally designated as an outdoor play and learning environment	

ITEM 2. Outdoor Gross Motor Features

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😀	😐	😢	
The outdoor environment has three or more outdoor gross motor features (e.g. climbing features or looping pathways)	The outdoor environment has two outdoor gross motor features (e.g. climbing features or looping pathways)	The outdoor environment has only one or no outdoor gross motor features (e.g. climbing features or looping pathways)	

ITEM 3. Outdoor Learning Centres

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😀	😐	😢	
The outdoor environment has three or more outdoor learning centres (e.g. gardening area, hide or dramatic play area)	The outdoor environment has two outdoor learning centres (e.g. gardening area, hide or dramatic play area)	The outdoor environment has only one or no outdoor learning centres (e.g. gardening area, hide or dramatic play area)	

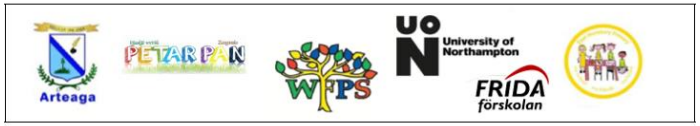


ITEM 4. Plants and Habitats

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
The outdoor environment includes a diverse selection of <u>many</u> plants and habitats representative of local flora and fauna	The outdoor environment includes a diverse selection of plants and habitats representative of local flora and fauna	The outdoor environment includes at most a few plants and/or animal habitats	

ITEM 5. Natural Features

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
The outdoor environment has <u>all these</u> natural features <u>and more</u> that enrich children's play and learning, including: • non-toxic trees, shrubs, and vines • topographic variations (e.g. mounds, terraces, slopes) • a variety of ground surfaces (e.g. mulch, grass, pebbles) • smooth rocks, wood or logs • non-poisonous flowering plants, garden plants and vegetables • birdfeeders, bird baths and birdhouses	The outdoor environment has <u>all</u> the natural features that enrich children's play and learning <u>from this list:</u> • non-toxic trees, shrubs, or vines; • topographic variations (e.g. mounds, terraces, slopes); • a variety of ground surfaces (e.g. mulch, grass, pebbles); • smooth rocks, wood or logs; • non-poisonous flowering plants or garden plants and vegetables; • birdfeeders, bird baths and birdhouses	The outdoor environment has <u>few or no</u> natural features that enrich children's play and learning <u>from this list:</u> • non-toxic trees, shrubs, or vines; • topographic variations (e.g. mounds, terraces, slopes); • a variety of ground surfaces (e.g. mulch, grass, pebbles); • smooth rocks, wood or logs; • non-poisonous flowering plants or garden plants and vegetables; • birdfeeders, bird baths and birdhouses	



ITEM 6. Outdoor Water Source

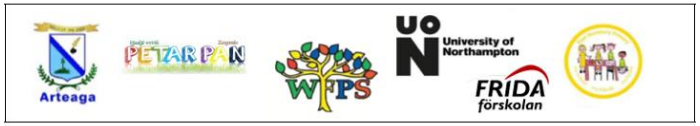
Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
An outdoor water source for irrigation is available and accessible to children	An outdoor water source for irrigation is available	No outdoor water source for irrigation is available	

ITEM 7. Wheeled Toys

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
The outdoor environment has a looping pathway and a wide range of wheeled toys	The outdoor environment has a looping pathway and some wheeled toys	The outdoor environment has no looping pathway and no wheeled toys	

ITEM 8. Time

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
All children have constant free access to the outdoor environment and are actively encouraged to go outside every day.	At least 30 minutes of outdoor time is offered to each child daily per three hours spent in the school or kindergarten	Fewer than 30 minutes of outdoor time is offered to each child daily per three hours spent in the school or kindergarten	



ITEM 9. Fruits and Vegetables

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
Consumption of fruits and vegetables grown in the outdoor environment is actively encouraged.	Consumption of fruits and vegetables grown in the outdoor environment is expressly allowed.	No fruits or vegetables are grown in the outdoor environment. Children are not allowed to eat fruits or vegetables grown in the outdoor environment.	

ITEM 10. Professional Development

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
Teachers' professional development for enhancing and using the outdoor play and learning environment is provided and all teachers in the setting have accessed it	Teachers' professional development for enhancing and using the outdoor play and learning environment is provided	Teachers' professional development for enhancing and using the outdoor play and learning environment is not provided	

ITEM 11. Outdoor Space

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
The outdoor environment has at least 7 square metres per child, and at least once a week, outings to nearby parks or outdoor public spaces are provided	The outdoor environment has at least 7 square metres per child.	The outdoor environment has is less than 7 square metres per child, or there is no outdoor environment at the school or kindergarten	

ITEM 12. Science Resources

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
😃	😐	😢	
The outdoor environment has a wide range of science equipment available to children (e.g. tools, mirrors, magnets) and a new and stimulating science activity is set up for children daily.	The outdoor environment has a wide range of science equipment available to children (e.g. tools, mirrors, magnets)	The outdoor environment has no science equipment available to children (e.g. tools, mirrors, magnets).	

ITEM 13. Science Processes: Non-living

Excellent	Adequate	Inadequate	1,2,3?
3	2	1	
😃	😐	😢	
Children actively explore non-living aspects of the outdoor environment. Scientific words and concepts constantly feature in discussions (e.g. floating, sinking, melting, evaporation, forces, temperature, heat, pressure, volume, hardness)	Children are actively encouraged to explore non-living aspects of the outdoor environment. Scientific words and concepts often feature in discussions (e.g. floating, sinking, melting, evaporation, forces, temperature, heat, pressure, volume, hardness)	Children are not encouraged to explore non-living aspects of the outdoor environment. Scientific words and concepts rarely or never feature in discussions (e.g. floating, sinking, melting, evaporation, forces, temperature, heat, pressure, volume, hardness)	

ITEM 14. Science Processes: Living

Excellent	Adequate	Inadequate	3,2,1?
3	2	1	
			
Children actively explore living processes in the outdoor environment (e.g. plant growth, insect habitat, hatching birds, birth of mammals). Scientific words and concepts constantly feature in discussions (e.g. habitat, hibernation, life cycle)	Children are actively encouraged to explore living processes in the outdoor environment (e.g. plant growth, insect habitat, hatching birds, birth of mammals). Scientific words and concepts often feature in discussions (e.g. habitat, hibernation, life cycle)	Children are not encouraged to explore living processes in the outdoor environment (e.g. plant growth, insect habitat, hatching birds, birth of mammals). Scientific words and concepts rarely or never feature in discussions (e.g. habitat, hibernation, life cycle)	