[EVALUATION TOOL KIT]

[Deliverable 6.2]

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ER4STEM - EDUCATIONAL ROBOTICS FOR STEM

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1 EXECUTIVE SUMMARY

1.1 ROLE/PURPOSE/OBJECTIVE OF THE DELIVERABLE

This document presents the development and contents of the evaluation tool kit to be used in the evaluation of workshops during years 2 and 3 of the project. It is designed to be implemented by any partner in any ER4STEM context to collect data which will be analysed and form part of the yearly evaluation.

1.2 RELATIONSHIP TO OTHER ER4STEM DELIVERABLES

The development of this tool kit is informed by the outcomes and recommendations of D6.3. Integrated into each workshop (WP2) and with adaptations into each conference (WP3), the tool kit will be used to collect data at each site. Technology specific questions identified by partners will be used to inform technical developments (WP5). This data will be analysed in year 2 (D6.4) and year 3 (D6.5) and used to inform the development of the ER4STEM framework (WP1) and design of best practice activity plans (WP4). Data management is set out in WP8 (D.8.1).

1.3 STRUCTURE OF THE DOCUMENT

This document begins by describing the development of the tool kit before presenting the contents of the evaluation tool kit. The contents of the tool kit include data collection instruments, protocols, ethical approval and informed consent documents.

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2 EVALUATION TOOL KIT DEVELOPMENT

In this section of the report, the development of the final tool kit is presented. In project year 1, the evaluation pre-kit was designed (D6.1) and implemented in 48 workshops. Here, partners experiences of using the pre-kit during workshops and the impact on the evaluation (D6.3) are presented as the key determinants of changes to the evaluation kit. The evaluation of year 1 presented in Deliverable 6.3 concludes with a series of recommendations, all of which have implications for the tool kit to be used in years 2 and 3. These recommendations are recapped before outlining the changes made.

2.1 OVERVIEW OF YEAR 1 IMPLEMENTATION

The biggest challenge was to design an evaluation kit that could be implemented by partners with a range of experience of collecting data, running workshops and teaching in general. Particular factors included:

- the experience, or lack thereof, of partners with respect to data collection, teaching and robotics;
- the variety of contexts, including formal in-school workshops linked to the curriculum, extra-curricular workshops held within the school and workshops held outside a formal education environment;
- a range of workshops which would last upwards of 6 hours, with little or no information on how the workshops would be designed;
- and implementation with children between the ages of 7 and 18, who would be a primary source of data.

As outlined in the pre-kit (D6.1) in detail, a mixed-method approach to data collection was identified as most suitable for this project. Qualitative data takes primacy as it allows for the necessary depth of analysis required to identify areas for the development of the Framework. However it is also necessary to evidence similarities or differences between this project and existing research into educational robotics. Research in the area of educational robotics has largely taken a quantitative approach to data collection and although it has provided some evidence on the outcomes for children engaging in educational robotics activities, at best it is limited to identifying what happens (within the range of questions asked). Without qualitative data we cannot begin to explain why or how, which are necessary for the development of the ER4STEM Framework. There is also an issue that those that employ a mixed-method approach use quantitative tools as the primary data source, with open questions in questionnaires or short interviews used to provide supporting evidence. The issue with this is that the there is a lack of rigour in the analysis of the qualitative data, with under reporting the qualitative data analysis, leading to questions being raised about the potentially anecdotal or cherry-picked quotes presented. Therefore in this evaluation, qualitative data takes primacy and the data analysis approach uses supporting and refuting evidence to triangulate findings.

A semi-structured approach to qualitative data collection was identified as the most suitable. This provided structure where appropriate to provide rigour, and flexibility to account for individual research contexts. Data collection began before the workshop with a Draw-A-Scientist (at work) and throughout the workshop either written observations were recorded or video data was collected of

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the whole class and/or a focus group. Mid-way through the workshop, students were asked to complete a reflective task and a final reflective task was incorporated into the post-workshop questionnaire. At the end of each of the sessions, the tutors were asked to complete a reflective form. After the final workshop session, a focus group (ideally the same focus group in the observations) was invited to take part in a short semi-structured interview. At the end of the workshop artefacts of learning that were created by the students were recorded, this included images of robots that were created, copies of code, structured tasks and students' notes.

Quantitative data was collected through pre- and post-workshop questionnaires, to rapidly survey the opinions of students. The primary purpose of this data was to provide an overview of the background of participants and the outcomes from the workshops from the perspective of the participants. Both quantitative and qualitative have acknowledged limitations but by using a mixed-method approach many of these can be countered.

Table 1 presents an overview of the data collected across the 48 workshops. Using the pre-kit (D6.1), evaluation data was collected during all of the 48 workshops. As described in D2.1, of the 1228 students who participated in workshops and the conference, 1133 (92%) completed the pre-workshop questionnaire and 1052 (85%) completed the post-workshop questionnaire. This data is used to gain evidence on students' experience, attitudes and assumptions. To complement this, 1094 (89%) completed the Draw-a-Scientist task.

Table 1 Overview of data collected

	Number of workshops	Number of participants
Pre-questionnaire	48	1133 (92%)
Post-questionnaire	48	1052 (85%)
Draw-a-Scientist	48	1094 (89%)
Observations	47	n/a
Interviews	35	193 (16%)
Artefacts of Learning	47	n/a
Student Reflections	40	Varies (individual and group)
Tutor Reflections	45	Varies (all or some tutors)

To gain an in-depth understanding of the workshops, to inform the development of the framework; observer, teacher and student perspectives were recorded through various instruments. In addition to those already mentioned, 39 of the 48 workshops (81%) were observed using a variety of tools including written observation schedules and video. In all but one of the remaining 9 workshops, photographs provided an alternative snapshot record. To understand the workshop from the perspective of the teacher or tutor, reflections were collected from 45 of the 48 workshop tutors (93%). A sample of participants who attended 35 of the workshops took part in a small-group interview after the workshop. This sample represents over 16% of all participants in year 1, which we consider to be particularly high. Additionally, 83% of students produced personal or team-based reflections on their experiences. The interviews and reflections supplement the post-workshop

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questionnaires, observations and artefacts of the learning process, to provide a detailed insight into the learner experience during the workshops.

The intention in year 1 of the project was to use the pre-kit to collect baseline data with which to assess the ER4STEM Framework against, in years 2 and 3. The other aim was to pilot the kit in relation to the evaluation criteria, in preparation for years 2 and 3. It is clear from the evidence presented in D6.3 that the pre-kit achieved both aims and so the development of the tool kit for the next two years focuses on addressing what works less well from both the perspectives of the partners and the evaluation outcomes. Due to the success of the pre-kit, a series of recommendations could be made for the development of the Framework (WP1) and Activity Plan (WP4), which would in-turn affect the Repository (WP5) and Workshops (WP2).

2.2 PARTNER EXPERIENCES

Here the perceptions and experiences of partners regarding the pre-kit are presented at three stages: the initial presentation of the pre-kit at the partner meeting in Prague, January 2016; a mid-point meeting in Vienna, April 2016; and during the summer of 2016 after workshops had been completed.

Pre-workshops

Following the meeting in Prague at which partners were first introduced to the pre-kit, the main concerns that partners had were in relation to: gaining informed consent; gathering observational data and the overall length of the data collection activities.

Regarding informed consent, partners were referred to the ethical and legal requirements that the project needs to meet. Together partners developed informed consent forms and procedures that would meet these requirements within their own countries and across the project as a whole.

A standard approach to gaining informed consent is detailing the different types of data collection tools. However there were concerns that parents would tend to opt-out, due to general concerns about access to images of children which is often reported in the media. It was felt that these concerns were not related to the research and although there was information about how the data would be collected, stored and handled, it could result in reduced access. To address this, parents had the option to give consent for their child to participate in the research but not to have images (still or video) recorded. Another concern was that with one parent withholding consent for video data collection, no videos could be made and therefore observations would be reliant on tutor written observations which would be time consuming, particularly when they are both trying to teach and write observations. However a number of approaches to mitigate this issue were discussed and agreed upon.

There were general concerns about the length of the data collection activities and the fact that these would reduce the time spent engaging in the robotics workshops. Partners were encouraged to consider how these could be integrated into the workshop activities. The Greek partners who have relevant previous experience provided some solutions. This included the finally agreed upon blog for the reflection but there was a lot of uncertainty about this solution. The final reflection was integrated into the questionnaire to reduce the number of tasks that students were completing. The questionnaires were also revised down, with the caveat that this would reduce the validity of results.

Mid-point

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At the mid-point meeting in Vienna in April 2016, partners were asked for their opinions on using the pre-kit. Not all partners had implemented workshops at this point and so some original concerns were raised again, without experiences on which to judge the pre-kit. To structure the feedback, partners were asked to discuss and respond to a series of questions.

When asked what the hardest part of using the pre-kit was, the following points were raised: translation; explaining some of the questions to younger children; the time it takes to collect the data (25% or more of workshop); fitting in the mid-point reflection; teaching & collecting data at the same time; explaining scaled questions. The practical problems around the questionnaires, specifically relate to younger children and from this the potential of a modified questionnaire for younger students was proposed for years 2 and 3. At this point it is reasonable to expect that partners would find acting as a participant-researcher difficult, both in terms of time and performance, particularly when they have limited experience of running educational robotics activities or collecting data.

When asked what the easiest part was, the Draw-a-Scientist task and final interviews were identified as the easiest because children enjoyed them. This is interesting as both activities occur outside the formal workshop time and were originally identified as potentially problematic because they would take time from the workshops. In addition the questionnaires and tutor reflections were also referred to.

The partners identified different activities as rewarding. One team mentioned the interview, Draw-a-Scientist & videos “because they reveal interesting behaviour patterns and teach us how to improve what we are doing”. This is particularly interesting as one of the expectations is that partners will develop their pedagogic practices through engagement with the ER4STEM project. The interviews were also viewed as affirming: “the students seem very happy and inspired by their interaction with the robots”. Artefacts of learning, specifically “ones where students had to document the steps they used for programming” were also seen as beneficial. So overall those activities which provided rapid feedback on the workshop or students understanding were the most rewarding, even if earlier identified as time-consuming.

To reduce the time spent during workshops on data collection activities, partners were asked to share their tips on integrating the pre-kit with their workshops. While one partner stated that they weren’t integrated, others identified that they had integrated the reflections as part of the workshop activities and interviews were done whist other students were engaged in another task. Rather than ask students to stop what they were doing and complete the mid-point reflection (even if this could be at the end of start of a day), one partner went group-to-group speaking to teams and recording their answers to questions. Some partners also arranged for students to complete the Draw-a-Scientist task before the workshop. General organization and preparation were also recognized as important with some feeling that they would become quicker over time.

In response to the question, “what one thing would you change?”, a range of answers were given. The two clearest issues were with the questionnaire in terms of length and appropriateness for younger pupils, and the overall time. The issue of time was unpacked a little when partners were asked what they learned from collecting the data. From these responses it appears that undertaking the data collection is not the most time-consuming aspect but planning and processing the data is. As part of this, translations appear to cause the biggest problems.

Again, partners referred to the pedagogic value of the data collection. This time reference was made to developing partners’ knowledge and understanding of the children that they were meeting for the first time and working intensively with for 1-3 days.

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End

Between the mid-point review and the end of the workshop implementations in year 1, partners were asked to provide feedback on the pre-kit via a short online form. Only one partner completed this, however the results of this are interesting, showing that at one point the pre-questionnaire was identified as the most difficult and later the easiest part of the evaluation pre-kit. This revealed that there was some confusion around the question about future ambitions with some children interpreting it as activities rather than careers, which highlights a point to fix in both pre and post-workshop questionnaires.

Partners generally found that the questionnaire items were too difficult for younger children, with only one mentioning this as an issue for the interview. While the questionnaire questions are fixed, the interview questions are provided as a guide and interviewers asked to adapt them to suit their needs. This may be a training point that needs to be picked up. Observations were also consistently problematic, particularly in relation to noting the time when specific actions occur and the level of detail required. This highlights a need for some training on conducting observations.

After all workshops were completed, each partner was asked to complete a short evaluation of the year. Regarding the observations, one of the partners noted that asking the class teacher to write observational notes on the focus group was a particularly effective strategy, whilst another noted the issues in reviewing videos to make notes on student activities (together with transcriptions) took as long as the workshops themselves. Although one partner stated that they needed to be more observant in notes, the data analysed in the evaluation was sufficient to provide indicators of interesting episodes within the data which the analysists could focus on. Although some partners enlisted classroom teachers to make observations or conduct interviews, some found that the teachers were not present for the whole workshop or did not provide support during the workshop. For example, in one tutor reflection it was noted that disruptive behaviour was not addressed by the class teacher who sat doing their own thing throughout. So it would be infeasible to rely on teachers for data collection. Although popular with younger students, the Draw-a-Scientist activity was less popular with older students in some contexts – this had already been identified as a potential issue and so students were invited to write a short description – however other partners stated that they did not have these problems.

It was noted by some that with time they had grown in confidence delivering the workshop and collecting data, with both the progress and the process improving through refinement. The Draw-a-Scientist was noted as particularly effective for gaining an understanding of students' preconceptions before the workshop.

Some suggestions for streamlining the process were identified, such as using spreadsheets to collate information that is currently collected through text documents, to allow for automatic data validation and aggregation. There is some discrepancy between the Qualtrics generated spreadsheets and the files provided for input of paper-based questionnaires which slows down the processing of data. Drop-down input values would also improve reporting quality. Another suggestion for younger children is the use of emoticons and other visual elements for younger children. This can be achieved in both paper and online questionnaires but online students would have to adjust a slider which is set to a default neutral response.

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Another practical problem was the distribution of student numbers. It is recommended that partners share their approaches with each other and try a variety to find out what works best for them, as an inefficient process will be time consuming.

Some partners decided to give students control of the video cameras and while this worked in some situations it did not work in all. Another practical point was that to conduct the interviews some tutors felt that they would have to leave the students on their own with nothing to do, even though they were with their teacher and usually one other tutor. One solution to this problem used by another partner was to engage the children in a short final activity whilst interviewing the focus group. Here a reflective activity would be particularly useful as it could evidence learning.

One partner continued to raise the issue of translations at this point in the process, raising concerns that this along with other paper work took as long as the workshops. The use of the online questionnaires would reduce the required time to input data, similarly the use of closed questions with pre-selected options would reduce the need for translation. However interviews would still need to be translated and without interviews it is difficult to gain any depth in understanding of students' experiences from their own perspectives.

Another point that was highlighted is consideration of students who participate in more than one workshop over the three years and whether they need to participate in all data collection activities, new activities and what other procedures are affected. From discussion with partners there was general agreement that returning students would be provided with the same student ID, or their IDs would be linked to allow for tracking across workshops. The baseline data collected through the Draw-a-Scientist would not have to be repeated, although it is also acknowledged that their views could have changed. However the pre-questionnaire will provide useful information on whether there has been any long-term impact of the previous workshops on the participants and so will remain the same as a comparator.

2.3 EVALUATION RECOMMENDATIONS

The workshop tutors, most of whom had little or no experience as researchers, acted as participant-researchers, collecting data during their own workshops. This has a certain number of advantages, such as no language barriers, ease of access, control over timings of structured data collection and finding contextually appropriate data collection activities. An example of the latter would be the quick group-by-group discussions held at the start of the second day of the Bulgarian workshop to record each group's reflections on the previous day. Another example was the Maltese 'write a postcard' solution. With this comes certain disadvantages, including variation in the form of the data (for example between the Bulgarian and Maltese reflections the students are addressing different audiences and so would say different things, one was spoken and the other written) and rigour in its collection. However, unlike a typical participant-researcher, each workshop tutor handed a complete set of data for their workshop over to an experienced data analyst. The process of data analysis was divided between the three academic project partners who had different roles. Although the academic partners could analyse their own data, checks for interrater reliability could be used to ensure consistency in data analysis approach and therefore rigour. This suggests that introducing some flexibility to allow partners to adapt certain data collection activities to their own contexts could overall have advantages that out-weigh the limitations of this approach, particularly with the approach to data analysis chosen.

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Another point to note is that the artefacts of learning, shown in the case studies presented in D6.3, provide one of the few insights into what children actually engaged with, the extent to which they engaged and the understanding or misunderstandings that they developed. These are essential if we are to provide evidence of learning.

The year 1 evaluation (D6.3) presents the following recommendations for future evaluation:

1. Use 21st Century skills as a unit to encompass industry skills and soft-skills.
    - **Evaluation** – merge analysis of industry skills and soft-skills under the heading of 21st Century skills, adjusting research questions and focus accordingly; and sub-divide into sections on teamwork and collaboration, communication, creativity and critical thinking.
2. Consider creativity as leading to innovation and entrepreneurship
    - **Evaluation** – merge innovation and entrepreneurship in data collection and analysis.
3. Examine critical thinking through a focus on reflective thinking
    - **Evaluation** – provide flexibility within the evaluation for a range of reflective tools to be used; work with WP4 and WP2 to develop tools which can be used to meet requirements and provide evidence of learning.
4. Provide evidence of learning
    - **Evaluation** – collate examples of measurable objectives and how students can evidence their achievement of these objectives through their productions and reflections; use these to analyse learner engagement in subsequent years.
5. Differentiate activities
    - **Evaluation** – review activity plans and wider workshop data to identify and analyse the use by tutors and uptake by students of differentiated activities; track students to questionnaire data to assess impact and compare with previous years.
6. Developing new entry points
    - **Evaluation** – analyse future activity plans to identify the types of entry points; analyse them against the following criteria: goal or non-goal orientated; gendered or non-gendered activities; opportunities for a creativity and/or fictitious elements; routes for students to rapidly develop their own problems to solve and to make the workshop personally meaningful; analyse workshop data to find supporting or refuting evidence of these types of entry points and students' responses.
7. Develop approaches to the orchestration of teamwork, with particular consideration of mixed-gender groups
    - **Evaluation** –use the developed tools to provide a frame for the analysis of teamwork in future workshop
8. Evaluation of specific tools
    - **Evaluation** – identify how data collection on the use of specific tools can be accomplished within a tool-kit which will be implemented by all partners
9. Changing and sustaining attitudes to STEM
    - **Evaluation** – consider whether explicit opportunities to discuss issues alter attitudes to STEM.
10. Draw-a-Scientist activity
    - **Evaluation** – Find a solution to gender-balance, to prevent or mitigate imbalance in the presentation of the task.
11. Raise awareness of pedagogic strategies and their impact
    - **Evaluation** – use the activity plans to evaluate tutor actions and student responses to identify what works

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Of these, many are already integrated into the evaluation kit and from the year 1 evaluation we have evidence that they are successful. Some will inform the evaluation of years 2 and 3 as they relate to the evaluation questions and criteria. From these requirements only the Draw-a-Scientist activity requires modification. The only requirement which is not already allowed for within the current evaluation pre-kit is the evaluation of specific tools.

So as not to over-burden the students with additional questionnaire items, an open question will be added to the interviews, providing an opportunity for the interviewer to explore with the students their experience of using the tool, ways it could be developed and other technology specific questions that may be relevant. For example, with SLurtles it would also be useful to find out about students' impressions of working and collaborating in a virtual space.

2.4 CHANGES MADE

Protocol:

- Reporting of general workshop information via standardised spreadsheet
- Include activity plans in workshop information
- Partners find a time efficient approach that works for them in the distribution or recording of student numbers.
- Follow a standardised file naming approach which does not include the name of schools or date of the workshop.

Activity Plans:

- Clearly identify which of the recommendations presented at the Malta milestone meeting have been implemented, with a brief statement on how and why.
- Clearly identify any changes from previous activity plans as part of their ongoing development, with a brief statement on how and why.

Draw-A-Scientist:

- For languages where the term 'scientist' is not gender neutral, in year 2 of the project the task will be "draw a female scientist or male scientist".
- In year 3 this will be reversed.
- Limited to 10 minutes
- For each workshop partners to create a single PDF or PPT file for data transfer

Questionnaires:

- Modified version for younger children
- Reduce the number of open questions to reduce the need for translation
- Reduced overall length
- Change "What do you want to do after you finish school?" to "In the future, what job would you like to do?"
- Standardised spreadsheets for data input with drop-down input values.
- Remove duplicated questions
- Rephrase questions for clarity

Student reflection:

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- Ongoing throughout workshops
- Integrated with workshop activities
- Needs to be flexible in form.

Artefacts of learning:

- Ongoing throughout workshops
- Need to demonstrate the work completed by students in a form that could allow a workshop tutor, teacher or researcher to assess the work in relation to the objectives stated in the activity plan.
- Needs to be flexible in form, with options chosen to suit the workshop activities

Observations:

- Class teachers could be asked to write observational notes if available.
- If video is recorded, observational notes only need to include key moments witnessed by tutors at the time, there is no need for tutors to review all video files.

Interview:

- Add a question to provide entry to explore the use of specific tools.
- Limited to 10-15 minutes.

Ethics and data protection:

- Informed consent is still required of parents and students but only parents are required to provide a signature.

3 TOOL KIT CONTENTS

3.1 EVALUATION PROTOCOL

This section presents the planned evaluation protocol to be used in the tool kit to be used in workshops, with modification as described for conferences and returning students. This will be treated as a living document: As partners undertake workshops and conferences they will be asked to report on their experience of using the tool and alternations will be made as required. It is anticipated that changes are most likely to be influenced by the development of the Framework. Changes made will be reported in the end of year evaluation reports D6.4 and D6.5

The audience for the protocol are the members of ER4STEM.

Before the first workshop session:

Ethics:

- If conducted in a school, informed consent **must** be given by the school to carry out the research.
- Informed consent to collect and store data **must** be given by parents.

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  - If a parent does not give consent, no data can be collected from their child.
  - There must be an opportunity for parents to ask questions about the research before giving consent – it may be helpful to hold a short meeting to brief parents.
  - A signature is required.
- Informed consent to collect and store data **should** be given by students.
  - They need to be informed in an age appropriate manner and within schools, this may be facilitated by the class teacher.
  - There needs to be an opportunity for students to ask questions about the research before giving consent.
  - No signature is required.
- Informed consent to collect and store data must be given by tutors (those running the workshop)
- All signed consent forms must be stored by the partner organisation.
- When conducted in a school, parents are informed of the dates and the contents of the workshop through information material. In this, they are reminded of their right to withdraw their child from the study at any time, without this leading to any negative consequences. They are further informed that any change in their preferences on video/audio recordings or participation in the EC initiative on open access to data could be reported to the local ER4STEM partner, organizing the workshop.

Data Protection:

- Student's names should not be included in the raw data, where possible. For example, on a questionnaire.
- Each student should be randomly allocated a student number **before** the workshop and told to use this on the questionnaire and any other written material.
  - This must be recorded and held separately from the evaluation data according to the Data Protection Act in your country.
  - The 'Participant Key' Excel document is a proposed solution for storing the participant number and student name together. You will need this at various points throughout the project and it may be required in the future. **N.B.** You must adhere to your own country's Data Protection Laws in the storage of this data.
  - This must be held securely within the partner organisation and not shared with anyone outside the organisation.
  - N.B. It is up to individual partners to ensure that a **returning student** is given the **same** student number at every workshop that they attend. PRIA and TUW will need to find a mutually beneficial system, supported by the pre-questionnaire.

Data Collection:

- Draw a scientist at work:
  - Must be done before the first experience.
  - If in a school, this could be done in advance by the teacher in class.
  - These need to be digitised with names removed and student numbers added (see instructions at end).
  - **Returning students** do not need to complete this, they may if they wish to.

3.1.1 AT THE START OF THE FIRST WORKSHOP SESSION:

Data Protection:

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- Give the students their student number. An easy solution to this is by providing the number at the top or on the back of name badges. Partners should find a solutions that works well and is most time efficient for themselves.

Preparation:

- Set up video/audio recording equipment.
    - Explain that video/audio recording equipment will be/is set up in the room.
    - You may ask for a volunteer group to be recorded during the sessions
        - This group could be shown how to use the recording equipment and empowered to act as researchers – moving video cameras to make sure important moments are captured, or turning off audio recorders when they don't want to be recorded (obviously encourage them to keep these on but equally we don't want to record personally sensitive information).
        - N.B. This should be the same group which participates in a group interview at the very end of the workshops.

Data Collection:

- Pre-questionnaire (online or paper copy):
    - Select the questionnaire for the correct age group and/or reading ability.
    - This collects background information on each student and requires their student number.

3.1.2 DURING EVERY WORKSHOP SESSION:

Data Collection:

- Observations:
    - Monitor video/audio recording equipment.
    - If videoed, formal observations should only include key moments.
    - Formal observations on the 'case study' group as possible.
        - Note when you make these observations (timestamp).
        - These include written notes and photographs.
    - Note your own thoughts/ideas throughout the sessions.
        - Written notes are easiest to keep but you could use an audio recorder.
    - A class teacher may also be invited to write observation notes.

3.1.3 AT THE END OF EVERY WORKSHOP SESSION:

Data Collection:

Tutor reflection:

- Complete online or on paper.
- This is a reflection on how the session went, possible changes for the following workshop and possible change for re-runs – including why.
- Be as honest as possible.
- If a section is irrelevant leave it blank.

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3.1.4 HALF-WAY THROUGH:

Data Collection:

- Artefacts of learning:
  - For EACH team collect:
    - Code
    - Images of robots (video if relevant)
    - Team reflection.
      - Each team creates a short team reflection on their experience so far. See 'Artefacts of learning' document for examples.
      - The team's response should be discussed within the team (not a sub-set of the team) and they should be encouraged to be as honest as possible.
  - Other Artefacts:
    - Plans/diagrams/notes/presentations and any other artefact (evidence of engagement/learning) should be recorded digitally.

3.1.5 AT THE END OF THE FINAL WORKSHOP SESSION:

Data Collection:

- Artefacts of learning
  - For EACH team collect:
    - Code
    - Images of robots
    - Team reflection (in an appropriate format)
- Small group interview.
  - This should be with the focus group and include a minimum of 2 students.
    - It could include two group of students to a maximum of 5 students.
  - Other students can participate in separate small group interviews if there is interest/willingness and there are staff available.
  - The interviews may be conducted at the same time as students write their final reflection
    - If this is not possible, in a classroom setting, each group 'interviews' another group. This should be audio recorded, transcribed and translated.
      - N.B. In this situation one interview MUST be led by the workshop lead.
  - All interviews should be audio recorded.
  - Interviews must last no more than 10-15 minutes.
- Post-questionnaire
  - Online or on paper
- Final tutor reflection

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3.1.6 AFTER EACH COMPLETED WORKSHOP:

Data Collection:

- Complete the 'Workshop Information' online spreadsheet
    - Include the name of the workshop and the number of students, noting the number of returning students
    - Include the context of the workshop, e.g. integrated in a normal schools lesson, extra-curricular activity in school or out of school.
    - This will also be used in WP2

Preparing Data:

- Session information:
    - Group information (including gender and identifying the focus group)
    - Activity Plans
        - Clearly identify which of the recommendations presented at the Malta milestone meeting have been implemented, with a brief statement on how and why.
        - Clearly identify any changes from previous activity plans as part of their ongoing development, with a brief statement on how and why.
    - Teaching materials: Handouts, worksheets, presentations, videos or any other material created for the purposes of teaching (in English or with translation).
- Draw a scientist:
    - Blank out student names and add numbers where necessary.
    - Create a single PDF of PPT file for each workshop.
- Observations:
    - Anonymise observation notes
- Artefacts of learning, teacher and student reflections:
    - Translate and anonymise.
    - Digitise any non-digital data (scan or take a high-quality photograph)
    - Collate each group's work in a separate folder or file.
        - The folder should be labelled with the group's name or number
- Audio recordings of interviews:
    - Transcribe (using template) and translate into English.
    - The original language translation can be included as it can aid in identifying translation errors.
    - Anonymise
- Paper-based questionnaires
    - Translate free-text responses.
    - Anonymise
    - Input all questionnaire responses in provided Excel files.
- Online questionnaires
    - Translate and update within Quaitrics OR by downloading the data from Qualtrics, translating and including in the data pack sent to Carina.

Data Management:

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- **All original files (including audio and video) must be kept by the partner who collected the data until October 2023.**
- **File naming:**
  - Follow a standardised file naming approach which does not include the name of schools or date of the workshop.
- **Zip all but audio and video recordings and email to Carina:**
  - **N.B. ONLY Anonymous data may be sent in this way. ANY data with personally identifying information in it (e.g. videos and photographs) must be encrypted – follow separate instructions below.**
- **Encrypt audio and video recordings and send to Carina.**
  - **N.B. Encryption keys must be kept private.**
  - ONLY audio recordings which have not be translated and transcribed need to be sent.

ALWAYS keep a secured copy of original files (until October 2023)

3.2 CHECKLIST

While the protocol provides a comprehensive description of the data collection process, a quick review checklist was created to increase rigor. The checklist combines the requirements of WP2 and WP6 to ensure that all information that is required for the success of the project is prepared, collected and stored in a systematic way and to reduce the duplication of effort.

Preparation for the workshop				
Task	**When**	**Notes**	**File / Template**	**WP**
Adapt/Distribute information about workshop/project	1 month before			General
Send consent form to teachers/schools	3 weeks before			WP 6
Send consent form to parents	2 weeks before			WP 6
Send consent form to students	1-2 weeks before	You may want to do this in school or ask the teacher to do it.		WP 6
Draw a scientist – ensure that it is female/male (year 2)	1-2 weeks before	This can be done in class by the teacher before the workshop		WP 6
Get the list of students participating in workshop	1-2 weeks before	And confirm informed consent has been given.		General
Assign students to the code (anonymisation)	1 week before			WP6
Prepare badges for the students with the student code	1 week before			General
Prepare materials for workshop Presentations, Materials, Hardware, Software	2 weeks before			
Print or have links for - Pre/Post Questionnaires	1-2 weeks before		Qualtrics or paper	WP 6

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- Interview Questions - Observation protocol - List of artefacts of learning to collect - including a plan for the blog/reflective writing. - Tutor Reflection				
Change Log / Activity Plan		Update/upload to server		WP2, WP4 & WP6
On the day of the workshop				
Set up and explain video/audio equipment	-			WP 6
Give group names to every "team"	-			WP 6
Distribute the Pre-Questionnaire	-		Qualtrics or paper	WP 6
Student Observation (might require extra person)	-			WP 6
Complete group information	-			WP6
At the end of every workshop session				
Tutor Reflection	-			WP 6
Take Videos/Pictures of the artefacts created	-			WP 6
Copy the code created				WP6
Half-way through				
Ask student to reflect on their learning	-			WP6
End of final workshop				
Ask students to reflect on their learning	-			WP 6
Small group interview with the group - Audio recorded	-			WP 6
Distribute the Post Questionnaire	-		Qualtrics or paper	WP 6
Take Videos/Pictures of the artefacts created	-			WP 6
Copy the code created				WP6
Tutor Reflection	-			WP 6
After the workshop				
Complete workshop information/meta-data	0-1 week after workshop			WP2 & WP6
Update activity plan identifying key information for analysis relating to the so-called 10+1 Commandments	0-2 weeks			WP4 & WP6

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Anonymise / Scan and Upload the "draw a scientist"	0-2 weeks after workshop			WP 6
Translate / Anonymise / upload paper-based Questionnaires (excel)	0-2 weeks after workshop		Excel files for pre- and post-	WP 6
Upload paper-based tutor reflections	0-2 weeks after workshop			WP 6
Upload observation notes	0-2 weeks after workshop			WP 6
Transcribe / translate / upload the transcribed audio recordings	0-2 weeks after workshop		See Word doc for template	WP 6
Upload Artefacts of learning encrypting any sensitive record	0-2 weeks after workshop			WP 6
Translate / Anonymise / upload reflections	0-2 weeks after workshop			WP6
Encrypt and upload sensitive audio/video	0-2 weeks after workshop			WP 6
Update online monitoring form with workshop information	0-2 weeks after workshop			WP 2 / WP 6
Transfer complete data pack to Carina	2 weeks after workshop			WP6

Table 2 WP2 and WP6 checklist for workshops

3.3 INFORMED CONSENT

Standard informed consent forms were created for each partner to translate and insert context specific information. Informed consent is requested from schools in which the research will take place, teachers (mentor/facilitator/tutor) involved in the delivery of the workshop, parents and children. Two versions of the child information sheet were created, with one designed for children over the age of 14 (the 3rd age group in the project). The assumption is taken that if information is delivered in an age appropriate way, with opportunities for questions to be asked, even very young children are able to decide whether they are willing to be included in research data or not. Only children who also have parental permission to participate are included in data collection. Children will not sign their forms but will be asked to write their name if they agree and to tell their teacher if they are unhappy about the research project and wish to withdraw.

Within the informed consent forms, there is an option to opt-out of video and audio recordings and the open data pilot, to address concerns which are anticipated. Below is an example of the parental information sheet and informed consent form:

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EDUCATIONAL ROBOTICS FOR STEM RESEARCH

INFORMATION FOR PARENTS

Researchers:

Prof. Markus Vincze (vincze@acin.tuwein.ac.at), Senior Research, Automation and Control Institute, Technical University of Vienna, Austria.

Dr Carina Girvan (girvanc@cardiff.ac.uk), Lecturer in Education, School of Social Sciences, Cardiff University, UK.

With: _____

This research is funded by the European Commission, EU Horizon 2020 (Project reference No. 665972)

Purpose of the research

The purpose of this research is to evaluate the use of robotics for science, technology, engineering and mathematics (also known as STEM) education. To do this we are running many robotics-based learning activities in both school and out-of-school settings across Europe with different age groups. To evaluate the activity your child is involved in, we need to understand their experience of the activities and what they have learnt from them. We also need to understand your child's level of interest in STEM subjects and careers. By the end of this research we will have developed a range of activities to be used by teachers across Europe to develop children's interest in STEM subjects and their curiosity about the natural, mechanical and digital world around them.

Your child's involvement

So that we can develop effective learning materials and understand students' developing ideas, knowledge and attitudes, we request your permission to collect data in the following ways:

- Questionnaires at the beginning and end of the lesson/series of workshops.
- Video/audio recording of the lesson/activity/workshop.
- Written researcher observations
- Copies of children's work.
    - Examples include photographs or videos of the robots that they have created, a written account of their experience or drawings.
- Audio recorded interviews in small groups.

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Involvement in the research is voluntary and you may withdraw your permission for your child to be involved in the research at any time without explanation, by contacting _____ or Dr Carina Girvan.

How we will store, protect and use your child's data

This research follows the guidelines set by the British Educational Research Association (BERA) and complies with the Data Protection Act in _____ This research has been reviewed and approved by the School of Social Sciences Ethics Committee at Cardiff University, UK.

- Any personally identifying information will be stored as encrypted files on password protected drives in accordance with the Data Protection Act in _____ .
- Data will be stored for no less than five years.
- All audio recorded data will be transcribed and anonymised.
- Names and any other personally identifying information will be removed from all other data.
- A randomly assigned participant number will be used to refer to your child and their school for the purposes of storing and analysing the data.
- Data will be shared with research partners working on the ER4STEM project, for the purpose of analysis. They will only have access to this data if they agree to the terms specified here.
- Anonymised data, such as quotes or images may be used in reports, publications, presentations and other research outputs.
- No images containing children's faces will be used in research outputs.
- A randomly assigned pseudonym will be used when quoting or referring to any data in presentations and publications.
- Both teachers and researchers will be working closely together throughout the project. If a child discloses any information which raises a child protection issue, this information will be passed on to the school and dealt with in accordance with their child-protection policy.

The project is part of an open access data initiative by the European Commission. This means that some anonymised data from the project will be made available to researchers outside the ER4STEM project. Here are some important points to note:

- Only fully anonymised data will be shared.
    - This means that it will not be possible to identify your child within the data.
- This will include questionnaire responses, written observations, images of objects created by children, documents created by children and transcripts of interviews with children.
- No video, audio or images of children will be included.
- Those researchers will only have access if they agree to the same terms specified in this form.
- You may choose to opt-out this part of the project separately.

Questions and withdrawal

If you have any questions about the research or wish to withdraw your consent, please feel free to contact _____, Dr Carina Girvan at Cardiff University (Email: girvanc@cardiff.ac.uk), _____ or any member of the research team. If you have more questions or concerns, please contact the Chair of the School of Social Sciences Ethics Committee, Prof Alan Felstead (alanfelstead@cardiff.ac.uk)

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EDUCATIONAL ROBOTICS FOR STEM RESEARCH

PARENTAL CONSENT

I, the undersigned, confirm that:

- I have read and understood the above information about the project.
- I have had an opportunity to ask questions about the study and my child's participation.
- I voluntarily agree to my child participating in the research project.
- I understand that I can withdraw at any time without giving reasons and that there will be no penalty for withdrawing.
- The collection, use and storage of all data has been explained to me.
- I understand that only anonymized, data will be used by researchers. I am aware that all names and other personally identifying information will be removed from the data.
- I understand that any personally identifying information, which is collected by the research team, will be stored according to the Data Protection Act. This includes video and audio recordings which will be kept on password protected drive stored in a locked place and will not be distributed to third parties.

❑ Please tick if **you do not want** audio or video recordings to be made of your child for the purpose of this research.

❑ Please tick if you want to **opt-out** of the open access data initiative by the European Commission.

Child:

_____ _____

Name of Child Child's School

Parent/Guardian:

_____ _____ _____

Name of Parent/Guardian Signature Date

To keep you informed about the project, please provide your email address:_____

Researcher:

_____ _____ _____

Name of Researcher Signature Date

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3.4 WORKSHOP INFORMATION

This is standard information that needs to be collected about every workshop. All information is to be included in the folder 'workshop information', along with the activity plan and any teaching resources (e.g. handouts, instructional material or slide shows). **N.B.** Meta-data will be collated via an online spreadsheet.

3.4.1 META-DATA

Partner:

Workshop start date:

Workshop end date:

Number of sessions:

Country:

In-school context?

Extra-curricula activity?

Type of school:

Lead by:

Other tutors/mentors:

Was the class teacher present?:

Did they support the session?

How?

Activity Plan (title):

Links to recommendations:

Age of youngest participant:

Age of oldest participant:

Total number of participants:

Any variation in student numbers?

Absence: State student number and sessions from which they were absent in the following format. Use a semi-colon to separate multiple entries.

Total number of male participants:

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Total number of female participants:

Number of participants in the smallest group

Number of participants in the largest group

Total number of groups at start:

If any news groups were formed, state how many:

How were the groups formed?

Why?

Robotics kit:

Programming languages:

Primary domain:

Stated objectives:

3.4.2 GROUP INFORMATION

In order to analyse qualitative data generated by groups and to track individual students anonymously to join questionnaire and qualitative data together within single case studies, information about the composition of each group is collected. The group name/number is listed for tracking purposes, followed by the student number and gender of each participant within the group. If there is a child who is not participating in data collection, the student number '000' is used. This ensures that no data from these children are mistakenly captured from qualitative sources and the composition of each group can be compared in the analysis.

The workshop leaders are also asked to identify the focus group on this form, by marking it with a *.

3.5 DRAW A SCIENTIST

This task is modified based on critiques in the literature from simply 'draw a scientists' to 'draw a scientist at work'. To address concerns that this may appear to be 'childish' to older participants, there is the option to write a description or add text to the picture. To support the open response of participants, this task is presented on a single side of A4, with brief instructions and a blank box to fill.

In project year 2, languages such as German which use gendered nouns will present the female form of the word, followed by the male form. In project year 3 this is reversed.

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Student Number: _____

DRAW A SCIENTIST AT WORK

1. Based on what you know, draw a scientist at work.
2. When you have finished, add words around the picture to describe the scientist.

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3.6 QUESTIONNAIRES

The questionnaires are designed to collect data rapidly and systematically from a large number of students. To support the process Qualtrics is used to provide a web-based and mobile-compatible version of the questionnaire which is formatted to closely resemble the paper-based questionnaire. The advantage of the Qualtrics system is that the work-package leader was able to set up one form and copy it for each language that the workshops would take place in. Partners could then translate the questionnaire directly with no concerns about editing the underlying structure. Once the questionnaires have been completed, a CSV form can be generated and merged with questionnaires completed in other languages as they share the same structure. As there are some open questions, this also provides an easy way to identify and translate non-English submissions, for the purpose of analysis. Only two project partners used Qualtrics in year 1 and so a standardised spreadsheet with drop-down input values is created.

The school is used as a proxy for socio-economic status which is difficult to measure accurately without information about parental income. This would be an inappropriate question in this research and therefore a proxy for this information was chosen.

N.B. At the year 1 review meeting it was noted that 'science' is not a consistent term across countries and age groups. So each partner will provide example subjects that students in their country will study, in brackets next to the first mention of science.

Below the paper-based versions of the questionnaire are presented, which are provided to each partners for translation in case of technical issues such as lack of internet access. In this case, partners are provided with an Excel file to complete with the questionnaire data from each workshop.

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3.6.1 PRE-QUESTIONNAIRE (11-17 YEAR-OLDS)

We would like to find out some information about you.

Please take your time to answer these questions.

If you do not understand a question, please tell us.

You may skip any question you do not want to answer.

About You

What is your student number?

I am a: ☐ girl

☐ boy

How old are you?

What language(s) do you speak at home? ☐ English ☐ [Insert local language] ☐ Arabic
☐ Other, please state……

Which school do you go to?

In the future, what job would you like to do?

Have you ever created a robot before? Yes/No

If yes, where did you create it? ☐ At school ☐ At a club/workshop ☐ At Home

What did you do?

Have you ever done any programming before? Yes/No

If yes, where did you create it? ☐ At school ☐ At a club/workshop ☐ At Home

What did you do?

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How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
I like using computers					
I know a lot about robots					
I learn best with other people					
I like science					
I like maths					
I like working on my own					

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
I like working in teams					
I like trying to solve difficult problems					
I need help solving problems					
I am good at solving problems					
I want to understand more about mechanical things					
I want to solve problems that can help people					

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How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
I prefer tasks that only have one correct answer					
I like to keep working on a project until it is perfect					
I like it when I can solve problems quickly					
I think it is important to learn about science					
I like learning about how things work					

About School

What is your favourite subject in school?

☐ [local language] ☐ Maths ☐ Science ☐ Computers (ICT or computer science) ☐ English ☐ Art ☐ History ☐ Geography ☐ Music ☐ Other language ☐ Technology (woodwork, metalwork, engineering) ☐ Other subject, please state …….

Why?

Which subject do you like the least?

☐ [local language] ☐ Maths ☐ Science ☐ Computers (ICT or computer science) ☐ English ☐ Art ☐ History ☐ Geography ☐ Music ☐ Other language ☐ Technology (woodwork, metalwork, engineering) ☐ Other subject, please state …….

Why?

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These questions are about maths.

How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
In general I find maths easy					
Maths lessons are boring					
We have fun in maths lessons					
Maths is important for the job I want to do					
My teacher thinks I am good at maths					
I get good grades in maths					
I think maths is difficult					
I have to work on my own in maths					
Maths is the most interesting subject in school					
Maths is important to learn					
Most of my friends are good at maths					

Would you like to study maths when you are older?

☐ Yes ☐ No

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These questions are about science (for example XXX subject).

How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
Science is the most interesting subject in school					
In general I find science easy					
Science lessons are boring					
We have fun in science lessons					
Science is important for the job I want to do					
My teacher thinks I am good at science					
I have to work on my own in science					
I think science is difficult					
Science is important to learn					
I get good grades in science					
Most of the students in my class are good at science					

Would you like to study science when you are older?

☐ Yes ☐ No

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

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3.6.2 PRE-QUESTIONNAIRE (7-11 YEAR-OLDS)

We would like to find out some information about you.

Please take your time to answer these questions.

If you do not understand a question, please tell us.

You may skip any question you do not want to answer.

About You

What is your student number?

I am a: ☐ girl

☐ boy

How old are you?

What language(s) do you speak at home? ☐ English ☐ [Insert local language] ☐ Arabic

☐ Other, please state……

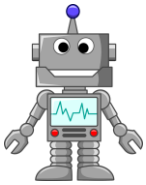
Which school do you go to?

In the future, what job would you like to do?

Have you ever built a robot? Yes/No

If yes, where? ☐ At school ☐ At a club/workshop ☐ At Home

What did you do?



Have you ever done any programming? Yes/No

If yes, where did you create it? ☐ At school ☐ At a club/workshop ☐ At Home

What did you do?

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Tell us how much you agree or disagree with these statements.

Circle one face for each statement:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I like using computers					
I know a lot about robots					
I learn best with other people					

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I like science					
I like maths					
I like working on my own					

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I like working with my friends					
I like problem solving					
I need help solving problems					
I like working with new people					

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About School

What is your favourite subject in school?

☐ [local language] ☐ Maths ☐ Science ☐ Computers (ICT or computer science) ☐ English ☐ Art ☐ History ☐ Geography ☐ Music ☐ Other language ☐ Technology (woodwork, metalwork, engineering) ☐ Other subject, please state …….

Why?

Which subject do you like the least?

☐ [local language] ☐ Maths ☐ Science ☐ Computers (ICT or computer science) ☐ English ☐ Art ☐ History ☐ Geography ☐ Music ☐ Other language ☐ Technology (woodwork, metalwork, engineering) ☐ Other subject, please state …….

Why?

These questions are about maths.

How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Mathis is easy	😀	🙂	😐	☹	😣
Maths lessons are boring	😀	🙂	😐	☹	😣
I have fun in maths lessons	😀	🙂	😐	☹	😣
Maths is important	😀	🙂	😐	☹	😣
My teacher says I am good at maths	😀	🙂	😐	☹	😣
I have to work on my own in maths	😀	🙂	😐	☹	😣
I am good at maths	😀	🙂	😐	☹	😣
My friends are good at maths	😀	🙂	😐	☹	😣

Would you like to study maths when you are older?

☐ Yes ☐ No

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These questions are about science (for example XXX subject).

How much do you agree or disagree with these statements?

Please tick:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Science is easy	😀	🙂	😐	☹	😣
Science lessons are boring	😀	🙂	😐	☹	😣
I have fun in science lessons	😀	🙂	😐	☹	😣
Science is important	😀	🙂	😐	☹	😣
My teacher says I am good at science	😀	🙂	😐	☹	😣
I have to work on my own in science	😀	🙂	😐	☹	😣
I am good at science	😀	🙂	😐	☹	😣
My friends are good at science	😀	🙂	😐	☹	😣

Would you like to study science when you are older?

☐ Yes ☐ No

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

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3.6.3 POST-QUESTIONNAIRE (11-17 YEAR OLDS)

We would like to find out some information about you.

Please take your time to answer these questions.

If you do not understand a question, please tell us.

You may skip any question you do not want to answer.

About You:

What is your student number?

I am a: □ girl

□ boy

How old are you?

Which school do you go to?

In the future, what job would you like to do?

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About the activities:

Please tick:

The problems we had to solve were:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
Interesting					
Difficult					
Fun					

Working with robots was:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
Interesting					
Difficult					
Fun					

Working in a team was:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
Interesting					
Difficult					
Fun					

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Working with robots I had to use my knowledge of… (please tick all that apply)

☐ Science

☐ Maths

☐ Technology

☐ Art

☐ How things work

Working with robots has helped me learn about… (please tick all that apply)

☐ Science

☐ Maths

☐ Technology

☐ Art

☐ How things work

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Please tick.

During the workshop…

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
					
I identified a problem to solve					
I worked on something that I was interested in					
I tried to solve an important problem					
I worked as part of a team					
I worked on my own					
I helped create a robot					
I helped programme a robot					
I was able to choose what I wanted to do					
I feel that other people did not listen to me					
I did most of the work					
I was encouraged by my team					
I gave up too quickly					
I worked hard					
I was bored					
I helped someone					
I liked sharing what I had done with other people					

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What have you learned today?

What have you learned about yourself?

What have you learned about working with other people?

What have you learned about robots?

Now that you have completed the project, think carefully about the following statements and tick all the ones that describe how you feel:

- ☐ I would like to try to solve more challenges like this one
- ☐ I am now more interested in studying science
- ☐ I am now more interested in learning about how things work
- ☐ I think I am good at maths
- ☐ I think I am good at science
- ☐ I think I am good at working in a team
- ☐ I like using computers
- ☐ I would like to build and programme robots to solve problems in the future
- ☐ I would like to use robots to learn new things in the future
- ☐ I understand how important maths is
- ☐ I understand how important science is
- ☐ I would like to learn more about programming
- ☐ I would like to learn maths in robotics workshops like this one
- ☐ I would like to learn about science in robotics workshops like this one
- ☐ I understand how robots can be used to solve important problems
- ☐ I would like to do more activities like this one

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Overall I would give this workshop:

How many stars? 

Because:

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

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3.6.4 POST-QUESTIONNAIRE (7-11 YEAR OLDS)

We would like to find out some information about you.

Please take your time to answer these questions.

If you do not understand a question, please tell us.

You may skip any question you do not want to answer.

About You:

What is your student number?

I am a: ☐ girl

☐ boy

How old are you?

Which school do you go to?

In the future, what job would you like to do?

About the activities:

Please tick.

The problems we had to solve were:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Interesting	😀	🙂	😐	☹	😣
Difficult	😀	🙂	😐	☹	😣
Fun	😀	🙂	😐	☹	😣

Working with robots was:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Interesting	😀	🙂	😐	☹	😣
Difficult	😀	🙂	😐	☹	😣
Fun	😀	🙂	😐	☹	😣

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Working in a team was:

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
Interesting					
Difficult					
Fun					

During the workshop…

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
I solved a problem					
I worked as part of a team					
I worked on my own					
I built a robot					
I programmed a robot					
I was good at listening					
I gave up quickly					
I worked hard					
I was bored					
I helped someone					

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What have you learned today?

What have you learned about yourself?

What have you learned about working with other people?

What have you learned about robots?

Overall I would give this workshop:

How many stars? 

Because:

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

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3.7 OBSERVATION PROTOCOL

To supplement the collection of observation data by video, and an alternative option when video is not available an observation protocol is provided for written observations. Below is the protocol as given to colleagues, beginning with guidance and followed by the document to be completed:

3.7.1 GUIDANCE

We want to know how and why things are done in the particular ways that they are done. But most of these things are common and familiar to us and therefore go unnoticed. The purpose of this observation schedule is to help you look for and notice these things.

During the workshops you will make your recordings on an as-and-when basis, either using the form or a blank sheet of paper. The events listed are prompts to help you think of things that might be interesting.

These might be in the form of a note to remind you to write something more about an incident later, e.g “G1 (group 1) dysfunctional”

Where possible, please note the time with reference to the recording.

At the end of the workshop quickly review these notes and add any details that you remember.

You may use these notes to as part of your reflections if they are significant to you.

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3.7.2 DOCUMENT TO BE COMPLETED

Organisation:

Completed by:

Date:

Events:

- Gender is mentioned
- One or more students 'take-over'
- One or more students are not engaged
- One or more students teach another student
- Future plans are mentioned
- Examples of good/bad team work

What did you notice?

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3.8 TUTOR REFLECTION

The purpose of this reflection is for the teacher/tutor/mentor/facilitator of the workshop to consider how each session has gone and why, as well as identify possible changes that could be made. This is an important log of decisions taken and serves multiple purposes: Development of workshops; data for WP2; and data for WP6. In WP6 it provides the analyst with a way to understand which decisions were taken and why, without having to interview tutors after every workshop. It provides the necessary detail for an outsider to understand how the workshop is run, beyond what is presented in the activity plan and provides a report on action from a specific view point which is unavailable in the observation data.

The tutor reflection has been created for use in hardcopy only, as the online version was only used in a small number of instances.

3.8.1 DOCUMENT

Before completing this reflection, please take a few minutes to think about today's session. What were the highs and what were the lows?

Organisation:

Date:

Session number (session x of y):

Tutor:

During today's session:

What percentage of your time do you think you spent:

- Teaching the whole class?
- Working with groups?
- Watching the students work?
- Other? (please state below)

Were there any students/groups that needed extra support to work well with others?

- Yes/no
- Why do you think this was?

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Were there any students/groups that found the activity too difficult?

- Yes/no
- Why do you think this was?

Were there any students that did not engage with the project?

- Yes/no
- If yes -> How do you know this?

- Why do you think this was?

How did you support the students' learning?

What was the most difficult thing to teach/support students with? Why?

What was the most successful part of today's session? Why?

What 3 things would change for next time?

1.

2.

3.

What have you learnt from today's session?

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3.9 ARTEFACTS OF LEARNING & STUDENT REFLECTIONS

3.9.1 PROTOCOL

In the **middle** and at the **end** of the full workshop, collect **code**, **pictures** of the robot (or video of the robot in action), **completed worksheets** and **reflective writing** from EACH team.

Student reflections:

Reflection is an important tool for learning and occurs at many levels. Through reflection children can demonstrate not only what they have learned about what they did but also what they have learned about themselves through doing the activities. Reflections can be on both processes and outcomes of learning.

To integrate reflection activities they need to have a purpose for learning and be related to the workshop activity and so there is flexibility in how these reflections might take place.

Reflection will be new to many students so some supports will be necessary. A typical sequence for a **mid-point** reflection would involve the children writing a description of what happened, tutors then review and add **one** prompting question (for example: why did you do that?; why is that important?; how did you learnt that?; why did that happen?; what did you learn?), which the students then respond to before continuing with the workshop. At the **end** of the workshop students can add more to their original reflection or create a new one, depending on the task.

- a video report for other children on what they did;
- a 'top 5 tips' for working with others shared on a blog;
- a postcard written to a friend telling them about their day;
- a guide for parents on how to solve a challenge they have been working on;
- a video diary on each day
- a change log;
- a whole class discussion about what has been learned, followed by time for each child to write a sentence about what **they** have learned.
- a KWL worksheet

Alternatively, small groups can write or share with a tutor who makes notes on the following:

Mid-point

Group name:

What is the challenge that you are working on?

What is your greatest achievement as a team so far? (this could be team work,

learning, creating, anything relevant to them)

How did you do this? (they could include pictures)

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What next?

Workshop end:

Group name:

What have you created? (they could include pictures)

What was your biggest challenge/success?

How did you solve it?

What would you tell someone else who is going to do this project?

Artefacts of learning

In addition to the student reflections, there are a range of artefacts of learning that will be created in a workshop. These artefacts are anything that show what they have achieved, the process of learning and students' ways of thinking and working.

These include:

- Code in development and completed
- Images of robots under construction and completed
- Worksheets completed by children
- Presentations created by students
- Reports written by students

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3.10 SMALL GROUP INTERVIEW

Small group interviews were chosen as the most suitable method to collect the views and opinions of participants to develop a deeper understand beyond the questionnaire data. Small groups are preferable to individual interviews when interviewing children, particularly when they have participated as a group as speaking to an adult (teacher or researcher) can be intimidating and limit the quantity and quality of data.

Options on how the interviews could be conducted, based on context, are presented in the evaluation protocol (section 3.1 above). The questions set out in the protocol below are flexible, they are designed to guide the conversation but not limit it. Split into four topics, which are to be discussed in turn for ease of analysis: Context; Activity; Learning; and Opinions. These cover research questions and objectives of the ER4STEM project which are difficult to answer/achieve by quantitative data alone.

Below the interview protocol is presented, followed by the interview transcription template to maintain consistency:

3.10.1 INTERVIEW PROTOCOL

Guidelines:

- After asking a question, give the children time to think about their answer. Try not to fill the silence.
- Be responsive to what the children say. Ask 'why' and other follow-up questions if interesting and relevant.
- Questions can be rephrased and reordered but the topics should be covered in the order set out below: Context, activity, learning and opinions.
- It may not be relevant to ask every question.

For out-of school contexts ONLY

1. Why did you decide to take part in the workshop/competition? (did they choose or were they sent)

Context

1. Tell me about what you did.
2. Who did what?
3. Who decided what you would do (the problem to be solved and/or the organisation of the group)? / Who decided that you would do that?
4. Have you ever done anything like this before (robotics/programming/solving problems)?
5. Did you already know how to do some of this or was it all new?

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Activity

1. What was the most challenging thing that you did?
2. What was the most interesting thing that you did?
3. What would you change to make the activities/day/week/competition even better?

Learning

1. What have you learned? (STEM/robots/programming)
2. How did you learn? (working with others, through the robot, watching others, talking to others, listening to the teacher, etc)
3. What have you learned about yourself?
4. What did you already know that helped you today?

Opinions

1. Who do you think would be the best scientists/engineers?
    a. What are their skills/characteristics?
    b. **IF** gender is mentioned, **THEN** ask more about this using 'why' questions'. If no mention, do not ask.
2. Before this activity/workshop/competition were you interested in science/maths/technology/how things worked?
    a. Why/why not?
3. Has this workshop changed that view?
    a. Why?
4. Do you think working with robots will help other students to become interested in science/maths/technology/how things work?
    a. Why?

For specific tool use ONLY (e.g. Andrix and SLurtles)

1. What did you think of working with [tool name]? (easy/difficult)
2. How could it be improved?
3. [any other specific question of relevance for partner]

3.10.2 TRANSCRIPTION TEMPLATE

Date:

Partner Organisation:

Interviewer:

Participants: Here indicate which participant number each speaker is.

Transcript

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Interviewer: Text goes here.

Child 1: Text goes here.

Child 2: Text goes here.

Notes

Note	Example
Use left brackets to indicate the point at which speakers overlap.	I: so [how C2: [and I liked
Punctuation indicates pauses or intonation. Full stop long pause. Comma short pause. No other punctuation should be used.	What do you think?
Empty parenthesise indicate the transcriber's inability to hear what was said.	In science and () and at home
Use parenthesise to indicate words that the transcriber is uncertain about.	Were there (some) things you didn't like?

Table 3 Transcription template notes

3.11 DATA STORAGE

The pre-kit also includes information on the storage and protection of data (see 3.1). The protection of personally sensitive data is key and will be held by the partner who collected the data. Only anonymised files will be shared for the purpose of data analysis. Any potentially sensitive data which must be shared will be encrypted prior to sharing the data. Partners are responsible for protecting and backing-up the data that they store. More details on this are found in the data management plan in WP8.

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4 SUMMARY

This deliverable presents the development of the evaluation tool kit to be used in years 2 and 3 of the project. The tool kit includes the tools necessary to collect the required data, along with a clear evaluation protocol and checklist to ensure rigour in data collection. The contents and procedures have been reviewed and agreed with all project partners. This will be treated as a living document, as the project develops, particularly the Framework (WP1), items may be added or removed to address the changing needs of the project.

5 CONCLUSION / OUTLOOK

The next step is for the tool kit to be used as part of the workshop activities in WP2 and conferences in WP3 during project years 2 and 3. Data collected by partners will be shared with the WP leader once anonymised and fully processed for the purpose of analysis and evaluation of years 2 and 3 (D6.4 and D6.5).

6 GLOSSARY / ABBREVIATIONS

EC	European Commission
ER4STEM	Educational Robotics for STEM
REA	Research Executive Agency
STEM	Science, Technology, Engineering, and Mathematics

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