The Art of Science Learning

WP4 Assessment Analysis

Overall Highlights and Recommendations

French Case Study

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Overall highlights

Transversal Competences - Goal 3

Learning to Learn

- **Students' perception towards the value of learning science did not seem to change** after the project.
- The **way facilitators led the workshops**, by establishing a horizontal relation with the students and creating a climate of trust and a playful **atmosphere allowed students to freely share and develop their ideas and reflections**.
- Despite of this, the science **learning process did not seem to reach its potential,** mostly due to a **lack of connection between the reflection activities** in the first part of the workshops and **the PERSEIA creation process through the research on students' topics**. Such lack of connection induced a confusion about the aim of the reflection activities hindering the capacity of the process to foster students' learning to learn skills.
- Due to the reduced amount of time devoted to students' reflection on their own research question (both within and outside the workshops), **students could not really develop a reflective thinking on their topics and on their own process of learning science.**
- In contrast, thanks to the time dedicated to train students in theatrical skills and the constructive approach transmitted to students, they could **rely on their previous knowledge, their creativity and assess their own process of learning performing art**.

Social and Civic competences

- Students' **collaborative skills have been fostered and students' communication skills have been largely reinforced, thanks to the development of the different theatrical exercises** all along the workshops.
- Except few exceptions, **all the students reported having highly participated into the project**, and having **shared work with their peers.**
- All along the workshops, students showed a **general respectful and helpful relation with each other**, and **no major difficulties** among themselves were observed.
- **Collaborative work was fostered** among students thanks to several dynamics: students' improvisations, development of the PERSEIA and -to a lower extent- the reflection process on students' research questions.

Sense of Initiative

- **Neither clear leadership** among students **nor clear students' ability to manage and plan a project** was observed while doing the workshops and for the creation of the PERSEIA, mainly **due to the fact that most activities and theatrical developments were directed by the facilitators**.
- The use of **theatrical improvisations** as a way to raise students' ideas for the elaboration of the PERSEIA **allowed students to develop a sense of initiative and creativity.**
- **Students' self-confidence has been largely reinforced** and fostered through their participation in the different workshops.

RRI Values - Goal 4

Inclusiveness

- The workshops overall managed to achieve a **high degree of inclusiveness**, with a gender-balanced involvement of students.
- This high participation of students within the workshops has been possible thanks to an **emotional support and fostering dialogue** between students.
- Although **the content of the PERSEIA was mostly led by the facilitators**, students felt they **could overall make choices during** the workshops and the PERSEIA creation process**. However, students' perceptions towards their possibility to make choice largely varies between schools,** with students in **Marie Curie** reporting having **less opportunities for their ideas to be integrated in the PERSEIA.**

Engagement

- **Students were highly engaged in the workshops**, showing a **higher engagement** when working **on theatrical exercises** and the **elaboration of the PERSEIA than** when **participating in the reflection activities** (specifically in Vauréal).
- The workshops **did not seem to reach an optimal cognitive engagement of students,** due to **the format** and **the accessibility of the reflection activities** proposed**,** but also to the **disconnection between reflection activities** and **the research process regarding students' question.**
- **Students' engagement got higher** when they realized **all the activities led to the creation of the final performance**
- **Cognitive engagement through the development of research on students' questions could not reach its optimal potential** as a too little time was devoted to explore students' research questions (especially in Vauréal).

Ethical aspects

- **Ethical issues have not really been approached** through the PERFORM project, and no **precise time was devote to this with students**.
- **Contrasting perspectives when approaching science or a given scientific issues have not been really developed**, probably **due to the lack of depth in the approach to scientific topics**.
- Overall, **gender issues regarding science and science learning were not really approached during the workshops**, as observed through the sessions**.**
    - However, the **project emphasized the societal relevance of the topics developed**, by integrating students' research questions, which relied on societal issues, into the creation process, even if they did not really fit into STEM topics.

The Creation of the PERSEIA - Goal 2

- Overall, the main strength of the final PERSEIA, for every group of both schools was **their artistic component and accomplishment**. **All the performing resources** available (stage, curtains, lights, music, attrezzo) **were used** in all the PERSEIA, in real or reproduced context of theatre. As well, a real attention was given to produce a final product that students might be proud of. The final PERSEIA allowed us to see that students have largely benefited from a process of artistic and performing skills learning, through a process of embodiment of the different aspects, as almost all of the students were able, even only after the realization of seven workshops of practice, to enter in their role-play.

- Another interesting and strong aspect of the PERSEIA relates to **the students' appropriation of their research question through embodiment**. In that sense, because most of the tasks and exercises realized in order to create the PERSEIA required students to integrate their research question with the body (by mimicry situation, emotions and ideas), the final **PERSEIA showed a representation of research questions and intellectual processes through the body**, what is totally out of schooling and academic way of communicating science. In that sense, PERSEIA communicated with other languages than the verbal pathway, by using performing resources and artistic elements to share and transmits ideas, feeling and emotions related to each of the different topics presented.

- Despite these important strengths, the **weight of the scientific content in the PERSEIA largely depended on the sketches performed**. Not all the sketches did allow understanding what was the scientific topic, research or data that were communicated.

- Many sketches showed students' research interests and topics but stayed at a **superficial level of description**. For many of them, the performance allowed students to present, by verbally saying their research questions, but without any more elements.

- In the same line, **although some sketches showed contrasting perspective** on a same topic, it occurred in **few sketches and the contrasts raised were somehow disconnected from the scientific content**.

- Such lack of scientific content **might be largely due to the approach developed for the PERSEIA, as most of the sketches were mostly raising questioning about the topics chosen by students** (illustrating somehow the different reasoning students went through during the workshops) **rather than bringing scientific answers and insights about the specific topic.**
- Despite of this interesting approach, **some sketches lacked of scientific accuracy** and transmitted **confusing elements that relied on common perceptions rather than scientific insights**.

Therefore, the final PERSEIA **hold a major artistic component that combined body, face and voice expressions to transmit messages and to communicate the topics students explored during the workshops**. Because the format used to develop the scenes favoured the use of body, picture, and artistic way of communicating rather than language, the **part dedicated to scientific explanation and reasoning was reduced in some sketches**. Moreover, because some sketches used the irony and exaggeration, this format somehow troubled the content of the message that wanted to be transmitted and did not allow identifying what was the scientific content.

Overall Recommendations

Regarding Transversal Competences

- In order to **better foster students' ability to value science**, to learn how to learn, and develop reflective thinking, **more time and space should be devoted to the process of research among students (both related to the questions and topics developed during the workshops)**.

- In that sense, in order to better foster both the learning autonomy and awareness of students' learning process, **more space should be given to reflection activities that explore students' questions**, **all along the different workshops.** Based on students' research question, learning science abilities such as reframing scientific concepts would be largely more fostered.

- In order to foster students' self-organization and autonomy, a **more balanced way between time guided by the facilitators *vs* students' self-organization should be considered during the workshops. For instance,** the **final PERSEIA could be more co-developed with students**, by **giving them more responsibilities** towards the creation of the script of the PERSEIA, **fostering students' ability to manage projects**.

- As enhanced **collaborative and communication skills** appeared **as students' main learning outcomes** from the project, **exercises related to body awareness and acting** should be maintained as a **key stone of the workshops**.

- A **special attention to students' needs, questions and doubts** during the whole process **should be maintained**, as it **highly contributed to students' engagement into the project and students' improvement of self-confidence**.

Regarding RRI Values

- In order to **better foster the cognitive engagement** of students during the workshops, it seems **worth focusing on students' own research questions to develop different aspects** (such as gender, societal contextualization, ethics integration and critical thinking) **rather than reflection activities** that are not connected with the questions developed for the creation of the PERSEIA. By integrating RRI values in the process of research on students' questions, it might handle with the potential difficulties for some students to get engaged in more classical activities of reflection (such as reading and elaborating written ideas).

- Cognitive engagement could also be fostered by connecting the STEM-related topics approached through PERFORM with the schooling curriculum, so that students can apply the learning generated in a broader scale.

- Students should **be clearly communicated since the beginning the different steps of the project and their participation in a final event** performing in front of an audience. Opening the choice of the audience could encourage students' participation and appropriation of the process.

- If students' research questions are contextualized within ECR topics, then such questions **should be intimately related to students' concerns and daily life**, for them to feel motivated to get involved in the process of research.

- As research questions brought by students were not precisely related to STEM but could allow to approach different aspects related to RRI values, and also to allow students to be aware of the diversity of disciplines that belong to science, it seemed **relevant not to limit the topics to STEM.**

- The creation **of the groups of students who will participate to PERFORM should be carefully thought**, as the difference between groups of volunteers and groups composed by students who were not wishing to participate largely affected both the process of the PERSEIA creation and students' overall cognitive and emotional engagement.

Regarding the PERSEIA

- To maintain the format of communicating science as it relies being an innovative and creative way of communication, fostering the participation of all the students.

- The final PERSEIA to benefit of a **deeper work of research and integration of scientific content into the creation of the sketches.**

- To maintain the presentation of every students' research question in the content of the PERSEIA, especially if all the topics chosen by students are not developed in the scenes.

- To **complement the aspects that developed approach of students' reasoning process by integrating more scientific content**(implying thus more time for students to do research based on scientific resources)