D7.2 Internal evaluation yearly report

Matteo Merzagora and Meriem Fresson

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1. Introduction

This report summarizes the outcomes of the evaluation conducted on the pilot stage of the TEMI trainings. We include in this introduction some general trends. In depth considerations and data interpretation are provided in the following chapters, following the organisation set out in the Evaluation Strategy (D7.1). More extensive raw data are included as Appendix.

1.1. Methodology

This report was conducted according to the evaluation plan set in D7.1. This document explained the goals and workplan of WP7 evaluation, thought as an internal learning instrument to ensure communication and progression throughout the project and to promote reflexivity among the partners, focusing on the teacher training programme of TEMI.

This report is related to Phase 2 – “Evaluation of the pilots”, concentrating on teachers and organizers of training workshops. Its main aim is evaluating partners’ uptake of the CPD framework and its local implementation in pilot workshops. In the evaluation plan, we identified the following elements to be evaluated in this phase, which we will address individually in the sections of this report:

A – The training programs in relation to D4.1 (see section 2 of this report)
B – The practical implementation of the trainings (see section 3 of this report)
C - The learning outcomes for the teachers (see section 4 of this report)
D - The training methodology (see section 5 of this report)
E - The mysteries and the training materials (see section 6 of this report)
F – The minimum thresholds and quantitative indicators (see section 7 of this report)

As indicated in the evaluation strategy (D7.1), the first element of the chain going from the vision of a TEMI enquiry lab all the way to the impact on students, is the methodology lead by WP4. Moreover, the life of the project sets at this time the revision of this methodology, before the roll-out phase. This is why, as planned, we have put a strong focus on this aspect in our observation of the pilot training workshops.

As defined in D7.2, we have used a set of tools designed in coordination with other work package leaders to gather the information needed to provide this analysis. We also relied on a set of complementary documents provided directly by partners or other work package leaders. All these elements are listed in Annex 1. In synthesis, they consist in:

- A simple satisfaction questionnaire filled in by teachers, aimed at understanding which elements of the training were more appreciated, and for which reasons
- A more in depth questionnaire filled in by the teachers, aimed at understanding their perception of the different components of the trainings.
- A questionnaire for organizing partners
- Semi-structured interviews with the partners
- The reports on individual training workshops
- Several other materials were used, such as previous deliverables, or documentation produced by individual partners.
In this report, we chose not to describe the result of each evaluation step/tool separately, but to combine them to produce a set of results organised according to the evaluation objectives.

The results presented here should be looked at with caution since they represent only a part of the overall participants. 76 teachers from 6 sites (5 countries) out of 175 teachers (43%) could fill in the final teacher questionnaire (Docs 4.1 and/or 4.2 from the evaluation toolkit). Complete answers can be consulted at the following address: https://fr.surveymonkey.net/results/SM-Z8DC2ZT8/.

The missing answers are due in particular to the following reasons:

- UL used a in-house questionnaire, due to a misunderstanding about the evaluation tasks (they will use the common questionnaire for cohort 2)
- UniHB did not follow the methodology yet, and it was therefore impossible for them to answer the questionnaire.
- UniVie did only “advertising workshops”, using only part of the methodology: final teacher questionnaires were therefore non-applicable. Satisfaction questionnaires were filled in.
- CUNI did not fill in the final teacher questionnaire at the time of submission of this deliverable. Satisfaction questionnaires were filled in.
- SHU trained the first 20 teachers before the Leiden partners meeting, thus before the questionnaire was ready.

We consider this as insufficient in order to extract solid information, and the reasons for this lack of participation need to be addressed and solved in the next TEMI year. Answers to the satisfaction questionnaire (Doc 3 from the evaluation toolkit) from 7 sites (6 countries) were collected (complete results can be consulted at the following address: https://fr.surveymonkey.net/results/SM-Q3LBX7M8/)

1.2. Nature of the participants

About 175 teachers participated in the first TEMI cohort, based on the questionnaire collected at the end of April by WP5. They participated in CPD in 10 sites, from all 9 countries. A few encounters with teachers happened after this date and are not included in this figure. The teachers had very different backgrounds, and the various levels of experience in teaching and in IBSE are quite diverse, as illustrated in figure 1 and 2.

![Figure 1: Final teacher questionnaire. Distribution of the years of experience of teachers participating](image1)

![Figure 2: Final teacher questionnaire. Distribution of the level of experience of teachers with IBSE](image2)
1.3. Satisfaction of the participants

The “satisfaction questionnaire” filled in by teachers provides a simple but interesting overview, as shown in figure 3 (results of satisfaction questionnaires for specific workshops have been communicated to each concerned partners, and are available on the Survey monkey website). In fact, teachers are globally very satisfied by the training offered. However, results show that the “applicability” criteria scores lower than the other criteria. This appears to be quite consistent throughout all European activities, giving a clear indication that, in the second cohort of the TEMI project, specific attention needs to be given on the practical implementation of the activities and methods proposed.

![Satisfaction questionnaire chart](chart.png)

*Figure 3: Satisfaction questionnaire. The averages for all sessions of all trainings of the first cohort are reported.*

36 teachers were able to apply the TEMI approach in the classroom (see figure 4). 17% of all respondents declared to have applied it as it was presented during the training, while a large majority, 83%, adapted it to fit their own needs.
When asked about the quality of the information the teachers received before the training, only 44% felt it was complete (48% considered it “just sufficient”; 8% “insufficient”).

When asked about the element most liked and most disliked in the training, teachers mostly pointed out:

- liking to learn about a new/different method
- liking activities of lesson planning closely linked to their actual practice
- Being sensitive to the group dynamic: they liked working in groups, getting and analysing practical examples from colleagues and training teams, exchanging experiences in an atmosphere of cooperation, while they disliked the same exchange sessions when too few teachers were contributing to this dialogue.
- The 4 TEMI innovations appeared to be valued in different ways:
  - the 5Es approach, when mentioned, was only commented positively;
  - mysteries: teachers enjoyed being in the shoes of students and discover. A certain lack of reflexivity on this aspect could be pointed out, even though certain teachers pointed out liking the general stimulation for self-criticism (mainly UMIL)
  - showmanship: teachers are divided about this innovation, that appears as liked very much by some (when teachers are “passive” mainly) and disliked by many when they have to act in first person and become active (“I didn't like the social interaction, I thought it was a bit artificial. I don't like presenting in public (acting, playing together). I'm not prepared to do everything I do with kids in the classroom in front of my colleagues”; “Theater. New. Scary. Why?”, “The role playing part. New and uncomfortable situation”). A general problem of shyness appears beyond showmanship implementation (disliked: “Having to present (yes as a teacher!!”)”). Its lack of applicability was also mentioned by one person.
  - GRR or related features were significantly not mentioned at all

The variety of activities and ideas was also appreciated, and a significant number of teachers said there was nothing they disliked (18 people). Special mentions of specific trainers or invited experts were expressed. Adaptation of the training to the level of teachers is required: one of them indeed mentioned a “Lack of basic preparation to tackle IBSE”. Some teachers point out that the transition from session one and two was not useful, and several of them pointed out that time was too short. However, it is well known that this type of comments occur systematically in training activities, and we do not suggest that this imply a stretch of the time devoted to the training; or less attention devoted to transition among sessions.
Good ideas for improvements from teachers include providing all material in local language or examples from other countries' existing mysteries.

The TEMI trainings were considered to help tackle aspects of the curriculum for 82% of the respondent, which means that this was not the case for a non negligible 18% of the respondents. Amongst the 5 partners who used the final teacher questionnaire, two have an equivalent ratio around 68% of teachers saying the training did help in this regard, and two had excellent rates of 100% yes and 93% yes (LEI and SHU).

Answers to a specific question about how much the training matched their needs, 78% of the teachers thought the training mostly or entirely matched them, and 93% of them feel the training was at an appropriate level for them (neither too advanced, not too elementary).

An analysis of the answers to the question about the expectations of the teachers before the training mainly shows 3 tendencies:

- Teachers have a desire for concrete tools ("tools", “ideas”, “methods”, “tips”, “strategies”, “techniques”, “practical”, “usable”, “immediately applicable”, at local school level), with still a few people longing for “didactic deepening” or “theory”, a usual trend for training workshops in general.
- A large part of teachers seems to have understood one of the key aspects of TEMI: the motivation of the students. They were looking forward to learning how to “motivate”, “engage”, “hook”, “improve interest”, “challenge”, up to “inspire” students. This element should be put in relation to the rates given to communication, mainly considered “just sufficient” (48%), indicating that efforts should not be devoted to conveying the message about motivation, but to other factors, that could be the other TEMI messages, or just the clarity of the modalities for participation. Two more explanatory pieces of feedback tell us concretely: “I didn't know what to expect, I understood that the workshop had to do with mystery stories, but I didn’t know it had to do with enquiry activities that start with a mystery story that you have to solve. But because I fully trust the TPD organisers, I assumed that it must be interesting.” and “Few [expectations], got the question... do you want to join a course in science education.
- The message about TEMI providing new tools seems to have come through also. Teachers were craving for “new”, “original”, “different” and express a desire to renew their teaching and be inspired. The results of the evaluation show that this specific need was well answered to if we look at the 3 top positions in which are the answers containing the word “new” to the question “What do you feel you gained from the training?” (“A motivation to renew my teaching” 65%, “New tools for my teaching” 63%, “A new approach to teaching” 55%)

Other messages include a specific interest for “showmanship”, “teacher as an actor”, “tools for drama” and more generally an approach through “creativity”. Also, teachers mentioned interest in “help” and “advice” and for exchanges with colleagues.

Many of them came with the intention of improving their teaching and they feel that they did not waste their time and are very eager to try the approach in class, as shown by the top position of these answers in Figure 5.
**Do any of these sentences correspond to how you feel right now:**

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>I want to try this out in class with students</td>
<td>88%</td>
</tr>
<tr>
<td>The time was worth it</td>
<td>70%</td>
</tr>
<tr>
<td>I can improve the enthusiasm of my students for my classes</td>
<td>55%</td>
</tr>
<tr>
<td>This was fun!</td>
<td>38%</td>
</tr>
<tr>
<td>I feel I am able to do it, I feel ownership for the method</td>
<td>35%</td>
</tr>
<tr>
<td>I am happy with the resources &amp; lesson plans I am taking home with me</td>
<td>30%</td>
</tr>
<tr>
<td>It was challenging!</td>
<td>28%</td>
</tr>
<tr>
<td>I interacted with a competent trainer that knows his/her theory behind the method</td>
<td>26%</td>
</tr>
<tr>
<td>I am not feeling overwhelmed, some aspects of workshop were familiar</td>
<td>10%</td>
</tr>
<tr>
<td>I am sceptical but curious</td>
<td>2%</td>
</tr>
</tbody>
</table>

Figure 5: Final teacher questionnaire. Most significant feeling of teachers coming out of the final workshop, in decreasing order.

This desire becomes a reality in most cases, but at least a quarter of the teachers did not get a chance to apply it yet this time. The reasons for this gap between wills and action should be carefully analysed and acted upon. The teachers mostly gained out of the workshops a motivation to renew their teaching and new tools for their teaching (see figure 6).
1.4. Practical advice in synthesis

The evaluation exercise allows drawing the following list of practical pieces of advice for the prosecution of the TEMI project:

- We should devote more attention to a clear communication to teachers before the trainings
- A greater attention should be given to the applicability of the training content
- A greater equilibrium among the 4 innovations should be sought, in particular the GRR and Showmanship element needs more development and sharing among partners
- Within the 5E, the “evaluation” element appears to be the least understood, and deserves more attention in the future
- Clearer instructions and learning objectives need to be clearly specified to teacher in each session
- The level of flexibility with which the methodology should be applied needs to be clearly defined within the consortium
- Existing expertise within the consortium should be shared more (e.g. concerning showmanship)
- Attention should be given to the building of a community among teachers, following best practices available within the consortium
- There is a risk of insisting on existing communities rather than enlarging them or reaching to new teachers
- There is a need of guidelines for adapting the content of the training to teachers with different levels of experience in IBSE
- The novelty of the TEMI approach should be self-evident, and not declared, as already innovative teachers might feel patronized.
- Time and effort devoted to evaluation should be explicitly included in the programmes.
- When the desire of applying TEMI approaches in the classroom did not result in actual application, the reasons need to be clearly analysed. Shared guidelines should be identified concerning the application in classroom.
- A non negligible 18% of the respondents declared that the training did not help tackle aspects of the curriculum, which deserves a deeper analysis of the relations of the content with curriculum.
- The high level of appreciation by the teachers of the use of mysteries, showmanship, engage phase, etc. could induce an overfocus on "appetizers" identified by TEMI rather than on a fully structured CPD that we intend to develop.
2. The training programs in relation to D4.1

The pilot training programs developed by partners as collected by the WP5 team are in Annex 2 of the present report. They will be further commented in D5.2 report due end of July.

<table>
<thead>
<tr>
<th>Partner</th>
<th>Structure and length of training</th>
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<tbody>
<tr>
<td>SHU</td>
<td>6 hours face to face + 1 h prep, plus 1 h follow up - total 8 h each</td>
</tr>
<tr>
<td>Weizmann</td>
<td>4 half days of 4 h</td>
</tr>
<tr>
<td>HiVe</td>
<td>Cohort 1: 2 days of 4 h each</td>
</tr>
<tr>
<td>LEI</td>
<td>2 days of 6 h and 4h15</td>
</tr>
<tr>
<td>UL</td>
<td>2 days of 5h45 each</td>
</tr>
<tr>
<td>UniVie</td>
<td>2 separate workshops of 3 h</td>
</tr>
<tr>
<td>UMIL</td>
<td>5 encounters with the teachers, of 4 h each</td>
</tr>
<tr>
<td>CUNI</td>
<td>2 consecutive days of 6 h each plus 2 days encounter for part 2 in June.</td>
</tr>
<tr>
<td>UniHB</td>
<td>Approximately 5 encounters of 3 h each.</td>
</tr>
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<table>
<thead>
<tr>
<th>Partner</th>
<th>Type of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHU</td>
<td>Biology, chemistry and physics teachers of 11 to 16 year old students</td>
</tr>
<tr>
<td>Weizmann</td>
<td>High school and junior high school science teachers from Israel who specialized in different science disciplines, e.g., biology, physics.</td>
</tr>
<tr>
<td>HiVe</td>
<td>The majority of the participants teach grades 8-10.</td>
</tr>
<tr>
<td>LEI</td>
<td>All high school teachers from The Netherlands</td>
</tr>
<tr>
<td>UL</td>
<td>4 pre-service science teachers and 5 in-service science teachers from 5 second-level schools in Ireland</td>
</tr>
<tr>
<td>UniVie</td>
<td>Chemistry teachers attending an event</td>
</tr>
<tr>
<td>UMIL</td>
<td>in-service teachers teaching in the first two years of a professional school, studying to get the qualification for secondary school teaching, not familiar with the topic of the organisers (physics)</td>
</tr>
<tr>
<td>CUNI</td>
<td>High school teachers from Prague and its surroundings.</td>
</tr>
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</table>
| UniHB     | Eight teachers with teaching experiences from about 15-40 years (age ~45-65). The group is very experienced and is participating in different curriculum development projects following the model of Participatory Action Research in science education since 1999 (Mamlok-Naaman & Elks, IJSME 2012). The group meets regularly once a
The number of meetings with a group of teachers goes from one (UniVie advertising workshops) to four (Weizmann, and probably CUNI). However, most partners have followed the 2 day structure presented by WP4 leader (SHU) at the Leiden partners meeting.

Partners UniVie and UniHB preferred to follow a different pattern, organizing 3 hours “advertisement workshop” preparing the following cohorts, waiting to have a sufficient amount and variety of materials and mysteries to be able to answer most of the teachers’ needs, whatever their level and subject. At the time of this report, CUNI has not yet conducted the second part of its workshop.

Some partners modified the order of some of the elements of the methodology. UMIL modified the structure placing theatre shows at the beginning and end, and adapted the program in order to match the needs of a specific group of teachers already engaged in a training programme. They also added 2 afternoons of discussion of what was done in the classroom (with a group of teachers in each). UL had the teachers try out in class the 5E lessons developed by pre-service teachers before the first meeting.

The partners have generally felt quite free to adapt the model. Indeed, each partner oriented the focus on a certain aspect: Weizmann with the showmanship dimension, present in 3 of the 4 sessions for example; CUNI with mysteries and 5Es; UniHB with the 5E and GRR model, UL with “the transformative power of practice”; LEI with a lecture from an astronomer about galaxies as an introduction to the mystery (although they do not intend to keep it as is since it was considered too advanced by most participants).

Nevertheless, during our interviews several partners pointed out the need for more clarity in defining to what extend the methodology of D4.1 “Training methodology and quality framework” (see section 2 “Coherence and flexibility”) should be closely followed (see for example June 3rd post from Ingo Eilks on Basecamp). In fact, this can range from a general outline of a sequence of step, down to the use of the very same power point slides presented by SHU. Although it was then clarified that a high level of flexibility is allowed, provided that this is justified and communicated to provide new inputs to the methodology, it seems that this issue deserves more discussions based on the revised methodology at Milan partners meeting and more precise decisions made about the level of flexibility.

Only 4 of the 9 partners openly mentioned in the program a time dedicated to “evaluation” or “questionnaire”. It will be reminded to the others to include it in their later programs.
3. The practical implementation of the trainings

Strategies in terms of practical implementation have had to adapt to local constraints. When changes were made between various sessions, it was towards an increased number of practical activities in the workshops (CUNI, HiVe).

3.1. Time gaps

The various time gaps between the sessions were as follows: SHU 10 weeks; UL 11 weeks; Weizmann approximately 4 weeks between each of the 4 trainings; HiVe 4 or 5 weeks. This is in general longer than what was planned in the methodology. Partners who chose a rather long gap of time are mainly planning on sticking to these time gaps (or even increasing them slightly) for the future cohorts, as they are considered adequate for the tasks set. “Based on our experience, 4 weeks is the minimum time needed between trainings in order to give teachers opportunities to implement 5E” (HiVe).

The cohorts which adopted a shorter gap of time between the two sessions were mainly organized this way for practical reasons due to local constraints.

UMIL had 1 week between workshops 1 and 2, and about a month before session to discuss the implementation in the classroom. This appears to be due to specific needs of a training program to which the UMIL team adapted their workshops. LEI had a medium time of two weeks, and report that “most teachers had enough time to implement a mystery in their class. At the same time, the break should not be too long, to keep the momentum and to not have to repeat parts of the first workshop.”

CUNI did two consecutive days on two occasions, with part of the same teachers (in the second session, about half of new teachers and half who went to the first training). There were 4 months between training sessions 1 and 2.

A brief discussion on this issue is probably useful, so that the pros and cons of different approaches are clearly set out and communicated within the consortium.

3.2. Building a community of practice

Most partners had dedicated time in their program for the teachers to present or discuss what they had done in class: SHU (10 mins per group of 2 to 3 teachers), LEI (15 minutes), CUNI (30 minutes), UL and HiVe (2.30 hours), Weizmann (approximately 3 hours), UMIL even had a specific session for it (4 hours).

Several partners pointed at the creation of a community as a critical issue. Within the training, the participant especially enjoyed exchanging with their peers. It was particularly the case for some areas where the teachers had never had an opportunity to do it, like in the cities where HiVE workshops were set. But several partners indicate to have faced difficulties when trying to bridge people who had never been in the dynamics of sharing about their practice and would probably benefit from a conversation with the trainers who had more success (UL for example), even though the solutions might need to be different from one country to the other.
Good practices

UL used Google + Community as one of the tools to keep in touch with its teachers. The feedback was good, even though one should be careful that the level of technicality won’t put off the teachers and make sure that they have a chance to try it in a safe environment (possibly dedicate a bit of time during the training to learning how to use it). “We would advise other partners to give clear instructions on the teachers' expectations of involvement in the forum (upload own lessons, comment on other teachers' lessons etc)” (UL). “Using Google + forum I can get help from other members of community” (a teacher who participated to the UL pilot training). To learn more about this, we suggest partners to read the UL Workshop 1.2 report, section 1.4.1 “Virtual community of practice”. On the same line, HiVe tried using a shared Dropbox folder, but with less success: the participants didn’t make it their own, and expressed discomfort with the idea of sharing all their on-going work and encountered technical difficulties.

A second element revolves around the role given to the teachers in the training itself. Indeed, pre-service teachers, who had developed TEMI lessons before the first workshop, were invited by UL to speak of their experience in workshop 1 to in service teachers. The result was both empowerment on the side of the pre-service teachers and satisfaction from the teachers to be able to talk with peers, tackling real life problematic. UL also made a point of involving the teachers in the planning and presentation of their second workshop and next cohorts. CUNI also used the teachers from their first workshops to train new participants and based the program of the next encounters on the opinion of the fist participants.

Relying on strongly committed teachers at first can definitely help to reach a wide community and give more visibility. UL relied on the extra motivated pre-service teachers, but there are other types of people. CUNI and HiVe for example reached to participants (teachers and experts) to the existing IBSE projects at national and UE level (SUN, Veda není žádná veda; FP7 ESTABLISH, S-TEAM and Mind the Gap). Post doctorates can play a role too (Weizmann).

Countries in which it was possible for trainers to go visit the teachers in their classrooms or to have trainers or co-trainers who are themselves teachers seem to have greatly improved the sense of community.

According to UL, “the overall aim of UL’s TEMI workshops is to transfer ownership of the TEMI idea to the participating teachers [...]”. This type of approach probably helped building a sense of community among the involved teachers.

If building a community starts before the training, it continues evolving between and after the workshops. In this sense, tasks assigned in between workshops play a role. They went from very little (SHU: “one thing to practice or disseminate the innovations”), up to several tasks (UL – Implementation of at least 5 of the TEMI Lesson ideas, and Development of at least 2 new, uploading them and participating to discussion on Google Forum, completion and return of the TEMI Teacher Diary, Teacher Questionnaire and Pupil questionnaire – these tasks were pointed at by the teachers as heavy but enjoyable: “Too much work required re lesson planning, teacher diary, writing up lessons, uploading etc. But not a criticism – Learned a lot from it.”). Other tasks included: story telling of what was done in class, preparation and design of a brief show using mysteries, creating a video clip about your work, thinking about your own mystery lesson, implementing one example of 5E and mysteries in your practice.

In this respect, we recommend that we set a clearer standard, even though leaving flexibility in its implementation.

As far as the « after workshops » phase is concerned, not all partners mentioned they have kept in touch with the teachers. This is also an element that needs to be clarified for the TEMI second cohort, in order to commit all partners to a comparable level of teacher engagement in the long term.
3.3. Recruitment

A potential risk of the TEMI cohorts is the tendency to only reach existing communities to avoid the difficulties of having to create one. Still, in some cases, recruitment of new people went well, and happened through a magazine article, for example. More generally, recruitment was not a major issue for all partners (UL, Weizmann), but for some it was a subject of disappointment (LEI, SHU), because the numbers of teachers who subscribed dropped significantly before and/or in between workshops, leaving the TEMI message incomplete. We advise the commitment to participate to both workshops to be strengthened. This could take the format, as it was done by some partners, of a signed document. It was mentioned also that the teachers could be asked to find a colleague to replace them if they can’t come. More generally, better communication with teachers before the training might help and should be improved, since more than half of the participants considered the information they received was “just sufficient” rather than “complete”. The recruitment of future cohorts might benefit from the fact that most teachers who answered the question reported that they recommended the TEMI materials to their colleagues (74%).
4. The learning outcomes: reaching the desired objectives

The perception of the teacher with respect of what they gained from the trainings has been outlined in the introduction above, and will be further explored in chapter 5. We concentrate here on the identification of TEMI main objectives: their definition, the view of the partners in terms of their achievement, and a comparison with the outcomes pointed out by the teachers.

At the Leiden partners meeting, we focused on gathering the key objectives of the partners in the TEMI trainings. A questionnaire was then sent by WP5 to collect the level of importance given by partners to each objective on one hand, and the level of achievement of these objectives that they felt they reached. The outcomes of these two types of questions (presented in Annex 6), as well as the correlated feedback from teachers, inform us on whether we have indeed reached our collective goals or not.

The colorful table below shows that when asked to prioritize the different objectives, partners do not make the same choices. This is not necessarily a negative aspect, but it is essential that careful communication occurs within the consortium on the priority of objectives.

<table>
<thead>
<tr>
<th>CUNI</th>
<th>UniVie</th>
<th>HiVe</th>
<th>LEI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher motivation to engage</td>
<td>Desire to change one’s practices</td>
<td>Learn approach of mystery based IBSE 1/2</td>
<td>Applicable tools, materials and methods</td>
</tr>
<tr>
<td>Understand the approach of mystery based IBSE</td>
<td>Inclusion in CPD, ownership of personal development</td>
<td>Understand the approach of mystery based IBSE 1/2</td>
<td>Learn approach of mystery based IBSE (raise teachers one level)</td>
</tr>
<tr>
<td>Learn approach of mystery based IBSE (raise teachers one level)</td>
<td>Self efficacy, equipment for change</td>
<td>Higher motivation to engage</td>
<td>Understand the approach of mystery based IBSE</td>
</tr>
<tr>
<td>Applicable tools, materials and methods</td>
<td>Applicable tools, materials and methods</td>
<td>Turning teachers into ambassadors (cascading)</td>
<td>Turning teachers into ambassadors (cascading)</td>
</tr>
<tr>
<td>Interdisciplinary teaching, learning to deal with hot science</td>
<td>Understand the approach of mystery based IBSE</td>
<td>Inclusion in CPD, ownership of personal development</td>
<td>Interdisciplinary teaching, learning to deal with hot science</td>
</tr>
<tr>
<td>Inclusion in CPD, ownership of personal development</td>
<td>Learn approach of mystery based IBSE (raise teachers one level)</td>
<td>Desire to change one’s practices</td>
<td>Desire to change one’s practices</td>
</tr>
<tr>
<td>Desire to change one’s practices</td>
<td>Higher motivation to engage</td>
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<tr>
<td>Turning teachers into ambassadors (cascading)</td>
<td>Turning teachers into ambassadors (cascading)</td>
<td>Interdisciplinary teaching, learning to deal with hot science</td>
<td>Inclusion in CPD, ownership of personal development</td>
</tr>
</tbody>
</table>
4.1.1. Three main objectives

Three objectives were voted most highly by the partners: “Understanding the approach of mystery based IBSE”; “Providing enquiry skills – 5E’s”; “Providing applicable tools, materials and methods”. According to the analysis conducted after the first cohort, partners feel they have been successful in achieving these 3 top objectives. By looking at Figure 6 we can see that also the corresponding teachers’ opinions about what they gained from the training show that these main objectives were rather well reached. However, some comments appear necessary.

- “Understanding the approach of mystery based IBSE”: the confidence of teachers have expressed in applying mysteries (66% rated it with the two positive rates) conveys the message that this objective was rather well reached. Half the respondents said that they gained from the training “a better understanding of IBSE”: it would appear less important for teachers than for partners (it shows in 4th position out of 6 criteria) if not for the fact that they also feel they gained “a new approach to teaching”, which comes in second position, with 55% of the teachers voting for it.

- “Providing enquiry skills – 5E’s”: this objective seems only partly achieved if we look at Figure 7, showing the level of confidence of teachers in applying 5E’s (67% rated it with the two positive rates) However, as pointed out in section 5.3.2. about the 5Es innovation, this rate varies significantly among different countries.

- “Providing applicable tools, materials and methods”: four answers from teachers can give us information on their perception of this goal. 63% of them thought the training gave them “new tools for their teaching” and 52% “useful practical examples”. A majority of the respondents reported applying the approach and techniques (77%), but with 29 people ignoring the question. 38 % reported being “happy with the resources and lesson plans they were taking home with them”. So this last aspect leaves room for improvement. The answers to the “satisfaction questionnaire” (Doc 3) also show that the “applicability” criteria, even though it has good rates, is the lower compared to the other three criteria (see Figure 3).

4.1.2. Four other important objectives

Four objectives come right after the 3 main objectives listed above.

Two of them seem to cause no trouble:

- “Increasing motivation”: The motivation element is central in the teachers’ feedback, indeed they massively reported
  - For themselves: “wanting to try this out in class (82%), and gaining “a motivation to renew their teaching” (65%), these criteria are rated first in each case.
  - For their students: “being able to improve the enthusiasm of their students” (50%, ranked third out of ten criteria in the choices of the teachers)

- “Learn approach of mystery based IBSE (raise teachers one level)”: This objective is very close to the main objective “Understanding the approach of mystery based IBSE”, but differs in the sense that it doesn’t expect the teachers to get a deep understanding of the approach, just to make some progress from the level they came in with.

The other two objectives show a significant difference between the intent of partners and their feeling of achievement of these goals (more than 2 points of difference between the two aspects).

- “Promoting teachers professionalism (professional development)”
- “Facilitation of the implementation of TEMI’s rationale in the classroom”

If these two are still considered important priorities for next cohort, some more effort should be put in achieving them.
4.1.3. Other objectives

Among the other objectives, we can for example highlight “providing showmanship skills”. We can observe that it is not considered as such an important priority by partners (the rate is below average) and even less as an objective achieved (the rates for “achievement” are close to zero for “achieved” and “very well achieved”). This goes in the same direction as what we will observe later on the showmanship innovation: if we want more achievement in the area of showmanship, one of the keys seems to be to make it more of a shared focus. It should be noticed too that while mysteries, 5E’s and showmanship are listed in the objectives of partners, GRR is not.

Partners also point out the difficulty they found in promoting a reflexive process in the teachers.

4.1.4. Specificity of partners objectives

Specific partners have put a stress on learning objectives for the teachers, defining a more precise list of their own. For example, after the training, HiVe proposed a revision of the objectives as follows: Understand and be able to use inquiry-based teaching. Be able to match national curriculum with the TEMI-approach. Link theory and practice - make teachers are able to use TEMI method in their own teaching. Build teacher networks and facilitate exchange of best practices between schools. Make teachers see the benefits and opportunites of CPD. Sustain exposure to IBSE over a significant period of time.

For next cohort, a request to all partners to refine their own learning objectives prior to the workshops will be made, and we will investigate more closely which of those appear to be met. Below are examples of the revised learning outcomes wished for by UniVie and of observed learning outcomes by UL. The teachers are also asking TEMI to go in this direction, one of them openly requesting “To improve clarity of objectives to reach in each single phase”.

<table>
<thead>
<tr>
<th>Revised learning outcomes - UniVie</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 0</strong></td>
</tr>
<tr>
<td>To be acquainted with devices (pH meter, thermometer, …)</td>
</tr>
<tr>
<td>To conduct certain practices (to titrate, to filtrate…)</td>
</tr>
<tr>
<td>To follow safety guidelines</td>
</tr>
<tr>
<td>To follow descriptions of experiments, etc.</td>
</tr>
<tr>
<td><strong>Additionally on Level 1</strong></td>
</tr>
<tr>
<td>To observe</td>
</tr>
<tr>
<td>To document observations and interpret them in the team</td>
</tr>
<tr>
<td>Apply knowledge to come to conclusions and judgements</td>
</tr>
<tr>
<td>To justify conclusions with evidence-based arguments</td>
</tr>
<tr>
<td>To present and discuss results, etc.</td>
</tr>
<tr>
<td><strong>Additionally on Level 2</strong></td>
</tr>
<tr>
<td>To hypothesise</td>
</tr>
<tr>
<td>To plan and conduct experiments</td>
</tr>
<tr>
<td>To consider influencing factors, e.g., to decide about quantities, devices etc. and justify decisions</td>
</tr>
<tr>
<td>To control variables</td>
</tr>
<tr>
<td>To justify the experimental design</td>
</tr>
<tr>
<td>To match results with hypotheses</td>
</tr>
<tr>
<td>To change the experimental design reasonably, etc.</td>
</tr>
<tr>
<td><strong>Additionally on Level 3</strong></td>
</tr>
<tr>
<td>To ask scientific questions</td>
</tr>
<tr>
<td>To take responsibility for the whole investigation process, etc.</td>
</tr>
</tbody>
</table>

Feeling of Autonomy, Relatedness and Competence
### Excerpt of UL report

“The teachers

- became familiar with the 5E model of enquiry,
- evaluated the newly developed curriculum materials,
- learned how to use mysteries to engage students in structuring their ideas,
- developed their role as an expert in working scientifically (not as a dispenser of knowledge),
- practised generating their own TEMI-style lessons in a collaborative exercise,
- reflected with peers, scientific researchers and curriculum developers.”
5. The training methodology

5.1. IBSE

A study about IBSE in each partner country was produced at an early stage of TEMI (D2.2 “Local culture and IBSE strengths and challenges & bibliography mapping complete”).

Some partners conducted extra studies about inquiry practice (SHU, HiVe) and offered a conference on the topic in addition to the training (HiVe). UMIL and Weizmann also conducted wider pre-workshops questionnaires to know their audience better and evaluate their level.

Indeed, the partners faced a great variety of levels in the previous knowledge of IBSE (for HiVe and Weizmann good, for others lower) as shown in Figure 2 (see p. 2). On this aspect, UMIL expressed a concern about whether the TEMI training in their current form were adapted to teachers who are clueless about both their discipline and IBSE. It could be considered to have two different versions of the methodology, one for each level of teachers.

Some teachers pointed out that their current practice is not the “blackboard” way of teaching, and they did not appreciate when TEMI was presented as a new model opposed to a somehow old or inefficient model currently used. In future cohorts, trainers should therefore be careful not to make too much of a caricature, and assumptions about how new the TEMI approach is if they do not know well the background of the teachers they address.

5.2. The lesson design task

All partners included an activity in which teachers had to design a lesson. Also, they were attentive that a balance was kept between bringing ready-made examples, and helping the teachers develop their own examples. The lesson design task was done in groups of two or more in all countries.
5.3. The 4 innovations

The balance between the uses of the 4 innovations (Mystery, 5E, GRR and Showmanship) is a real issue for the time being. In fact, not all partners felt equally comfortable with all the 4 innovations, mostly in terms of their implementation, but also in terms of methodology. The responses of teachers to a question asking if they feel confident to apply the different innovation in the classroom are shown in Figure 7, offering a quantitative overview of this issue.

Average results throughout the TEMI partners show that most of the teachers are confident with IBSE and with showmanship (although individual reaction to this innovation are quite divergent, as detailed below), while Apprenticeship/GRR is the innovation that presents more difficulties.

As expected, the results show some degree of variability among partners. Full data are accessible from the Surveymonkey website (Doc 4: https://fr.surveymonkey.net/results/SM-Z8DC2ZT8/, Doc3: https://fr.surveymonkey.net/results/SM-O3LBX7M8/). It could be mentioned that at Weizmann 40% of the teachers do not feel confident on applying the 5E cycle, in a counter-tendency with the general data showing 5Es as highly applicable. For UMIL, a significantly lower than average level of confidence is shown on all innovations, with the exception of showmanship.

Some explanation of the general trend might come from two aspects:

- at the Leiden partners meeting, the two last innovations were tried less in depth by partners, and the development of these aspects were less advanced at the time. Indeed, the « showmanship » element replaced the « differentiated enquiry » innovation shortly after the Leiden meeting, in the December version of the methodology;
- with the exception of few very specialized partners, the trainers themselves are less accustomed in their usual training to the two last innovations.

In this respect, the existing knowledge of some partners (e.g., UMIL & Weizmann in terms of showmanship) should be better transferred to other partners. It seems necessary that there will be more discussion and training on GRR & showmanship at Milan partners meeting, and planning of extra “training of the trainers” session including the recent improvements should be considered.

The possibility of merging mysteries and showmanship, which are linked, was also mentioned: whatever the final decision, some discussion should happen to make it sure an important part of the approach (“how are the mysteries presented”) is kept by all in the trainings.

On the part of the teachers, most of them didn’t hear about the 4 innovations. For those who did, it was particularly important to bring these innovations together at the same time and give them coherence.

5.3.1. Productive mysteries to create curiosity

This innovation was well understood by all partners and used as a main feature in all trainings conducted. All trainings included the demonstration of at least a mystery.

Several partners openly stuck to SHU’s students’ questions first then traditional science content motto, with what they called a “first practice, then reflection” (UMIL) or a “teaching in context” (Weizmann) approach. UMIL for example modified its first way of presenting the mysteries to leave the teachers some time to explore individually the mystery.

**Good practices**

To create curiosity with mysteries, UniVie had several mysteries at a time at the disposal of the teachers on tables, a good way for them to go toward the mysteries, explore on their own, move around the room, start talking to each other, etc.

HiVe made sure they explained also what a mystery is not.

Teachers from the HiVe training workshops came up with an alternative way of framing a mystery: they started class by handing out 25 g of potato chips to each student. During that time they challenged the student to deduce what was going on. The task turned out to be: “What kind of physical exercise is necessary to metabolize the chips?” The teachers reported that students responded positively, and that they eagerly pursued the following inquiry.

5.3.2. 5Es

The 5Es were presented by all partners, with practical example, and sometimes an extra theoretical layer of a research paper (HiVe and LEI). When a research paper is used, it is advised to use a rather recent one if possible, so that it is not considered outdated by teachers. Another good practice consists in inviting the authors of the paper to participate to the training and discuss it themselves.

All partners seem to put most of the emphasis on the “Engage” part. This might somehow disrupt the balance among the importance of the other Es. In particular, it appears that teachers have a lot of concerns about the evaluation of the students (even though HiVe put a stronger focus on evaluation, which was not done by other partners, 3 of their teachers commented on the “what worked less well” mentioning “evaluation” or “formative assessment”). This aspect might need to be addressed in the methodology, providing specific guidelines on how to manage evaluation in the 5E cycle. The fact that the “Engage” part should come back at various stages of lessons and not only at the beginning might also need to be stressed more.
5.3.3. GRR

The apprenticeship/GRR element is one of the innovations that were less easily included by the trainings partners, for whom it remains mainly theoretical. In fact, it is explicitly present in only 4 of the 9 partners programs for the workshops.

This consideration is also reflected in the feedback of the teachers: it is the innovation that the teachers feel less confident to apply in their class, as shown in Figure 7.

A particularly evident sign that the teachers have not fully digested the theory of some of the innovations is that they don’t mention in their answers either the word “GRR” nor “apprenticeship”, “guidance”, “modelling”, “guided instruction” or “skills”. Nonetheless, some signs of success emerge, for example, from the report of HiVe “In the second cohort there was an increased focus on GRR during the presentations. Two schools had produced teaching materials on nutrition, and by comparing these two cases, GRR was nicely exemplified” showing that when GRR is put forward more, it seems to be reflected in the result.

Several partners think GRR is a good idea in principle, but it needs more time to be implemented. It seems to be especially difficult to use with the teachers who are not already familiar with IBSE. This element is supported by the fact that trainings which happen with more experienced cohorts of teachers did manage to implement it a bit more.

One of the knots of difficulty that was pointed out is that GRR relies on the dialogue between a teacher and his students, that is difficult to explain in abstract terms and would be better understood by showing it. The trainers expressed a “need to have more examples or more of an idea of how they can use/teach the GRR model in the workshops, e.g. use of probing questions, prompts (e.g. “what would happen if...”), GRR structured aids (the idea of an identification key or concept maps), creating teacher-student dialogue (for example: giving teachers the tools to be able to encourage students to provide answers in full sentences as opposed to just words, to get their students to justify and explain their investigative approaches and ideas)”. Extra effort should then be made to further explain & give practical tools to better implement this element.

Two of the partners adapted the model according to their previous experience.

In a first approach, UniVie replaced the GRR model with another approach for the gradual release and successful development of competencies, an inquiry-cycle with competences for inquiry and levels of inquiry (see Blanchard et al 2010 or Abrahams et al 2008 or Schwab 1967), since they were more familiar with that approach and could better explain differentiation strategies and developmental aspects.

In a second approach, HiVe focused on the different levels of inquiry, that were discussed, and it was pointed out that student responsibility and independence increases for each level. Changes were made between cohort 1 and 2 to allow teachers to better get a hold of this aspect, mainly through an attention to the identification of the learning outcomes attached to each level of inquiry. An effort was also made for it to be included both in the creation of own mystery lesson & presentation of what the teachers did in class. A couple of mysteries were used which exemplified GRR.
Good practice

HiVe relied on metaphors to help the teachers visualize this aspect, speaking about “apprenticeship-ladder”.

In Norway, the teachers are generally very good at explaining what students can do in science classes, but explaining why students should do a given activity is often neglected: it could be a question to embed in the guidelines suggested for future cohorts.

LEI explained the relevance of GRR by “pointing out the fact that students need a framework to actually be able to participate in inquiry based learning”, and its link to research. They also had the teachers fill in a sheet with the GRR model when designing their lesson.

It appears that more exchanges are needed among partners to come to a clearer and shared view on the role of the GRR innovation in the TEMI training. It was suggested that this could be the focus of the next training partners videoconference organized by Weizmann as WP5 leader. SHU mentioned they had already developed GRR towards a system for integrating skills development into the curriculum: these adjustments should be presented in more details in D4.2. As far as materials are concerned, UniHB worked with his group of teachers on two versions of the material, one to implement structured inquiry, one to implement guided inquiry.

The posture of the teacher

GRR seems to be an especially good tool to keep in mind in terms of meta approach, for the training of the trainers and teachers: it was used by some of the partners as a way to accompany the teachers (following the sequence “I do it, we do it, they do it”). Both UL and Weizmann proceeded this way.

Another example of the methods taught in TEMI trainings that was used for the training is what UMIL did with the 5Es: first the teachers experienced it and then it was presented theoretically only on the second day of workshop. Or else from CUNI: “the participants unveiled the principle by themselves and designed their own experiments to test their hypothesis”.

5.3.4. Showmanship

Partners’ realizations and opinions are very split on this:

- about the needs and desires of teachers: some said that the teachers were really motivated for this part (“The teachers were very positive about the idea to learn about showmanship, however, also mentioned to have nearly no experience in this domain”, “best part and most challenging how to develop showmanship”), others thought that “the teachers would not appreciate time being spent on this. It is not as practical to them in their everyday teaching as, say, the mysteries”. One comment on the teachers’ evaluation form was that the course was “applicable to the real life and work of the teacher”. [They] are aware that there is a certain level of showmanship needed to present a mystery but the teachers naturally picked up on this.”

- about the facility to implement it in the trainings: according to their level of experience on the matter, some partners are very confident to train to it, and some not at all (“It wasn’t clear to us and we did not have enough time”). As a result, some partners didn’t implement it at all, except in their own presentation of the mysteries, some focused only on some aspects linking teaching with showmanship, like stressing the use of the voice and body language, the space of the classroom and having the teachers enact characters, while others based their entire training on this dimension (even though keeping some of the other elements).
This item was discussed in WP5 videoconference in June. It will and needs to be the focus of the Milan partners meeting in November:

- because it is considered by many (partners & teachers) as the most innovative feature of the TEMI trainings
- because teachers seem curious about this aspect
- because UMIL, hosting, is an expert in this area
- because it is needed for the consolidation of a common vision of what is a TEMI training (should the showmanship element be an import component or a minor one, should it be left to the partners to decide?)

The levels of partners with this aspect are very different: as pointed out during the Paris meeting, the most experienced partners should pass on a bit of their knowledge and confidence to the others. It could be through a session they would lead together at Milan partners meeting, we suggest UMIL or Weizmann take the lead on this. The idea of having a thread on Basecamp to gather literature and exchange on our experiences on the topic could also be revived.

Good practices

In each training workshop, the teachers were offered a chance to practice their showmanship skills. In SHU’s workshops, the showman stayed to help the teachers build their lesson, in some training workshops, the expert just stayed for a presentation and not the other stages of the training. In UMIL, the stage director even helped to design the workshops.

The Weizmann team states: “It is important that the participants should experience a lesson in which a "fictive contract" or a "contract for fiction" is agreed upon. This contract establishes the rules which form a safe and embracing environment and which allow learning through fiction and showmanship to take place. [The expert] Amitai Milo [...] provided two models for effective storytelling. The body is an effective storyteller, and the neutral mask can be used as a tool to understand and learn the use and mastery of body language.

The combination of an artist and a theoretician seems to work pretty well. In this regard, LEI was very happy with the input of his illusionist-philosopher. “We hired an illusionist/philosopher to explain the theory behind magic, i.e. how to perform a trick or the engage phase of a mystery. This is theory about how to create suspense, how to create credibility, how to make sure the audience has all the required knowledge to be amazed (i.e. have a cognitive dissonance in their head), how to create a competition (i.e. performer against imaginary bad guy, public against public, etc.), how to keep the attention focused.” It is felt that these types of expertise should be formalized and shared within the TEMI partnership.

Weizmann’s workshops included TEMI activities in which the teachers acted as students.

The number of times that the teachers meet can also play a role in the confidence that they feel to try their acting skills in the workshops: the more they meet, the more they will feel at ease in taking risks in front of the group. Self-confidence is indeed a low in the outcomes of the trainings, since only 5% of the respondents mentioned it was something they gained from it (see figure 5).

Yet, not all teachers are expected to have become extra self-confident when coming out of the workshops, just as it is not expected of all trainers to train showmanship by themselves. Indeed, it is reminded that, according to the methodology, showmanship can either be a skill of the teacher or he can use an external device or expert: more examples and tools for people favouring this approach that does not rely on the teacher himself should be provided and shared within the consortium. One can mention, for example, the way UMIL teachers had the students design movies with Playmobil toys. This type of example gets rid of one of issues that were raised linked to having an external expert come over, which is budget to have this person come more than once. Nevertheless, a variety of experts can be invited to the training or the classroom. This time for SHU it was a magician, for Weizmann an improvisation theatre and actors’ trainer, for HiVe a communication expert, for LEI an illusionist-philosopher. Not all experts require to be paid: science communication experts in training could be thought of more often for example.
CUNI provided a good example of doing part of a training workshop on showmanship while not being experts of the matter themselves: “This innovation was used in the activity called “Space probe”. The lecturer was in the role of an authority ordering a space mission to safely put a probe on Mars. The participants had an egg (the probe), a plastic bag, two sheets of paper and a piece of thread. The landing on Mars was symbolized by dropping the egg from three meters. The participants tried to solve the task by themselves and they also suggested possible ways of presenting this method. The lecturer pointed out the inquiry aspects and also the possibility of developing social relationships in the group. The participants applied their knowledge from real life – the principle of a parachute, air pillow, etc.”

An interesting point emerged from Weizmann’s group of teachers: one of the teachers reported that the students were disappointed when they found out the story that was told to them was made up: fiction should then be used with caution.

5.4. Application in the classroom: what worked best? What worked less well?

The teacher questionnaire included two open questions through which teacher could identify the main element of success and failure in the application of the methodology in class. The answers allow highlighting how the “engage” aspect of the methodology was often pointed out as the stronger element: in fact, about 2/3 of the teachers pointed out as the “best” elements the presentation and discussion of “the mystery”, the “engage phase”, “the story”. Showmanship also appears in a few answers, while an encouraging high number of “everything” would surely please the organisers...

Only 14 out of 75 teachers indicated what worked less well. This is encouraging on one side, but makes the task of indicating possible improvements harder. In fact, teachers who responded indicated a quite wide range of issues (from an experiment that did not work to the available time...). The only issue recurring 4 times is “evaluation and assessment”, possibly indicating (but with little statistical significance) that special attention should be given to this aspect in the next cohort.

5.5. Link with local curriculum & other teacher constraints

The link with local curriculum is considered to be rather good by most teachers, yet it is considered as a weakness for a non-negligible 18% of the teachers. It could be a matter of making it more clearly perceptible by teachers. When not already done, perhaps a more systematic study of the potential & effective links of the TEMI workshops in the curriculum of each country should be conducted.
UniHB conducted specific workshops in which the teachers were asked to give some ideas and choose among the mysteries presented the ones that are best linked in their opinion with the national curriculum. The objective was also to capture what were the hot topics in the teachers class, and therefore make sure the trainings are trendy and in tune with teachers preoccupations. “Teachers raised the point of how to connect the – often uncommon and exotic – content to the syllabus and curriculum.”

HiVe also pushed the teachers to find the links by themselves: “The teachers were given advice throughout the process of designing their lesson (e.g. we challenged teachers to be explicit about the link to the curriculum [...]).” HiVe also mentions the help they got in this process of linking what TEMI does with the local context: “First day of second cohort we were fortunate to be visited by an additional expert from the Directorate: Reidunn Aarre Mathiessen gave a short talk linking the national effort on evaluation to the 5E cycle”.

They also used local context material on IBSE and the 5Es, working with the teachers on a paper on 5E’s written by Norwegian authors (Fiskum & Korsager).

The Weizmann team used the 5E Evaluation phase to create a link with the curriculum. The teachers had to think of a way to evaluate the activity that was aligned with the Israeli curriculum.

In other groups, teachers sometimes pointed out that TEMI was more or less suitable for specific groups of students (less for groups preparing for an exam, more for students who usually have lower grades or who are studying a certain subject...).
6. The mysteries and the training materials

SHU provided tools for the trainings: some of them were used as is, and the partners also developed their own local tools (see table in Annex 4).

The mysteries that the partners mentioned using as examples in the trainings are listed in the table of Annex 5.

For the teachers, it is pretty clear what a good mystery is. The graph below (Figure 10) shows that its first quality should be to make students ask questions, and then to dazzle students. Other criteria are less relevant, but it should be noted that they respond better to short mysteries rather than ones that span over several lessons and to mysteries that are subject specific rather than interdisciplinary.

**Figure 10: Final teacher questionnaire. Percentages of agreement given by teachers to a selection of mystery characteristics for what makes a good mystery for the classroom**

It seems that experiments directly performed in the room were the most used and presented type of mysteries in the trainings, compared to videos, stories, letters, etc. Some partners even put a stress on the lab experiments as opposed to the ones done with everyday life material (UMIL and UL for example took
teachers into the labs for the mysteries phase): the balance should be watched to keep a diversity of tools so that the teachers that are less comfortable with one can go with another. Finally, as pointed out by Ingo at Leiden partners meeting, teachers’ answers to the question about what could be improved show that they are indeed craving for more materials, mysteries and examples, as well as for several relating to the specific discipline or grade they teach.
7. The minimum thresholds and quantitative indicators

The minimum thresholds announced in the DOW and those agreed upon by the consortium are not particularly high neither binding. Without giving too many constraints to partners, some more minimum thresholds could be set to ensure equal weight of partners in the project and general improvement of the TEMI brand.

The DOW indicates that each country should reach 10 to 15 teachers during the first year, adding up to 90 to 135 teachers. Some partners are a bit below, but others did more so in the end more teachers than planned were reached at European level. The detailed figures are presented below:

<table>
<thead>
<tr>
<th>Partner</th>
<th>Number of participants as to end of April 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHU</td>
<td>20 (18 more since)</td>
</tr>
<tr>
<td>Weizmann</td>
<td>18</td>
</tr>
<tr>
<td>HiVe</td>
<td>26</td>
</tr>
<tr>
<td>LEI</td>
<td>23</td>
</tr>
<tr>
<td>UL</td>
<td>8</td>
</tr>
<tr>
<td>UniVie</td>
<td>40</td>
</tr>
<tr>
<td>UMIN</td>
<td>15</td>
</tr>
<tr>
<td>CUNI</td>
<td>15</td>
</tr>
<tr>
<td>UniHB</td>
<td>8</td>
</tr>
<tr>
<td>TOTAL</td>
<td>173 (191)</td>
</tr>
</tbody>
</table>

The number of visits on the website gives useful pieces of information in the verification of the number of people reached beyond direct training. The analysis tool started recording activity of the website in the second half of May 2014: since this period, 311 individual persons have visited the website, 208 of them being new visitors. It was mainly read in English, the second most used language being German, which is no surprised since 2 of the partners delivering training workshops work in this tongue. As shown in figure 11 below, the most visited pages are “about”, “activities” and “Mystery of the Month”.

Figure 11: most visited pages of the TEMI website
D2.3 on Local recruitment strategy states that “each directly trained teacher should train by her/himself two further colleagues from the same school to adopt TEMI inquiries techniques and to participate in the learning community”. Since cohort 2 has not happened yet, it is not possible to tell if it did happen. In the next annual evaluation report, we will have a look at how many teachers said they got the information about the training from one of their colleagues.

During the Leiden partners meeting, it was also agreed that each teacher should do at least one lesson using the 5E model and develop at least one mystery based lesson of its own. Even though a majority of teachers answered that they did implement what they learned in the training (77%, see figure 4), a large part skipped the question: if we add up people who ignored it with people answering no (not considering those that only had the first part of the training), we come up with 42% of the participants not applying what they learned. Coupled with the lower “applicability” rate underlined as a result of the satisfaction questionnaire (see figure 3), this can be a subject of concern. To avoid this pitfall, it is probably needed to devote efforts on committing the participants to do at least one lesson, on reinforcing moments of exchange with teachers in and outside the workshops, especially keeping in touch with them after the workshops.
8. Annexes

Annex 1 - Material analyzed to create this report
Annex 2 – Programmes of the workshops
Annex 3 – Answers to questions to organizers (Doc 5 from the toolkit)
Annex 4 – Material used by partners in the trainings
Annex 5 – Mysteries used by partners in the trainings
Annex 6 – Excerpt of WPS questionnaire answers – objectives of the TEMI teacher training program (A) & achievement (B)
8.1. Annex 1 - Material analysed to create this report

- Previous reports (D.2.2 and 2.3, Reactions to testing of the template training at Leiden partners meeting (Summary of Partner feedback on the workshop simulation - excerpt from D4.1)
- Training programmes
- Answers to WP5 questionnaire and ranking of objectives by the partners
- Semi-directed interviews with partners UL (twice), Weizmann, HiVe, UMIL, LEI
- Semi-directed interview with a group of teachers from UMIL
- Answers to Doc 5 ("Questions to partners"): UL, Weizmann, HiVe, UMIL, LEI, SHU, CUNI, UniVie
- Reports on trainings: UL, Weizmann, HiVe, UMIL, LEI, UniVie, UniHB, CUNI (report from SHU to come after second day of training?)
- Answers to Doc 3 (« satisfaction questionnaire »): SHU, HiVe, UniVie, UMIL, CUNI, LEI
- Answers to teachers’ final questionnaires of: HiVe, UMIL, Weizmann, LEI (Doc 4.2) and SHU (Doc 4.1).
- Additional documents: UL own evaluation questionnaires, HiVe & UMIL own teacher questionnaire about IBSE, UL & HiVe commitment of participation docs, UL teacher diary, Google teachers-trainers chat exchanges and handouts, UniVie learning goals.
8.2. Annex 2 – Programmes of the workshops
8.3. Annex 3 – Answers to questions to organisers
8.4. Annex 4 – Material used by partners in the trainings

<table>
<thead>
<tr>
<th>Partner</th>
<th>Material used</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHU</td>
<td>Lesson plan, curriculum materials, 5E cycle sheet, mystery evaluation sheet</td>
</tr>
<tr>
<td>HiVe</td>
<td>5E poster, article on 5E by Fiskum &amp; Korsager, activity sheet</td>
</tr>
<tr>
<td>LEI</td>
<td>Lifeline/GRR sheet was taken home by teachers and filled in twice, once in each session, article “Beyond the Scientific Method: Model Based Inquiry as a New Paradigm of Preference for School Science Investigations”, excerpt of article “Advances in Research on Instruction”.</td>
</tr>
<tr>
<td>UL</td>
<td>Lesson planner, TEMI lesson template, literature about IBSE and 5E</td>
</tr>
<tr>
<td>Weizmann</td>
<td></td>
</tr>
<tr>
<td>UniVie</td>
<td>Worksheets and material</td>
</tr>
<tr>
<td>UMIL</td>
<td>Worksheets and material</td>
</tr>
<tr>
<td>CUNI</td>
<td></td>
</tr>
<tr>
<td>UniHB</td>
<td></td>
</tr>
</tbody>
</table>

8.5. Annex 5 – Mysteries used by the partners in the trainings

<table>
<thead>
<tr>
<th>Partner</th>
<th>Name of the mystery</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHU</td>
<td>&quot;Don’t open the bottle&quot; and 4 other mysteries</td>
</tr>
<tr>
<td>Weizmann</td>
<td>&quot;Sea sand overseas&quot;, “The disappearing ink&quot;</td>
</tr>
<tr>
<td>HiVe</td>
<td>Ghost story by Erduran &amp; Pabuccu (2012),</td>
</tr>
<tr>
<td>LEI</td>
<td>The water bottle, the candle/CO2 trick, a mystery about galaxies, several short examples of other mysteries</td>
</tr>
<tr>
<td>UL</td>
<td>Developed by teachers: “The Leaking Bag!”, “Burly Bubbled”, “Boyle-ing Point”</td>
</tr>
<tr>
<td>UniVie</td>
<td>&quot;Genie in a bottle&quot;, “Gelli Baff”, “liquid or solid”, “Never wet”</td>
</tr>
<tr>
<td>UMIL</td>
<td>&quot;The swinging spring&quot;, &quot;What kind of motion is this”</td>
</tr>
<tr>
<td>CUNI</td>
<td>&quot;Burning hands&quot;, &quot;Glasses&quot;, &quot;Floating cans&quot;, &quot;Floating egg&quot;, “Matter, are you alive?”, “The voltage rank of metals”, “Space probe”</td>
</tr>
</tbody>
</table>
8.6. Annex 6: Excerpt of WP5 questionnaire answers – objectives of the TEMI teacher training program (A) & achievement (B)

6A Following is a list of objectives which were suggested by the partners. Please rate each objective from 1-5 (1-not very important 5-very important)

The numbers which appear in each cell describe the number of partners who have chosen this option

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understanding the approach of mystery based IBSE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>2. Desire to improve one’s practices among teachers</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>3. Promoting teachers professionalism (professional development)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4. Facilitating the implementation of TEMI's rationale in the classroom</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>5. Increasing motivation</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6. Increasing self-efficacy</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>7. Providing pedagogical content knowledge (PCK) in general</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>8. Providing Showmanship skills</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>9. Providing story telling skills</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Providing Inquiry skills - 5E's</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>11. Providing applicable tools, materials and methods</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>12. Turning teachers into ambassadors (cascading effect)</td>
<td>2</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>13. Developing a sense of ownership towards TEMI project</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>14. Dealing with Interdisciplinary teaching</td>
<td>1</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>15. promoting a reflexive process</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>16. Learn approach of mystery based IBSE (raise teachers one level)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>17. Making teachers who did not participate in TEMI workshops envious</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Following is a list of objectives which were suggested by the partners. *  
Please rate each objective according to the achievement of this objective in the pilot program from 1-5 (1-not achieved 5-achieved)  
The numbers which appear in each cell describe the number of partners who have chosen this option

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Understanding the approach of mystery based IBSE</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>2. Desire to improve one’s practices among teachers</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>3. Promoting teachers professionalism (professional development).</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4. Facilitating the implementation of TEMI’s rationale in the classroom.</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5. Increasing motivation</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>6. Increasing self-efficacy</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>7. Providing pedagogical content knowledge (PCK) in general</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8. Providing Showmanship skills.</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9. Providing story telling skills.</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>10. Providing Inquiry skills - 5E’s</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>11. Providing applicable tools, materials and methods</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>12. Turning teachers into ambassadors (cascading effect)</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>13. Developing a sense of ownership towards TEMI project</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>14. Dealing with Interdisciplinary teaching</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>15. promoting a reflexive process</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>16. Learn approach of mystery based IBSE (raise teachers one level)</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>17. Making teachers who did not participate in TEMI workshops envyous</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
### Description of the Pilot teacher training program

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27 Oct</td>
<td>09:30-4:00</td>
<td>Innovations: 5Es, Mysteries</td>
</tr>
<tr>
<td>2</td>
<td>20th Jan</td>
<td>09:30-4:00</td>
<td>Innovations: GRR Skills teaching, Showmanship</td>
</tr>
<tr>
<td>3</td>
<td>20th Jun</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Description of the Pilot teacher training program Milano UMIL

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12/02/2014</td>
<td>14:30-15</td>
<td>Preliminary questionnaire on IBSE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-16</td>
<td>Introduction to TEMI and to scientific theatre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16-16:30</td>
<td>Engagement through theatre (trailers taken from some of our shows) and through real experiments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:30-18</td>
<td>Explore. Simple Mystery to be solved by the teachers as if they were students</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18-18:30</td>
<td>Explain. Discussion with the teachers</td>
</tr>
<tr>
<td>2</td>
<td>19/02/2014</td>
<td>14:30-15</td>
<td>Extend. A new, more complex, mystery has been proposed to the teachers who had to solve it.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-17</td>
<td>Teachers have worked in small groups to solve the mystery in the laboratory.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17-18:30</td>
<td>Evaluation of teachers’ work and ideas for the planning of an effective IBSE 5Es mystery based lesson</td>
</tr>
<tr>
<td>3</td>
<td>20/02/2014</td>
<td>14:30-16:30</td>
<td>Group work for planning a 5Es mystery based lesson.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:30-18:30</td>
<td>Teachers presented their projects with a general discussion on each project.</td>
</tr>
<tr>
<td>4</td>
<td>04/03/2014</td>
<td>14:30-16</td>
<td>Vision of the theatrical show “Enlightening the matter”.</td>
</tr>
<tr>
<td></td>
<td>16:18:30</td>
<td></td>
<td>Discussion about the engagement through theatre and the possibility of using it for engagement in the classrooms. Teachers are finally asked to test this approach in their classes in a 4 to 6 hours of lessons.</td>
</tr>
<tr>
<td>5</td>
<td>26/03/2014</td>
<td>14:30-18:30</td>
<td>Presentation of teachers work at school. Discussion and evaluation.</td>
</tr>
<tr>
<td>6</td>
<td>27/03/2014</td>
<td>14:30-18:30</td>
<td>Presentation of teachers work at school. Discussion and evaluation.</td>
</tr>
</tbody>
</table>

### Comments:

a) Before meeting 1 we made an evaluation of teachers/schools expectations and suggested some written material about IBSE.

b) In our project, scientific theatre should be presented at first, but in this case it has been impossible to choose the lesson calendar as our lessons were inserted into a pre-defined course.
c) In the final evaluation teachers have been divided into two groups: some followed meeting 5 and some meeting 6.

NOTE: in the on-line questionnaire, we did not include meetings 5 and 6 since there was no place. This is why we indicated 8 hours for the meeting 4.
### Description of the Pilot teacher training program – Uni HB- Bremen

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.2.</td>
<td>15-18</td>
<td>Outlining TEMI, Experiencing first mysteries</td>
</tr>
<tr>
<td>2</td>
<td>14.3.</td>
<td>15-18</td>
<td>Planning mysteries and how to document them</td>
</tr>
<tr>
<td>3</td>
<td>23.5.</td>
<td>15-18</td>
<td>Discussion about introducing mysteries and showmanship</td>
</tr>
<tr>
<td>4</td>
<td>27.6.</td>
<td>15-18</td>
<td>Implementation in class</td>
</tr>
</tbody>
</table>
Description of the Pilot teacher training program – CUNI- Prague

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31/1/2014</td>
<td>9.00-10.00</td>
<td>Mystery experiment in chemistry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10.00-11.00</td>
<td>Introduction to the TEMI project</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.00-12.00</td>
<td>IBSE and its structure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.00-14.00</td>
<td>IBSE skills and their development</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.00-16.00</td>
<td>IBSE ideas and their implementation</td>
</tr>
<tr>
<td>2</td>
<td>1/2/2014</td>
<td>9.00-11.00</td>
<td>Teachers’ ideas of an IBSE mystery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11.00-12.00</td>
<td>Evaluation of the ideas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13.00-16.00</td>
<td>Showing of participants’ experiments, evaluation, discussion</td>
</tr>
</tbody>
</table>
Program cohort 1 (Kongsberg municipality), Norway

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date</th>
<th>Session</th>
<th>Content</th>
</tr>
</thead>
</table>
| **Day 1** | 12.02.2014 | 09.00-10.00   | • Welcome and presentation of us and the participants the schools they represent.  
                          • Introduction to TEMI Project: Content and aim (5E and mystery).  
                          • What is IBSE: levels of inquiry (limitations and opportunities within each level, with examples)  
                          
                          **Kjetil and Jørn** |
|         |            | 10.15-11.15   | • Introduction to the 5E model: description of each step and justifications.  
                          • Hands-on activity (participants were subjected to a lesson based on 5E as if they were the pupils).  
                          
                          **Majken Korsager (Norwegian Centre for Science Education) and Kirsten Fiskum (Norwegian Directorate for Education and Training).** |
|         |            | 12.00-12.45   | Questionnaire *(Kjetil)*  
                          • Developing a lesson based on 5E, participants from each school worked together on a science subject they already were familiar with.  
                          • Poster presentation of the lesson.  
                          
                          **Korsager and Fiskum** |
|         |            | 15.00-15.30   | • Summary of the day  
                          • Task for the teachers before next meeting: Testing of a lesson based on 5E, in their own classroom.  
                          
                          **Jørn** |
<table>
<thead>
<tr>
<th>Meeting</th>
<th>Date</th>
<th>Session</th>
<th>Content</th>
</tr>
</thead>
</table>
| Day 2   | 19.03.2014 | 09.00-09.30 | Welcome, program for the workshop, short repetition:  
|         |            |           | • The GRR model.  
|         |            |           | • What is a mystery in science education (based on the definition from the consortium)?  
|         |            |           | *Kjetil and Jørn* |
|         |            | 09.30-12.00 | Workshop:  
|         |            |           | • Teachers presented their 5E lessons, tested with their own classes. Group discussion.  
|         |            |           | *Kjetil and Jørn* |
|         |            | 12.30-15.00 | Drama.  
|         |            |           | • Getting in to role: Theatre sports – body language, how to keep the dialog going, etc.  
|         |            |           | *Marte Amalie Johnsrud Kaardahl, communication expert*  
|         |            |           | • Examples of mysteries.  
|         |            |           | *Jørn and Kjetil* |
|         |            | 15.00-15.30 | • Dissemination – the way forward.  
|         |            |           | • Feedback from teachers.  
|         |            |           | • Questionnaire.  
|         |            |           | *Kjetil and Jørn* |
# Program of the whole workshop - WEIZMANN

<table>
<thead>
<tr>
<th>No</th>
<th>date</th>
<th>hours</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11/11/2013</td>
<td>16:00-20:00</td>
<td>Presentation of a TEMI activity – &quot;the disappearing ink&quot;. The 5E’s model of enquiry. Development of storytelling skills.</td>
</tr>
<tr>
<td>2</td>
<td>09/12/2013</td>
<td>16:00-20:00</td>
<td>Presentation of a TEMI activity – &quot;the sea sand overseas&quot;. Drama activities in science education.</td>
</tr>
<tr>
<td>3</td>
<td>20/01/2014</td>
<td>16:00-20:00</td>
<td>Presentation of a TEMI activity – &quot;magic candles&quot;. Participants report of their enactment of the TEMI activities in class. More drama activities in science education.</td>
</tr>
<tr>
<td>4</td>
<td>24/02/2014</td>
<td>16:00-20:00</td>
<td>Presentation of a TEMI activity – &quot;the love-meter&quot; and &quot;the mysterious cocktail&quot;. Participants devise their own TEMI activities.</td>
</tr>
</tbody>
</table>
# Program of the whole workshop Leiden NL

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>April 8th</td>
<td>15:00-15:30</td>
<td>Introduction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15:30-16:00</td>
<td>Definition of mysterie</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:15-16:30</td>
<td>Discuss article</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:30-17:00</td>
<td>Examples of mysteries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17:00-17:30</td>
<td>Guest lecture astronomer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17:30-18:15</td>
<td>Mystery on galaxies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19:15-20:15</td>
<td>Plan a level 1 enquiry lesson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20:15-20:45</td>
<td>Presentations by participants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20:45-21:00</td>
<td>Final discussion and next steps</td>
</tr>
<tr>
<td>2</td>
<td>April 22nd</td>
<td>16:00-16:15</td>
<td>Reflect on school implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16:15-17:15</td>
<td>Showmanship (illusionist/filosofer)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17:15-17:30</td>
<td>Teach enquiry skills with GRR model and discuss article</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18:30-19:30</td>
<td>Plan a level 2 enquiry lesson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19:30-20:00</td>
<td>Presentations by participants</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20:00-20:15</td>
<td>Evaluation and next steps</td>
</tr>
</tbody>
</table>
# Description of the Pilot Teacher Training program

University of Limerick, Ireland

January – April 2014

<table>
<thead>
<tr>
<th>Meeting Number</th>
<th>Date</th>
<th>Session</th>
<th>Content</th>
</tr>
</thead>
</table>
| 1              | 15 / Jan / 2014 | 9.30-11.05  | Introduction to TEMI Project  
TEMI Lesson Simulation  
5 E Model of Enquiry |
|                |              | 11.30-12.15 | Teaching to Motivate                                                    |
|                |              | 13.00-14.30 | What is a Mystery?  
Designing a TEMI lesson  
Pre-Service Science Teachers- Insights |
|                |              | 14.30-16.00 | TEMI Lesson Resources  
Developing a Community of Practice  
Tasks for Workshop 2 |
| 2              | 05 / April / 2014 | 9.30-12.00  | Feedback from Teachers  
Feedback from Pre-service Science teachers |
|                |              | 12.45-14.00 | Demonstration of TEMI engage activities in the Chemistry lab |
|                |              | 14.00-15.45 | Implementing a lesson using enquiry  
Developing a complete TEMI lesson  
GRR Model  
Alternative ways of introducing mysteries |
|                |              | 15.45-16.00 | Sustainability of TEMI project |
Description of the Pilot teacher training program- k NIVIE Austria

<table>
<thead>
<tr>
<th>Meeting number</th>
<th>Date of the meeting</th>
<th>Session (hours)</th>
<th>Content of the activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24/04/2014</td>
<td>15:15-15:45 / 08:30-09:00</td>
<td>Input about TEMI (what is it, aims, partners, PD offer), input about inquiry-based learning (inquiry-cycle, levels of inquiry) to make the frame transparent for the teachers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15:45-16:45</td>
<td>Engaging teachers with a mystery (genie in a bottle) and inquiring the phenomenon on level 1, afterwards reflection on level 1, collecting questions to extend to level 2, input about 5E model</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17:00-18:15</td>
<td>Teachers worked on 3 stations (tables with materials prepared to explore phenomena on level 2 (Gelli Baff, liquid or solid, Never wet)) with a final discussion</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: SHU
Date: 28/10/2013 - Workshop 1, 29/01/2014 - Workshop 2
Place: Sheffield, UK

### 1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

#### 1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)
  
  *We presented the mystery “Don’t open the bottle” - exactly the way we described it in the ‘owner’s manual’ and in Leiden.*

- How were its differences to traditional practice made clear?
  
  *We introduced it with a short introduction to what makes a good mystery, and we showed how students’ questions would then lead to uncovering the traditional science content later.*

- How was it made concrete with real examples in a science lesson?
  
  *We used a lesson plan and curriculum materials based around this mystery.*
How was the lesson design task or another approach used to practise it?

The teachers worked together collaboratively, to design lessons using mysteries and 5E’s, and a presentation to share ideas to the group.

1.2. Innovation 2: 5E learning cycle for teaching concepts

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)
  
  We presented the 5E cycle and asked teachers to fill in descriptions of the stages in the cycle as we demonstrated the lesson.

- How were its differences to traditional practice made clear?
  
  We highlighted the use of the Explore - students finding out - before the Explain, and the use of the Extend to transfer understanding.

- How was it made concrete with real examples in a science lesson?
  
  We used a lesson plan and curriculum materials based around the 5E.

- How was the lesson design task or another approach used to practise it? The teachers worked together collaboratively, to design lessons using mysteries and 5E’s, and a presentation to share ideas to the group.

1.3. Innovation 3: GRR model for teaching skills

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)
  
  We demonstrated the ‘modelling’ and then the ‘guided instruction’ part of the GRR model, with teachers acting as students.

- How were its differences to traditional practice made clear?
  
  We discussed the model, with extra slides on how it could be implemented over a whole course to develop students’ skills to mastery.

- How was it made concrete with real examples in a science lesson?
  
  We used a lesson plan and curriculum materials based on GRR

- How was the lesson design task or another approach used to practise it? In Workshop 2, teachers worked together collaboratively, to design lessons using explicit skill teaching, and a presentation to share ideas to the group.

1.4. Innovation 4: Showmanship techniques to maintain motivation

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)
  
  We had a magician who showed how a trick could be enhanced with showmanship
teachniques. He explained the techniques, and got teachers to apply themselves.

- How were its differences to traditional practice made clear? We used compare/contrast, ‘before’ and ‘after’ showmanship, to highlight the differences - and benefits.

- How was it made concrete with real examples in a science lesson? see above We used a lesson plan and curriculum materials based on GRR

- How was the lesson design task or another approach used to practise it? In the lesson design task, the magician helps teachers to add showmanship to their lessons.
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?
  2 workshops up until January, 3rd workshops in June. Each was 6 hours face to face + 1 hour prep, plus 1 hour follow up - total 8 hours each.

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.
  *In our 3rd workshop we are combining showmanship and mysteries into the same day, back to back, as this seems to make more sense than splitting up two very similar concepts.*

- What was the time gap between workshop 1 and workshop 2?
  10 weeks.

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.
  *Exactly as our pilot*

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.
  *We sent pre-reading and a survey about inquiry practice*

- Please describe any tasks that were set for the teachers in between workshops.
  *We asked them to do one thing- to practise or disseminate the innovations.*

- Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.
  *No. Many of the teachers in Workshop 1 could not attend workshop 2. At the time we just coped with the smaller number. After this we realised it would be best to commit to both workshops and 'require' them to send substitutes when the same teacher cannot come.*

- In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?
  *We had a very short review session, because they had generally not done their practice!*

- Did your second workshop change in any way after feedback from the first workshop. Please
describe significant changes and why they were made.
Yes, see above, we

- combined mystery and showmanship into the same part of day 1
- made more of explaining what makes a good mystery, and giving teachers practice selecting one
- changed the mystery so it had a great ‘wow’ value
- Developed GRR towards a system for integrating skills development into the curriculum
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: Dr. Dvora Katchevich, Dr. Malka Yayon & Dr. Ran Peleg

Date: 2013-2014

Place: Weizmann Institute of Science, Israel

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)

- How were its differences to traditional practice made clear?

- How was it made concrete with real examples in a science lesson?

- How was the lesson design task or another approach used to practise it?

When advertising the workshop, we declared that it will be a different and unique workshop which will involve drama as a tool in education. In order to implement it, the providers prepared activities which created a special atmosphere.
In addition to exposing the participants to TEMI rationale, we exposed teachers to new teaching methods that stimulate student motivation in general and motivation towards enquiry in particular, by employing storytelling and other dramatic resources. We enabled teachers to experience various dramatic activities that facilitated an open, accepting and embracing environment. We presented teachers with TEMI style ready-made activities and supported the teacher so they could develop their own story-based enquiry activities.

We decided to focus on story-telling skills, and therefore we had a workshop on this issue given by an expert from the Israeli theatre.

**Innovation 2: 5E learning cycle for teaching concepts**

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)

- How were its differences to traditional practice made clear?

- How was it made concrete with real examples in a science lesson?

- How was the lesson design task or another approach used to practise it?

In general the teachers that registered for the workshop are familiar with IBSE, and therefore, the workshop focused mainly on the "Engagement" part from the 5E’s proposed by Sheffield University.

While conducting or reflecting on each of the activities we emphasized the 5E’s components. For example:

<table>
<thead>
<tr>
<th>component</th>
<th>Sea sand overseas</th>
<th>The disappearing ink</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Engage</strong></td>
<td>A story about building sand castles</td>
<td>A story about disappearing ink</td>
</tr>
<tr>
<td><strong>Explore</strong></td>
<td>Teachers examined the dry sand and the regular sand</td>
<td>Teachers tried to make the ink reappear</td>
</tr>
<tr>
<td><strong>Explain</strong></td>
<td>Plenary discussion about the theoretical background behind the dry sand and the sand: the structure of the sand at the molecular level, hydrophobic and hydrophilic materials and interactions between them</td>
<td>Plenary discussion about the theoretical background behind the disappearing ink: Enthalpy, Entropy and chemical equilibrium</td>
</tr>
<tr>
<td><strong>Elaborate</strong></td>
<td>Design of inquiry (by the workshop providers)</td>
<td>Design of inquiry (by the teachers)</td>
</tr>
<tr>
<td><strong>Evaluate</strong></td>
<td>Presentation of results and conclusions in a dramatic way (three pictures)</td>
<td>Suggestion of evaluation such as lab report by teachers aligned with the Israeli curriculum</td>
</tr>
</tbody>
</table>
1.2. Innovation 3: GRR model for teaching skills

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

- How were its differences to traditional practice made clear?

- How was it made concrete with real examples in a science lesson?

- How was the lesson design task or another approach used to practise it?

The plan of the workshop was based on the three stages:

I do it

We do it

You do it

At the beginning, we presented ready-made activities, including the design of the inquiry. At this stage, the teachers behaved as learners, and also had to plan the inquiry. Afterwards, the teachers acted as teachers, and had to suggest the evaluation of the activity aligned with the Israeli curriculum.

In the last stage, the teachers were divided into groups, and were asked to design a new activity in order to implement it in their classes. The responsibility was given to the teachers together with the providers’ support.

We did not use the term GRR during the workshop.

1.3. Innovation 4: Showmanship techniques to maintain motivation

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

- How were its differences to traditional practice made clear?

- How was it made concrete with real examples in a science lesson?
How was the lesson design task or another approach used to practise it?

Participation in drama activities can generate an open and embracing environment, whilst promoting acquaintance between participants and develop showmanship techniques. It is important that the participants should experience a lesson in which a "fictive contract" or a "contract for fiction" is agreed upon. This contract establishes the rules which form a safe and embracing environment and which allow learning through fiction and showmanship to take place.

A 2 hours lesson was given by Amitai Milo who works in improvisational theatre and has a rich experience training actors. He provided two models for effective storytelling. The body is an effective storyteller, and the neutral mask can be used as a tool to understand and learn the use and mastery of body language. This session was led by Dr. Ran Peleg who is also an actor with training in the physical theatre. The purpose of the session was not to turn teachers into actors, but rather use tools from the world of drama and theatre in order to help teachers become more effective storytellers and improve showmanship.

After experiencing the activities above, the participants were given the stage to create their own activities. They were divided into groups according to their scientific disciplines, their students' age group, and the topics of interest. They began by brainstorming a topic, an experiment, or a story that would form the basis of their enquiry based activity. After some group work they presented the framework of their activity in order to receive preliminary feedback from their colleagues and from the workshop team.
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?
- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.
- What was the time gap between workshop 1 and workshop 2? We had one cohort of teachers who met four times. The gap between meetings was approximately one month.

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Hours</th>
<th>Description</th>
<th>Innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11/11/2013</td>
<td>16:00-20:00</td>
<td>• Presentation of a TEMI activity: &quot;The disappearing ink&quot;.</td>
<td>Innovation 1: (Productive) Mysteries to create curiosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• The 5E's model of enquiry.</td>
<td>Innovation 2: 5E learning cycle for teaching concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Development of storytelling skills.</td>
<td>Innovation 4: Showmanship techniques to maintain motivation (Implicitly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Innovation 3: GRR model for teaching skills</td>
</tr>
<tr>
<td>2</td>
<td>09/12/2013</td>
<td>16:00-20:00</td>
<td>• Presentation of a TEMI activity: &quot;The sea sand overseas&quot;.</td>
<td>Innovation 1: (Productive) Mysteries to create curiosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Drama activities in science education.</td>
<td>Innovation 2: 5E learning cycle for teaching concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Innovation 4: Showmanship techniques to maintain motivation (Implicitly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Innovation 3: GRR model for teaching skills</td>
</tr>
<tr>
<td>3</td>
<td>20/01/2014</td>
<td>16:00-20:00</td>
<td>• Presentation of a TEMI activity: &quot;Magic candles&quot;.</td>
<td>Innovation 1: (Productive) Mysteries to create curiosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Participants report of their enactment of the TEMI activities in class.</td>
<td>Innovation 2: 5E learning cycle for teaching concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• More drama activities in science education.</td>
<td>Innovation 4: Showmanship techniques to maintain motivation (Implicitly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Innovation 3: GRR model for teaching skills</td>
</tr>
<tr>
<td>4</td>
<td>24/02/2014</td>
<td>16:00-20:00</td>
<td>• Presentation of a TEMI activity: &quot;The love-meter&quot; and &quot;the mysterious</td>
<td>Innovation 1: (Productive) Mysteries to create curiosity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>cocktail&quot;.</td>
<td>Innovation 2: 5E learning cycle for teaching concepts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Participants devise their own TEMI activities.</td>
<td>Innovation 4: Showmanship techniques to maintain motivation (Implicitly)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Innovation 3: GRR model for teaching skills</td>
</tr>
</tbody>
</table>
Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

After experiencing the activities above, the participants were given the stage to create their own activities. They were divided into groups according to their scientific disciplines, their students' age group, and topics of interest. They began by brainstorming a topic, an experiment, or a story that would form the basis of their enquiry based activity. After some group work they presented the framework of their activity in order to receive preliminary feedback from their colleagues and from the workshop team.

Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.

The teachers were not asked to prepare pre-tasks for the workshop.

Please describe any tasks that were set for the teachers in between workshops.

The teachers were asked to improve, expand and elaborate the tasks which they began designing in the workshops. The teachers were also asked to write a reflective account of the enactment of their TEMI activity in class.

Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

Approximately 80% of the registered teachers attended each of the meetings.

In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?

In each meeting (apart from the first one) we had a 'field report' session in which the teachers were asked and encouraged to report and reflect on their past and planned implementation in the field.

Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

We had one cohort of four meetings. After each meeting the workshop providers met and reflected on the meeting.
TEMi workshops – Questions for organisers

In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: UNIVIE
Date: 24/04/2014, repeated on 25/04/2014
Place: Salzburg, Austria

1. The 4 innovations

The TEMi training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)
  We presented the mystery “Genie in a bottle”. A story was told about a mysterious ancient find – the genie, which had to be lured out with the help of the teachers. The phenomenon was described and analysed afterwards. The teachers could explore it on level 1.
  Three other mysteries were prepared in stations with material tables to explore the phenomena on level 2.

- How were its differences to traditional practice made clear?
  The story-telling and the engagement phase of the 5E model were explicitly reflected.

- How was it made concrete with real examples in a science lesson?
  The phenomena can be presented in a science lesson. We gave hints how to present them best. The exploration phase that was conducted afterwards can also be implemented in the lesson with the work sheets and materials we provided.
How was the lesson design task or another approach used to practise it? The teachers did not design a lesson themselves in this advertising workshop, but they could experience the exploration phase and how much the mysteries engaged themselves.

1.2. Innovation 2: 5E learning cycle for teaching concepts

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)
After the first mystery was presented and explored, we reflected the phases with the teachers. We had a PowerPoint presentation with the 5E model which will be handed to the teachers.

• How were its differences to traditional practice made clear?
in a discussion

• How was it made concrete with real examples in a science lesson?
we used the presented mysteries and possibilities to explore and extend the phenomena to explain the 5 E model

• How was the lesson design task or another approach used to practise it? -

1.3. Innovation 3: GRR model for teaching skills

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)
we did not use the GRR model, but an inquiry-cycle with competences for inquiry and levels of inquiry (see Blanchard et al 2010 or Abrams et al 2008 or Schwab 1967) to explain the gradual release and the successive development of competencies necessary

• How were its differences to traditional practice made clear?
level 1 was compared to standard experiments in class whereas level 2 was experienced as an innovative approach

• How was it made concrete with real examples in a science lesson?
see above

• How was the lesson design task or another approach used to practise it? -

1.4. Innovation 4: Showmanship techniques to maintain motivation

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)
we used it to present a mystery and told the teachers about it, but it was not a focus in this workshop
• How were its differences to traditional practice made clear?
  -

• How was it made concrete with real examples in a science lesson?
  -

• How was the lesson design task or another approach used to practise it?
  -
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?
  2 advertising workshops with two different groups of teachers, each lasted 3 hours

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.
  all in one workshop except the story-telling skills, because there was no time to practice that as well. Our focus was the mysteries and inquiry. We used the levels of inquiry and an inquiry cycle instead of the GRR model as we are more familiar with this approach and can better explain differentiation strategies and developmental aspects

- What was the time gap between workshop 1 and workshop 2?
  -

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.
  did not happen, no time in a 3h workshop for that

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.
  just an abstract to lure them to our workshop on this PD conference

- Please describe any tasks that were set for the teachers in between workshops.
  -

- Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.
  -

- In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?
  -
Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

no changes between first and second group
TEMI workshops – Questions for organisers

In order to evaluate the training methodology, we kindly ask you to answer to the question below. These items will be reviewed in the skype/hangout conversation that we will organize after the workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: UMIL
Date: 15/04/2014
Place: Milano

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

Without any explanation, we started showing a number of excerpts of our shows related with the theme of oscillations. The shows, by their own purpose, are surprising and extremely different by a lesson. They present mysteries without solving them.

- How were its differences to traditional practice made clear?

- We clarified the approach only later, in order to leave the teachers alone to manage with the mystery.

- How was it made concrete with exemplified in a science lesson?
We then presented many periodic phenomena, extremely different from one another. Some of them are for example the parametric oscillator (see March MoM on TEMI website); a ball sliding over a cycloidal track that performs always isochronal oscillations despite very different initial amplitudes.

- How was the lesson design task or another approach used to practise it?

Teachers had to construct a lesson with their students starting from a lab mystery

1.2. **Innovation 2: 5E learning cycle for teaching concepts**

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

We used the 5E cycle without anticipating it, and we explained the approach during the second day.

- How were its differences to traditional practice made clear?

In describing the 5E evident comparison with traditional practice have been explicated.

We tried to make teachers aware of the 5E mostly by doing 5E in the workshop and not so much by describing the pedagogical theory. Teachers were taught mostly the way they are supposed to teach.

A comparison with a typical secondary school lesson about oscillations has been presented

- How was it made concrete with exemplified in a science lesson?

We let the teachers live their first experience of students by offering a simple mystery: how can I prove that the motion of a mass hanging from a spring is harmonic? We used a simple problem to let them follow the scheme Explore and explain. We then moved on to a more complex mystery (Extend), of which teachers do not know the solution. The teachers had to do the experience on another experiment as if they were students, this time unknown to them (mystery: what kind of motion is this?)

- How was the lesson design task or another approach used to practise it?

1.3. **Innovation 3: GRR model for teaching skills**

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

- We showed clips of our shows on the theme oscillations, all spectacular and surprising, to surprise them with a simple argument that we assumed that they know very well (Engagement). We then let them live their first experience of students by offering a simple mystery, and then proposing a challenging practice.
• How were its differences to traditional practice made clear?

• How was it made concrete with exemplified in a science lesson?

In the first session teachers had to understand why a particular oscillator performed harmonic oscillation. The strategy adopted was their own.

In the second session teachers had to discriminate which of two different periodic motions were harmonic (both or neither also possible).

• How was the lesson design task or another approach used to practise it?

1.4. **Innovation 4: Showmanship techniques to maintain motivation**

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

Trailers of some shows have been presented

• How were its differences to traditional practice made clear?

obvious

• How was it made concrete with exemplified in a science lesson?

A real theatrical show “Let’s through light on matter” has been seen.

• How was the lesson design task or another approach used to practise it?

Teachers, divided into groups of 3-4, had to prepare a dramatization of 5 minutes on a chosen aspect related to oscillations and show it to us and to the other teachers.

Teachers were asked to implement 4 to 6 hours lessons finalized to the dramatization (done by their students) of a simple aspect of a physical topic. They have been examined on this point.
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?

4 afternoons + 2 afternoons of final discussion

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.

All

- What was the time gap between workshop 1 and workshop 2?

2 afternoon/week

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.

- Please describe any tasks that were set for the teachers in between workshops.

W2-W3 To prepare and design a brief show using mysteries

W4- final discussion prepare and design 4-6 hour lesson in their classroom using TEMI workshop and theatre scheme

- Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

- In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?

- Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.
TEMI workshops – Questions for organisers

In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: CUNI - 1st set of answers
Date: 31st January and 1st February 2014
Place: Prague

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)
  - We have used a mystery about the transport of water from a full glass to an empty glass. We will submit this mystery to dropbox.
- How were its differences to traditional practice made clear?
  - This experiment was presented as a mystery which the teachers should solve with the help of some material (wires, eyedrops, papers, strings…). In traditional practice, this experiment would be only demonstrated.
- How was it made concrete with real examples in a science lesson?
This topic is related to chemistry (capillary phenomena and chromatography) and biology (transport of water in plants).

How was the lesson design task or another approach used to practise it?

Our lesson began with the experiment and continued with gradual solving of the mystery (capillary phenomena). In traditional practice, these phenomena would be explain without any work from the students (and often without any experiment).

1.2. Innovation 2: 5E learning cycle for teaching concepts

How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

The mystery (experiment) was the Engage phase, the other phases followed with the practical work of the participants and in the end, all was explained theoretically.

How were its differences to traditional practice made clear?

In traditional practice, teachers only explain the problem and extend it.

How was it made concrete with real examples in a science lesson?

We are trying to use this approach in practice but this is only the beginning.

How was the lesson design task or another approach used to practise it?

See above.

1.3. Innovation 3: GRR model for teaching skills

How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

We have not used this model because we have only explained to the teachers how to apply this method on their pupils.

How were its differences to traditional practice made clear?

- 

How was it made concrete with real examples in a science lesson?

- 
• How was the lesson design task or another approach used to practise it?

  - 

1.4. **Innovation 4: Showmanship techniques to maintain motivation**

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)

  - We have not used this model because we have had only the pilot training session. The aim of this training was to prepare the final schedule for our first proper training which we plan to do in April.

• How were its differences to traditional practice made clear?

  - 

• How was it made concrete with real examples in a science lesson?

  - 

• How was the lesson design task or another approach used to practise it?

  - 
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?
  
  - We have had one pilot training consisting of two days (four blocks).

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.
  
  - We have used the Mystery concept and the 5E method in our pilot training. See above.

- What was the time gap between workshop 1 and workshop 2?
  
  - The training lasted for two days. We will have another training in April (2.5 months from the pilot training).

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.
  
  - Our participants have been given some Mystery topics in the pilot training. Right now, they have some time to think about their mystery lessons and we will see the results in April.

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.
  
  - We have not given the participants any pre-tasks.

- Please describe any tasks that were set for the teachers in between workshops.
  
  - We have given the participants the task of thinking about their own mystery lesson. We will see their results in April.
 Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

- In the pilot training, all the teachers were present for both days. In April, some of the teachers who participated in the pilot training will be present but we will mostly train new participants.

 In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?

- We have not had our second training yet.

 Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

- We have not had our second training yet but we are preparing it and it’s final schedule was decided after the pilot training depending on the opinions of the pilot participants. The participants filled in a questionnaire in which they commented about the training and had their own ideas about the second training. In the beginning, the teachers should try to solve some mystery by themselves and only after that should we explain to them the IBSE and 5E concept. During the second day of the training, the participants should think of their own mystery and the materials they will need. In the lunchbreak, we would buy the required materials and the participants would be able to try out their own mystery lesson.
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: CUNI - 2nd set of answers
Date: 31st January and 1st February 2014
Place: Prague, CUNI

The organizers and participants of this pilot training were already acknowledged with the proposed methodology. They have participated in the ESTABLISH (7. RP EU) or the national Věda není věda project.

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)

- How were its differences to traditional practice made clear?

- How was it made concrete with real examples in a science lesson?
• How was the lesson design task or another approach used to practise it?

We have used such mysteries which would really interest our participants and make them want to solve them.

We have used these experiments for the presentation of this innovation:
1) Burning hands (burning of natural gas): Why don’t we get burned? Which gas is burning?
2) Glasses: moving a liquid from one glass to the other via a bit of fabric or paper
3) Floating cans: floating on water of cans with a normal and “light” soda
4) Floating egg: floating of egg in various liquids of different densities

We have used liquids of various densities in preparing mixed drinks as a concrete example from real life.

The difference between classic methods and our method was mainly in the absence of an explanation of the mystery. The participants unveiled the principle by themselves and designed their own experiments to test their hypotheses.

1.2. Innovation 2: 5E learning cycle for teaching concepts

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

• How were its differences to traditional practice made clear?

• How was it made concrete with real examples in a science lesson?

• How was the lesson design task or another approach used to practise it?

This innovation was presented with the help of a scheme, which was situated on the floor of the class. The participants put parts of the cycle into the scheme and discussed their decisions. After that, we have used a concrete task (Matter, are you alive?) which was about the differences between living and non-living matter. The practical link is the use of yeast as an example of living matter (yeast cells). With the help of materials and worksheets, the participants were acknowledged with the main points of the 5E cycle and they were able to identify them in the material.

1.3. Innovation 3: GRR model for teaching skills

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

• How were its differences to traditional practice made clear?

• How was it made concrete with real examples in a science lesson?
• How was the lesson design task or another approach used to practise it?

This model was used in the experiment “The voltage rank of metals”. In acquiring information about the redox properties of metals, the participants worked in the following ways: 1) they were told the information; 2) they got the abbreviated information on small pieces of paper; 3) they worked with literature and the internet – the goal was to compare the relevance of this information.

In another phase of the training, the creation of one’s own activity, we have also stuck to this model. The participants first looked for the main aspects of the inquiry based teaching in already made activities, then they created their own and they discussed each step with their colleagues and the lecturer.

1.4. Innovation 4: Showmanship techniques to maintain motivation

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

• How were its differences to traditional practice made clear?

• How was it made concrete with real examples in a science lesson?

• How was the lesson design task or another approach used to practise it?

This innovation was used in the activity called “Space probe”. The lecturer was in the role of an authority ordering a space mission to safely put a probe on Mars. The participants had an egg (the probe), a plastic bag, two sheets of paper and a piece of thread. The landing on Mars was symbolised by dropping the egg from three meters. The participants tried to solve the task by themselves and they also suggested possible ways of presenting this method. The lecturer pointed out the inquiry aspects and also the possibility of developing social relationships in the group. The participants applied their knowledge from real life – the principle of a parachute, air pillow etc.
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?

We ran two training workshops – 31st January + 1st February and 6th-7th June 2014, we taught 12 lessons in each of them.

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.

(Productive) mysteries to create curiosity, 5E teaching cycle.

- What was the time gap between workshop 1 and workshop 2?

Four months.

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

Opening part – presentation of mysteries and trying the inquiry based teaching method (we have used a physics mystery for the participants to solve because it’s not their area of expertise). Acknowledging the participants with the IBSE method via using concrete already-made tasks. The participants then suggested their own ideas for creating tasks and the design of their lesson. They discussed their ideas with the lecturers and realised them.

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.

Think about some ideas for mysteries for creating curiosity.

- Please describe any tasks that were set for the teachers in between workshops.

Think about some ideas and methods for a concrete task.

- Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

The participants were half the same and half new.

- In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?

Discussion (30 minutes) and a questionnaire.
Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

We have added more practical activities so the training is more attractive for the teachers.
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: HBV
Date: 23/5-2014
Place: Horten

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)

  By defining a mystery in the context of TEMI (but also what is not a mystery)

  Presenting concrete mysteries to teachers.

  Contrasting a mystery to the traditional way of introducing a subject, e.g. the teacher enters the room, defining what should be learned, writing a formula and ask the students to read about the formula in the textbook.

- How were its differences to traditional practice made clear?
1.2. Innovation 2: 5E learning cycle for teaching concepts

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

  Somewhat similar to the question above, but also including a lecture on 5E (defining the E’s, relevant background, merits of 5E).

- How were its differences to traditional practice made clear?

  Same as last question. However, quite a few teachers pointed out that they already implement some of the elements of 5E, but using 5E make them more aware of all the elements involved in planning a lesson

- How was it made concrete with real examples in a science lesson?

  Teachers designed their own inquiry lesson based on 5E with a poster presentation as end results (poster is uploaded to Dropbox)

- How was the lesson design task or another approach used to practise it?

1.3. Innovation 3: GRR model for teaching skills

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

  We discussed different levels of inquiry and pointed out that student responsibility and independence increase for each level. During the teachers poster presentation (first workshop) and their presentation of trialled inquiry (second workshop) levels of inquiry and grr was a recurring theme.

- How were its differences to traditional practice made clear?
• How was it made concrete with real examples in a science lesson?

*We used teachers poster presentations and their presentation of trialled material as a starting point for making GRR concrete. In addition we (Jørn and I) had a couple of mysteries which exemplified GRR.*

• How was the lesson design task or another approach used to practise it?

*We challenged the teachers to think explicitly about “apprenticeship-ladder” and levels of inquiry when designing their lesson.*

1.4. Innovation 4: Showmanship techniques to maintain motivation

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

*We started by discussing the fact that teaching happens at stage - the students are the audience, and as teachers we need to get them interested and keep them wanting to learn. Aspects of this include use of voice and body language. In order to get more aware these gestures, we used theatre sports were participants were asked to enact different types of characters. Following the theatre sports, Jørn and Kjetil presented a few mysteries which included storytelling.*

• How were its differences to traditional practice made clear?

*Using storytelling/showmanship was a new approach for most of the teachers (perhaps everyone), and easily recognisable as such.*

• How was it made concrete with real examples in a science lesson?

*Our mysteries which included storytelling.*

• How was the lesson design task or another approach used to practise it?

*We plan to follow up this point when ensuring dissemination/cascading (see report).*
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?

  2 cohorts, 2 workshops in each cohort. Workshops lasted from 0830/0900-1530.

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.

  5E and mysteries was discussed/presented in the first workshop, and followed up in workshop 2. This goes for both cohorts.

  Showmanship was discussed in workshop 2 (both cohorts). We wanted the teachers to have experience with 5E before adding showmanship.

  Cohort 1: Levels of inquiry was discussed on workshop 1, and the term GRR was introduced during second workshop. In cohort 2, levels of inquiry and GRR were introduced simultaneously. During cohort 1 we experienced that teachers only superficially consider at which level a given activity is, and we made these changes in order to meet this challenge.

- What was the time gap between workshop 1 and workshop 2?

  4 weeks, 5 weeks if half-term break and Easter holiday is included (for cohort 1 and 2 respectively). Based on our experience, 4 weeks is the minimum time needed between training in order to give teachers opportunities to implement 5E.

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

  During first workshop teachers used the uploaded poster to structure their presentation. They were given advice throughout the process of design the lesson (e.g., we challenged teachers to be explicit about the link to the curriculum, if the engaging phase, how the plan to evaluate students, etc).

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.

  Read article about 5E (see report).

- Please describe any tasks that were set for the teachers in between workshops.

  Implement one example of 5E and mysteries in their practise.

- Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

  Cohort 1: One teacher did not attend any of the workshops. Second workshop one additional teacher was absent.
Cohort 2: One teacher absent first workshop, another teacher the second workshop.

This level of absence is within what must be considered reasonable. We strongly encouraged the absent teachers’ colleagues to convey the teaching materials.

- In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMi innovations?

  First half of second cohort was devoted to teachers’ implementation of 5E.

- Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

  Not any significant changes within the first cohort. However, in cohort 2 we added more hands-on activity in workshop 1 and increased focused on how to tell mystery effectively in workshop 2.
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: Leiden University
Date: April 8th and April 22nd 2014
Place: Leiden

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)

  I started off with an inswinger to introduce the teachers to the concept of mysteries. I explained the basics of the TEMI project and the properties, criteria and examples of good mysteries.

- How were its differences to traditional practice made clear?

  By showing a TEMI lessons start with an exciting inswinger and uses inquiry-based learning.

- How was it made concrete with real examples in a science lesson?
Several examples were shown; the water bottle, the candle/CO2 trick, a mystery about galaxies, and several short examples of other mysteries.

- How was the lesson design task or another approach used to practise it?

The teachers designed their own mystery during the lesson design task, based on the shown examples and definition.

1.2. Innovation 2: 5E learning cycle for teaching concepts

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

I showed the 5E cycle step-by-step and we practiced the 5E mystery with the water bottle and an a 5E mystery about galaxies together with the class. Also a comparison with the article was made to provide extra theoretical background.

- How were its differences to traditional practice made clear?

By pointing out that it are the students who do the work and try to solve the mystery. The teacher just provides the problem, he doesn’t solve it.

- How was it made concrete with real examples in a science lesson?

By showing mysteries that can actually be implemented into a science lesson.

- How was the lesson design task or another approach used to practise it?

The teachers design a mystery and had to describe each of the 5 steps.

1.3. Innovation 3: GRR model for teaching skills

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

The GRR model was shown and explained from a powerpoint slide, with reference to the article. While discussing the article, I pointed out which proposed methods in the article are actually a form of the GRR model.

- How were its differences to traditional practice made clear?

By pointing out that students need a framework to actually be able to participate in inquiry-based learning. If teachers apply inquiry-based learning, they don’t always teach students how to do research. With the GRR model, they can teach their students how to do research.
• How was it made concrete with real examples in a science lesson?

By referring to examples in the article.

• How was the lesson design task or another approach used to practise it?

When the teachers (re-)designed their mystery in the lesson design task of the second workshop, they chose the best fitting lifeline as a cognitive strategy students could use. They filled in the GRR model on how to teach this cognitive strategy.

1.4. Innovation 4: Showmanship techniques to maintain motivation

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

We hired an illusionist/philosopher to explain the theory behind magic, i.e. how to perform a trick or the engage phase of a mystery. This is theory about how to create suspense, how to create credibility, how to make sure the audience has all the required knowledge to be amazed (i.e. have a cognitive dissonance in their head), how to create a competition (i.e. performer against imaginary bad guy, public against public, etc.), how to keep the attention focussed.

• How were its differences to traditional practice made clear?

By pointing out many things that can be improved in a regular science demonstration.

• How was it made concrete with real examples in a science lesson?

By addressing how to perform an act in science class instead of on stage.

• How was the lesson design task or another approach used to practise it?

During the lesson design task of the second workshop the teachers (re-)designed their mystery with emphasis on the engage phase. They implemented what they had learned from the illusionist.
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?

There were 2 days of training. The first day lasted for 6 hours, the second for 4.5 hours. In between and before there was 6 hours of reading articles and implementing mysteries in the classroom.

- Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.

**First workshop:** 1.1 and 1.2

**Second workshop:** 1.3 and 1.4

- What was the time gap between workshop 1 and workshop 2?

2 weeks

- Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

We moved to a computer room, where teachers started designing a mystery in pairs. We made sure both teachers in a pair were of the same subject, so they could both implement the designed mystery in their class. They had one hour to design a mystery and prepare a short presentation. After that, there was half an hour for all the presentations. The teachers were asked to write down any feedback on a piece of paper and hand it to the presenters afterwards. Also, there was time for one or two public comments right after each presentation.

This method was the same in both the first and the second workshop. However, in the second workshop the pairs focussed on the engage phase (showmanship) and the cognitive strategies of the mystery they had designed during the first workshop.

- Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.
  - Article: *Beyond the Scientific Method: Model-Based Inquiry as a New Paradigm of Preference for School Science Investigations*

This provided a theoretical basis for the TEMI method of inquiry based learning. We discussed the article during the workshop.

- Please describe any tasks that were set for the teachers in between workshops.
  - Implement designed mystery in classroom
  - Article: *Extract from: Advances in Research on Instruction*

At the beginning of the second workshop we discussed the experience of implementing the mysteries in the classroom. Also, we discussed the article. This gave the teachers a theoretical background in cognitive strategies.
Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

There were 2 teachers that unsubscribe after the first workshop, because something came up on the date of the second workshop. Also, during the first workshop there were 3 teachers that left after the dinner break and didn’t come back for the second workshop. One of those announced this beforehand.

In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?

At the beginning of the second workshop, we held a discussion on their experiences with implementing their mysteries.

Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

No.
In order to evaluate the training methodology, we kindly ask you to answer to the questions below. These items will be reviewed in the Skype/Hangout conversation that we will organize after your workshops. You can answer synthetically in written form, and then elaborate on some of these issues during the interview.

You can answer by directly writing in this word document. Thank you for your collaboration!

Organizers: UL
Date: 15/01/13- Workshop 1, 05/04/13- Workshop 2
Place: The University of Limerick, Limerick.

1. The 4 innovations

The TEMI training methodology is based on 4 main innovations. Please comment on each of them.

1.1. Innovation 1: (Productive) Mysteries to create curiosity

- How was this innovation presented? (please describe in several sentences, and make reference to the materials you’ve submitted)

Workshop 1:

1. We demonstrated The Blue Bottle demonstration. The liquid inside the bottle goes colourless on shaking, but returns to its original blue colour when left to settle (see Powerpoint slides for Workshop 1 Session 1).

2. We showed a video of a Rolling Uphill demonstration where a pair of cones are glued together and placed on a pair of rails that are set at an incline. The glued pair of cones roll up the incline, seemingly defying gravity! (see Powerpoint slides for Workshop 1 Session 3).
3. We compared two approaches to teaching density: the traditional approach and the TEMI approach. The traditional approach started by giving the definition and the formula for density, doing some calculations, then some experiments to measure the density of regular and irregular objects and finally finishing with a test. This approach is often used in schools and was one that all participants were very familiar with. The TEMI approach started with the question: ‘why does one can of Coke sink in a tank of water and the other one float?’ (Engage), then moved on to some density tower experiments (Explore), explanations of what was happening, introducing the density triangle (Mass, volume, density) (Explain), and exploring the idea further by looking at everyday applications of density (Extend), again, before finishing with a test (Evaluate). (see Powerpoint slides for Workshop 1 Session 2)

Workshop 2:

Each in-service teacher demonstrated the ‘Engage’ part of their developed TEMI lessons in the laboratory.

• How were its differences to traditional practice made clear?

In Workshop 1, we introduced mysteries 1 and 2 without telling the audience (participants) what the mystery was. Instead, we asked them probing questions about the mystery which led them to finding out the scientific explanations. For mystery 3, we compared traditional practice with TEMI practice for teaching the same topic.

• How was it made concrete with real examples in a science lesson?

Mystery 1 – Link to syllabus: Oxidation & reduction. Everyday example: The process of rusting.

Mystery 2 – Link to syllabus: Forces (centre of gravity) & motion. Everyday example: Reason why double-decker buses have a wide base and narrow as they reach the roof of the bus.

Mystery 3 – Link to syllabus: Density. Everyday examples: Reason why a Diet Coke can floats and a regular can of Coke sinks in water, why oil floats on water, why an iron bolt may sink in water yet a ship can be made out of iron etc.

• How was the lesson design task or another approach used to practise it?

The teachers worked together in groups of 3’s and 4’s (with one pre-service science teacher in each group acting as a mentor) to design lessons using mysteries following the 5E model. Each group then presented their lesson ideas to rest of the groups.

1.2. Innovation 2: 5E learning cycle for teaching concepts

• How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

We presented the 5E cycle to the teachers and explained how it provides a structure for developing an enquiry-based lesson plan. We placed a particular focus on the
‘Engage’ phase, highlighting its importance in motivating students and grabbing students’ attention at the start of a lesson by raising questions (see Powerpoint slides for Workshop 1 Session 1).

- How were its differences to traditional practice made clear?

The difference between the 5E model of enquiry-based teaching and traditional practice was made clear by presenting the two different teaching approaches when teaching the same topic (density). The main difference being that the Engage and Explore stages come before the Explain stage, unlike traditional practice where students are ‘given’ information without having to think about it or engage with it at all.

- How was it made concrete with real examples in a science lesson?

We used the density lesson as explained previously.

- How was the lesson design task or another approach used to practise it?

In Workshop 2, each teacher worked with one TEMI team member and one pre-service science teacher in designing a full 5E lesson based on a lower secondary topic that was their least favourite to teach. The idea for this being that each teacher would go home with an exciting lesson plan to teach a topic that they find boring and/ difficult.

1.3. Innovation 3: GRR model for teaching skills

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you've submitted)

- How were its differences to traditional practice made clear?

In workshop 2, the teachers shared their experiences about implementing their developed TEMI lessons. Some of the teachers identified the challenge of prompting the pupils during the Explore phase of the lesson. All of the teachers agreed that the ‘Engage’ activities were effective, but in some cases (depending on class group), it was difficult to facilitate the pupils’ exploration of the concept. In many cases, this was because this teaching approach was unfamiliar to both the teachers and the pupils. The pupils were accustomed to the teacher giving the ‘correct answer’ or explanation.

- How was it made concrete with real examples in a science lesson?

Through discussion in workshop 2, the participants reflected on concrete ways that they could facilitate the pupils’ exploration in the science lessons. Examples of this included providing the pupils with an identification key, limiting some of the variables in an investigation, ensuring the pupils had a rationale and hypothesis for their investigation.

- How was the lesson design task or another approach used to practise it?
This was discussed in workshop 2 using lesson tasks that the pre-service teachers had developed between both workshops. The teachers discussed how to implement the GRR model with relevance to their own developed TEMI lesson ideas.

1.4. Innovation 4: Showmanship techniques to maintain motivation

- How was this innovation presented? (please describe in several sentence, and make reference to the materials you’ve submitted)

Showmanship was not explicitly introduced to this cohort of teachers. However, the teachers were made aware of the importance of ‘how’ they engage the pupils and introduce the lesson.

- How were its differences to traditional practice made clear?

Unlike traditional lesson introductions, the teachers were made aware of other possible ways of introducing the mystery at the beginning of a lesson; telling a story, presenting a problem, playing a short video clip, using a relevant extract from the news, demonstrating a discrepant event etc.

- How was it made concrete with real examples in a science lesson?

The teachers were reminded that the lesson should not begin with a definition or explanation, but instead with a question or problem. How the teacher presents this question to engage the pupils is essential to maintaining motivation.

- How was the lesson design task or another approach used to practise it?
2. CPD Framework

- How many workshops did you run, and what was the actual teaching time in each?

We ran two workshops:

**Workshop 1 (15/01/14)**

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<tr>
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<tr>
<td>Preparation time</td>
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<td>Time developing and implementing TEMI lessons (spent by teachers)</td>
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<td>Follow-up time</td>
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<td><strong>Total time</strong></td>
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**Workshop 2 (05/04/14)**

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<td>Preparation time</td>
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<td>Follow-up time</td>
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<td><strong>Total time</strong></td>
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• Please tell us which of the 4 innovations were in each workshop. If this is different to the Sheffield pilot, please say why.

Workshop 1 – Mysteries, Showmanship & 5E Model.

Workshop 2 – 5E Model, Showmanship, GRR Model.

• What was the time gap between workshop 1 and workshop 2?

11 weeks

• Please describe the 'Lesson Design' session where teachers practise the innovations by creating a TEMI mystery lesson. In particular comment on any differences compared to the Sheffield pilot.

Our ‘Lesson Design’ session was very similar to that of the Sheffield pilot. Teachers worked together collaboratively to design a TEMI mystery lesson, after experiencing a TEMI lesson simulation. In our workshops however, there was always one pre-service science teacher in each group acting as a mentor (as they had a lot experience in developing the TEMI lessons as part of their Final Year Research Project).

The Lesson Design session in Workshop 1 primarily focused on the 'Engage' phase of the 5E Model. The Lesson Design session in Workshop 2 focused equally on all Es of the 5E Model.

• Please describe any 'pre-tasks' you set teachers before the workshop and how it linked with the workshop content.

Teachers were given the opportunity to trial/evaluate TEMI lessons from a TEMI Scientific Mysteries module that was developed by one of the pre-service science teachers as part of his Final Year Research Project. This gave the teachers a sense of what TEMI was about before coming to the first workshop.

• Please describe any tasks that were set for the teachers in between workshops.

After Workshop 1, the teachers had to complete the following tasks before Workshop 2:

✓ Implementation of at least 5 of the prepared TEMI lesson ideas
✓ Development of at least 2 new TEMI lesson ideas
✓ Upload the new developed TEMI lesson ideas onto the UL Google Drive folder
✓ Actively contribute to discussion/comments on the UL Google + Forum
✓ Completion and return of TEMI Teacher Diary
✓ Completion and return of TEMI Teacher & Student Questionnaires

• Were all the same teachers present for both workshops? If not, please explain the difficulty and how you coped with this.

One teacher was unable to attend the second workshop due to falling ill (this teacher will attend the second workshop with the next cohort of teachers). This did not cause much difficulty.

All of the other teachers were present for both workshops.

• In the second workshop, what opportunity did you give for teachers to reflect on their school experience of using TEMI innovations?
Each teacher was asked (prior to the second workshop) to give a presentation at the workshop, based on their experiences of implementing TEMI style lessons in their schools. They were also asked to comment on their pupils' reactions in this presentation.

- Did your second workshop change in any way after feedback from the first workshop. Please describe significant changes and why they were made.

Following the first workshop we decided to:

1. Place more of a focus on the development of a whole lesson based on the 5E model, not just on the 'Engage' phase. This was done in order to make teachers feel fully confident in teaching through enquiry.

2. Include a one hour-long session in the laboratory in the second workshop to get the teachers actively involved in the workshop by presenting their own 5E TEMI lesson. [This turned out to be the teachers’ favourite part of the second workshop].