The Israeli TEMI case

The Israeli TEMI case: Adaptation of TEMI modules to the local context

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Organisation of the project

In Israel, the TEMI team at the Weizmann Institute of Science led two types of training programs: One which was open to all chemistry and science teachers (four cohorts), and the other which was part of a chemistry teachers' course at the Weizmann Institute (two cohorts). Overall, 120 teachers underwent intensive TEMI training at the Weizmann institute. The teachers were recruited through: (1) personal communication (via teachers who have undergone a CPD course at the Weizmann Institute previously), (2) the National Center for Chemistry Teacher, and (3) advertising in appropriate local science education websites.

The TEMI training programmes at the Weizmann Institute consisted of a two day intensive workshop over the summer school break. It allowed teachers to be immersed in the TEMI philosophy and the specific TEMI teaching style as well as learn practical examples that they could use in their classes. The summer workshop was followed by several afternoon meetings scattered over the school year. The scattering of these meetings allowed teachers to enact TEMI activities in class and report about them.

In the Israeli context, IBSE has been an integral part of the chemistry curriculum for many years. Many science teachers in Israel are familiar with IBSE, and therefore we were able to focus on the other TEMI innovations, specifically on showmanship. In our workshops we included many elements of storytelling, drama and presentation skills. We invited actors and experts to provide sessions on good storytelling, drama, presentation skills and physical theatre using masks. All training programmes were performed using the GRR methodology, in which the teachers act as students experiencing the mysteries. They gradually were responsible to develop their activities, gained a sense of ownership towards the program, and as a consequence presented the activities at local and national meetings. One of the science teachers who attended a conference in which TEMI activities were presented, claimed:

"I always thought that Chemistry was interesting enough … but there are always those [students] who are simply not interested, so I understood that I can reach a wider student audience if I will tell a story … now I also know that I can't come to class with a hunched back, because the body communicates as well.."

Teachers' feedback

Many of our teachers from the first TEMI cohort continued their collaboration with us, and they kept asking and looking for new TEMI activities. “Ready-made” TEMI activities were welcomed by the teachers, but they revised them according to their needs. They created their own TEMI-style activities, tried them out in class and reported about their experience to the workshop leaders as well as to their colleagues. This enabled a significant exchange of ideas.

We found out that teachers needed to feel confident with using the various strategies in teaching mysteries. For example, some of the local TEMI activities begin with a short story. In teachers' feedback we found out that teachers adapted the story to their own style. Those who were 'natural' story-tellers took the basic story and elaborated on it by adding details and narratives. Those who did not feel comfortable in telling a story, found other way, such as adapting the activity with a little introduction that did not require intricate story-telling skills.

The activities that were least welcomed in the CPD were those that had to do with pure drama. Teachers often found it outside their comfort zone and difficult to engage with. However, despite this sense of discomfort, these activities had an impact on teachers' awareness of their teaching.

Relevance to science education in Israel

Most of the Israeli teachers follow the Israeli science national curriculum, and therefore, in the

TEMI workshops we try to match the contents of TEMI modules to its requirements. Moreover, we plan some activities according to the national holidays, e.g., "A candle activity around Hanukah". The chemistry matriculation examinations also influence the development and implementation of TEMI models in Israel. The chemistry examinations include an IBSE unit, based on portfolio assessment which each student has to submit. Most of TEMI activities were developed with this in mind. For example, while implementing "The sea sand overseas" activity, the teacher engages students with a short story of a friend who was invited to a sand castle building competition, and received special hydrophobic sand to build a sandcastle. Students are then led to explore the properties of the sand and subsequently design and conduct a semi-open inquiry experiment which they place into a portfolio, in which they collect all their IBSE activities.

Future plans

Many of the TEMI activities were presented in different CPD workshops and we thus hope their legacy will continue. The main strength of the TEMI approach is in its powerful engagement of students. We filmed some of our activities to facilitate future implementation of TEMI in class. Most activities are easy to conduct, and do not require special equipment, but there are still some teachers who feel uncomfortable presenting a story, or doing some form of showmanship. Therefore, we conclude that despite the good will of many science teachers, those who will not attend a TEMI workshop will face difficulties in implementing TEMI's activities properly. However, we hope to be able to integrate TEMI workshops all over the country in different science programs.

Examples from the Israeli context

The Israeli team has planned several original TEMI activities such as "The Chemical Clock", "The Sea-sand Overseas" and "The Disappearing Lab Report". These can be found in the TEMI Book of Mysteries (http://teachingmysteries.eu/wp-content/themes/temi/pdf/Temi_teaching_guidebook.pdf) and in several other publications. In this article we want to describe the process by which TEMI-style activities can and should be adapted to the local context.

One of the goals of TEMI program was to exchange ideas between the different partners. Thus we incorporated several activities planned by different TEMI partners into our teacher training. Upon doing so, we realized that these activities must be adapted to the local context and seasoned with local spices in order to be suitable for use by the Israeli teachers. To highlight the adaptation process we provide three concrete examples. We hope that these examples can help educators who wish to use TEMI.

(1) Chemical Garden

The Chemical Garden TEMI activity was originally planned by the German TEMI team from the University of Bremen. The "Chemical garden" experiment is based on a well-known demonstration used to discuss the chemistry of salts, solubility, diffusion, and solutions (Dittmar, Mueller, & Eilks, 2015; TEMI project, 2015). The Bremen team adapted it to TEMI's rationale. In the experiment different salts are added to a water glass solution (sodium silicate). Within minutes or hours colourful structures are formed through precipitation, hence the name chemical garden (see Figure 1).

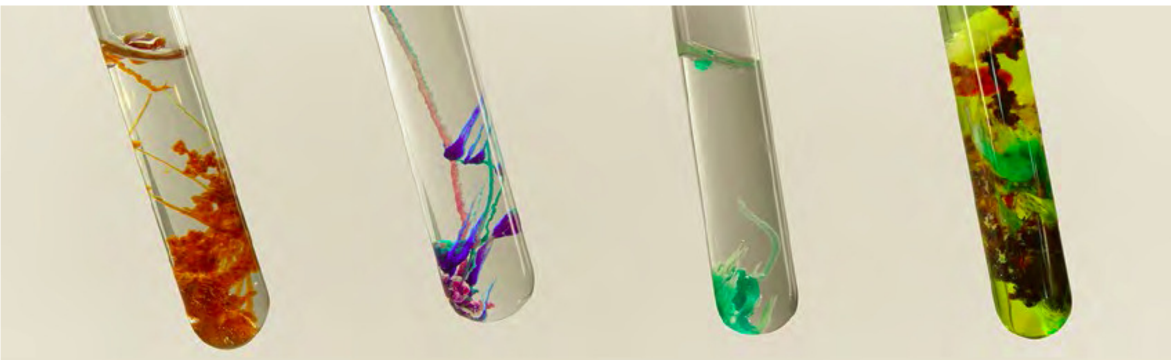

Figure 1: Samples of the "Chemical garden". Each colour is caused by a different metal salt added to the water glass (from TEMI project, 2015, p. 26)

The Chemical Garden has a special Israeli context. In 2003 the first Israeli astronaut, Ilan Ramon joined a NASA mission (STS-107) on the space shuttle Columbia. During the mission Ramon performed experiments designed by Israeli high school students. One of these experiments was the "Chemical garden". The purpose of the experiment was to try understanding the mechanism of crystal growth by performing the experiment in microgravity aboard the orbiting NASA space shuttle, which was suggested to be influenced by gravity (at the same time a control experiment was conducted simultaneously on earth). Sorrowfully, the mission ended in a tragic explosion of the shuttle as it entered earth atmosphere.

This story is strongly embedded in the Israeli collective memory and we thus wanted to use it to engage students and teachers in this activity. We started the activity by asking participants to close their eyes. We then played an audio track of space centre control (in Houston, Texas) playing a Hebrew love song (the first Hebrew song to be heard in space) picked by Ramon's wife (the Israeli astronaut) to wake up the astronauts in orbit. At the end of the song we told the story of Ramon, the mission, the students' involvement in the "Chemical garden" experiment, and the tragic end:

"On February 1, 2003, NASA mission STS-107 was to come to an end with the landing of Columbia in Cape Canaveral, Florida. Due to the historic significance, a live coverage of the event was broadcasted in several Israeli channels. The families of the astronauts were seen waiting on a podium with a clock counting down the time to the landing. When the clock showed zero no space shuttle was to be seen. A few minutes later the families were taken off the podium. Something had gone wrong. The space craft never landed. It disintegrated upon its return from Orbit above Texas."

The rest of the activity was performed followed the 5Es learning cycle as suggested by the Bremen TEMI team: In the explore stage we let participants try making their own "Chemical garden". We then explained the phenomenon in the "explain stage". The "extend stage" went back to the original story. We presented the results of the space experiment and explained how they differed from the results obtained on earth. Finally, in the "evaluate stage", participants were asked to photograph their "Chemical garden", and explain in their own words how it is created.

The "Chemical garden" activity is a well-known fascinating experiment. In planning our activity, we took advantage of an emotionally engaging context of space travel to attract the participants to do this experiment. The emotional motivation is prolonged, since the results of the experiment are not presented until the end of the activity (the "extend phase").

(2) How can we produce silver and gold out of copper? The activity *"How can we produce silver and gold out of copper"* was introduced by the Czech TEMI team from Charles University in Prague (see p. 16). In this activity, a copper coin is dipped into a boiling solution, and when it is removed from the solution the coin magically turns into "silver". The coin is then placed on a hot plate and magically transforms its colour into "gold".
The first stage involves the production of zinc which coats the copper coin and looks like silver. In the second stage, when the zinc-coated coin is heated, the zinc coat reacts with the copper and a golden coloured alloy, brass, is formed on the coin. The coin looks as a gold coin. Our review of this experiment revealed different implementation directions:

- Adding a short story that is set in the historical background of the alchemists, who tried to transform simple metals into gold. They were working in the framework of Aristotle's theory, and their ideas seemed to be unrealistic. However, modern science indicates that it can be done by radiochemical reactions. Referring to historical events in science, may show a broader picture of the development of science and the meaning of the nature of science. In this case, for example, teachers may point out the contribution of the alchemists to developments in metallurgy or in pharmacology.

- A few teachers suggested connecting the experiment to Archimedes' law, and asking students to experiment and calculate the density of the metals and then decide whether the coins were made of gold and silver. The results of this experiment were not good. However, after experimenting and many deceptions, the teachers who suggested this direction abandoned it as well.

- One of the teachers came up with the idea to combine the experiment with a real story about the alchemist Nicolas Flamel who lived in Paris, 1330-1418 (mentioned in "Harry Potter").

In summary, the above experiment is one of the most favorite TEMI activities. Teachers who implemented it in their classes have presented it to colleagues in various teacher meetings.

In the context of the curriculum, teachers have used this activity as an introduction to Oxidation-Reduction reactions or to experiments on alloys.

(3) Genie in a bottle

The activity was originally devised by the Austrian TEMI team at the University of Vienna (see p. 30). The activity begins with a demonstration showing a corked bottle. Upon removing the cork nothing happens at first, but then a stream of white 'smoke', i.e. the Genie, gushes from the mouth of the bottle (see Figure 2).

Figure 2: Genie in a bottle.

Hydrogen peroxide decomposes into water and oxygen at a slow rate. Adding a catalyst increases the rate of reaction. The 'genie' is produced as water and oxygen gases are produced in the reaction and water is condensed as fog. SHU and UniVie TEMI teams use the demonstration to deal with catalysts and method of measuring oxygen production, Our team decided to deal with one common misconception: students think that fog (condensation of water) is smoke. Since the Israeli TEMI team focused on the showmanship skills and storytelling, this mystery was wrapped into a story, a personal story that the teacher tells about her/his grandmother who left a mysterious bottle before she died.

To adapt it to suit the Israeli context we made a couple of changes:

(1) We wanted to set the activity within a story;
(2) We extended the discussion about "What the Genie is made of".

Conclusions

In this article we describe the Israeli context in which TEMI operates. We described three TEMI activities developed by other partners and adapted to the local context. We hope that these examples and the process of adaptation will support and encourage teachers to consider adapting TEMI activities into their local context (national, local and even school contexts). The adaptation can be characterized by two aspects.

(1) Connecting the activities to the Israeli curriculum, which makes their implementation in class much easier, and

(2) The connection to the local context, which makes it more appealing for the teachers and students. We may conclude that making these adaptations made the activities more engaging and relevant to our Israeli teachers.

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On the next page the Weizmann team describes a TEMI lesson in detail.