Reflection on Vigyan Pratibha teacher

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Background

Teacher Professional Development (TPD) programmes are designed to shape teachers' understanding of learning content and associated pedagogies in a structured setting. Ideally, TPD programs should be accessible to all teachers. However, due to various practical constraints, particularly in Indian schools, access to quality TPD programmes remains limited. Consequently, teachers receiving these opportunities are perceived as 'agents' responsible for disseminating their learning to fellow teachers. With better access to teacher communities, trained teachers can help expand the impact of TPDs through a cascade model. Moreover, it is interesting to explore how online TPDs can contribute to the anticipated cascading of professional practices. Against this backdrop, this paper discusses one such online TPD, featuring a brief analysis of an exemplar 'electroscope-making' session, and explains the agentic behaviour of a participant teacher, Raziya.

The TPD session discussed here was conducted under Vigyan Pratibha, a teacher capacity-building programme funded by the Department of Atomic Energy and led by the Homi Bhabha Centre for Science Education (HBCSE). The programme aims to provide an interactive space and access to resources and pedagogies for high-school science and mathematics teachers, facilitating their efforts to create a conducive environment for enhanced science and mathematics learning. The programme primarily caters to teachers from Kendriya Vidyalayas, Jawahar Navodaya Vidyalayas, Atomic Energy Commission schools and select state government schools. Vigyan Pratibha TPD camps are residential in nature, typically lasting 4–5 days and held twice a year, with teachers attending both camps. During these camps, the participants explore unique perspectives to engage with science and mathematics content through specially designed interactive units and receive basic skill training in these subjects.

Vigyan Pratibha Online Discussion and Electroscope-Making Session

During the COVID-19 pandemic, like many other in-service TPD programmes, Vigyan Pratibha TPDs temporarily shifted to an online format. To continue discussions on learning activities and associated pedagogies, Vigyan Pratibha discussion series was organized on an online platform.

Each VPDS session was conducted in two parts, with a three-day gap between them. This structure allowed teachers, like students, to engage in an activity-based challenge, work on the assignments and discuss their insights on the learning activity with fellow teachers in the follow up (second) part. The participation was voluntary and open to all teachers.

The session analysed in this paper involved an in-depth discussion on material selection for the electroscope-making activity. Additionally, it explores the agentic attributes of participating teachers, particularly Raziya (a co-author of the paper), who extended her educational collaboration with the TPD organisers. Raziya's journey serves as an inspiration for teachers seeking professional development opportunities and envisioning the extent of their potential impact.

Why Raziya?

Raziya participated in one of the initial VPDS sessions and went on to attend many sessions during the pandemic. A physics teacher teaching students of Classes 8 to 12 for the past 12 years, she is passionate about science education and has been actively involved in various school activities Besides, she has mentored students during science exhibitions and other competitions.

Raziya was interviewed by the Vigyan Pratibha programme team as part of the feedback process for VPDS sessions. In her initial reflections, she highlighted how pedagogy discussions were the most engaging aspect of the sessions, drawing teachers like her to continue attending the online TPD sessions. During the interview, Raziya also briefly discussed one of the VPDS sessions on electroscope-making and volunteered to revisit the session proceeding with the team. She remarked, "This (electroscope) session became a triggering point for my extended connections with the VP organising team."

Following Raziya's interview, this session was further explored to understand the factors that made her take on the agentic role, as envisioned in the TPD cascade model, and the process through which she did so.

The reminder of this paper provides details about the discussions during the electroscope-making VPDS session from Raziya's perspective, her extended connections with the TPD team and how her journey serves an exemplar for understanding the widespread impact of TPD.

Session Overview

An electroscope is a device used to detect charge. The electroscope-making activity is developed under the Makers' Space initiative, another project of HBCSE, and is designed to facilitate participants develop ideation, design thinking and problem-solving through model-making. A core tenet in designing a constructionist learning environment is the creation of physical entities and engaging in conversations around the making

In the VPDS session, the facilitators tweaked the electroscope-making activity, considering the participating teachers and the overall nature of TPD. Teachers engaged in the electroscope-making activity in the same way as Class 8 or 9 students would in a science project or laboratory, with the freedom to choose materials for design. They worked on designing, building the device and sharing their experiences. Though discussions were impromptu based on the choice of materials selected by teachers, the facilitator intended such interactions to be a key feature of the TPD session. After the hands-on experience, there was an extended discussion focusing on making the activity pedagogically enriching for students in a classroom setting.

In the first session, the facilitator demonstrated different ways to make an electroscope, discussed material selection and explained its functioning. During the interview, Raziya said, "I enjoyed this approach as a participant, but even more as a teacher! I believe that students can also be introduced to concrete physical concepts by designing or constructing a device, observing its working and gradually exploring the governing principle behind it."

Raziya's reflections provided a closer review of the recorded session, with key moments identified as interesting nodes from her perspective.

Parsing Material Choices

When probed about the kind of discussions held during the session, Raziya said, "We talked about the materials used in different electroscope models. We also tried to reason why a particular material was selected."

Raziya recalled how the discussions progressed to deciding materials for the electroscope design. Some participants who had previously made electroscopes shared their material choices, which the facilitator listed as they shared their experiences.

The schematic (Figure 1) shows the list of choices. For the wire, choices included copper or aluminum, while thin aluminum foil was used for the strips. The deflection of the strips was observed using objects like comb, plastic scale, cushion, nylon hair, etc.

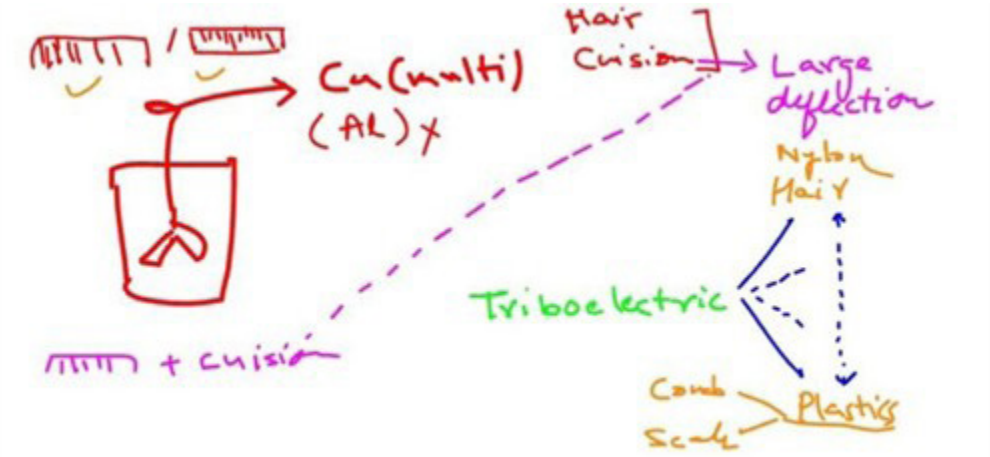

Figure 1: Triboelectric series exercise with identified materials for electroscope construction

Raziya paused when the schematic appeared and highlighted the facilitator's question: "How did you verify it (deflection), sir?" She pointed out that this question was raised when the teachers observed varying degrees of aluminum foil deflection with different materials and combinations. Raziya argued that the question effectively stimulated curiosity and encouraged in-depth reasoning. She added that one of the teachers mentioned about the triboelectric series to explain which combination or material led to maximum deflection. The schematic shows how the facilitator arranged materials like nylon, hair, plastic comb and plastic scale based on the teachers' descriptions of the deflection range, making it easier for fellow participants to follow with a clear visual reference.

During her secondary reflection, Raziya said she could also ask her students questions about materials that can be rubbed against each other to produce frictional charges. She pointed out other probing questions by facilitators, such as:

- "What determines which material should be used to charge the test object?"
- "How to determine the second object?"
- "Why does a particular substance behave this way (easily transferring electrons to another object)?"

Many of these questions were part of procedural discussions that Raziya identified as pedagogically important.

She added that the discussion could help establish a process of arranging materials in a certain order based on their charging tendency. The triboelectric series inherently follows the logic of arranging or ranking a range of materials based on their tendency to gain or lose electrons. Raziya found it engaging to apply this concept to the materials used in electroscope building, exploring how the triboelectric series aids in selecting appropriate materials for generating static charges while designing the model. She felt that the discussion seamlessly connected theoretical concepts with practical applications.

Brainstorming 'On-the-Go' Questions or Situations

Another noteworthy moment Raziya recalled was when a participant teacher, Abby (pseudonym), was explaining the charging process of an electroscope. Abby faced

difficulty in describing the stage where the leaves of the electroscope remained deflected even after the charged object was removed.

While watching the session video, Raziya recalled how her students had struggled to achieve sustained deflection in a pith ball-electroscope model, as described in their science textbook demonstration. She added that she had considered sharing this classroom experience with the fellow teachers during the session. The facilitator picked up Raziya's example for further discussion and suggested a method to reach a stage of in the electroscope charging process where the leaves remain deflected even without the charged object nearby.

"When a charged object is placed near the pith ball, the pith ball deflects. To reach the charged stage, an intermediate step is required where the electroscope is connected to the earth using wires while the charged object in its vicinity. Then, by removing the earthing and the charged object, sustained deflection can be obtained. The facilitator also demonstrated this process with the help of a video."

Raziya selected these examples for reflection, perhaps because she could herself experience the effectiveness of addressing spontaneous questions in a pedagogical context and valued their impact. Like Raziya, it is evident that incorporating such on-the-spot questions can create interesting avenues for teachers to bring some more relevant challenges and situations for discussions. In Raziya's words, "Just as I realised how I could have tackled this practical challenge experienced by my students."

Sharing of Electroscope-making Experiences

During the second session, the teachers were encouraged to discuss their electroscope designs, allowing them to explore intricacies of design and functionality through each other's models. This session was conducted after three days, during which 3–4 teachers, including Raziya, successfully created electroscopes.

Reflecting on the discussions, Raziya mentioned having several interesting conversations about design, material choices and working mechanisms through questions posed by both the participants and facilitators. She recalled, "Just to give an example, a teacher built his electroscope model using a coffee bottle, straw, copper wire, aluminum foil, compact disc and nylon cloth. He used a comb to rub against the nylon cloth to generate charges and shared his observations on the degree of deflection of the aluminum foil when the comb was brought close to the copper wire. He suggested that the deflection was proportional to speed of rubbing."

Raziya interpreted it as an exploration of the relationship between the speed of a moving comb and wire deflections. She also highlighted several passing comments, which may not have been discussed in detail but were significant in the TPD experience. For instance, she shared her initial attempts at electroscope construction using soldering wires, which were unsuccessful, leading her to switch to jumper wires. She discussed that probably the higher resistance of the wire resulted in a lower charge flow from the tip of the wire to the leaves.

She also recalled a query raised by another participant about whether air inside the electroscope or temperature variations affected the deflection of the metal strip in his model. The participants brainstormed possible answers to some queries and discussed what could be interesting to investigate further with students, including the impact of variables like the shape and weight of the deflection strip. After the discussion, Raziya reflected on how students might be interested in exploring material choices for electroscope construction and studying the effects of variables like humidity, temperature, foil shape, model symmetry, etc., on deflection.

The electroscope-making activity required the participants to think critically about diverse material selections. In the context of TPD, this session provided a platform for

considering multiple questions that arise while designing something, helping teachers refine their material choices and enhance their pedagogic preparation. Incorporating maker experiences into science learning enables teachers to place the process of making at the centre of learning, fostering deeper engagement with scientific concepts.

Blogging about the Tinkering

At the end of the first session, the teachers were introduced to the Metastudio open platform, developed for collaborative learning [3]. The objective was to encourage participants to use the platform to create and share blogs about their electroscope designs and tinker or engage in discussions with others beyond session participants.

Raziya presented her electroscope design during the VPDS session and also documented her model-building experience on the Metastudio platform. The Metastudio website features 'Build Your Own Electroscope' blogs, where Raziya's blog is included alongside those of previous participants.

Reflecting on this experience, she noted, "It was interesting to explore this online collaborative space on my own before recommending it to my students. I decided to incorporate the electroscope-making activity into my teaching plan for that year. Despite limited material options during the peak of the pandemic, we managed to carry it out successfully."

Going Beyond the Session in TPD Setup

Shortly after the session, Raziya expressed interest in getting more involved in Vigyan Pratibha activities. The following year, she was awarded a teacher fellowship, enabling her to spend time with the Vigyan Pratibha team and contribute to the planning of new TPD sessions and resource materials. Raziya continued conducting electroscope sessions with her students at school. Besides, she participated in various Vigyan Pratibha activities discussed in VPDS sessions. She shared these learnings with fellow teachers at her school who could not attend the sessions. Eventually, Raziya became a key team member for organising activities in her school and neighbouring schools. Additionally, she shared her experiences in conferences and forums.

Broad Takeaways

This article serves a dual purpose. Much of the anecdotal evidence discussed was selected by Raziya (the co-author) during reflections and presented by other authors. So, the process of member-checking strongly validates these discussions. The session featured rich discussions, and Raziya's post-facto reflections highlighted the significance of many conversations. Raziya emphasised that these discussions were not only important during the electroscope-making process but also pedagogically relevant for recreating similar experiences for students. In this way, she reestablished the pedagogical strength of the VPDS session.

The COVID-19 pandemic was a challenging period and demonstrated how teachers could continue their professional training and make it more meaningful for themselves and their peers who missed out such opportunities. Teachers participating in TPD should incorporate such reflective exercises more often in their professional practice and encourage other teachers to replicate this experience for students.

Raziya's journey demonstrates how pedagogical discussions and design experiences can be extended to fellow teachers, depicting her agentic attributes. Her ability to leverage these experiences for professional growth serves as an inspiration for other teachers to derive maximum benefits from similar TPD programmes.

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