RBPT Workshops in Mohali and Tezpur, 2017

Report of the Workshops at IISER, Mohali, and the University of Tezpur, January 2017

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1 Introduction and context

These two Workshops were the first part of a multi-year programme, funded by Newton Bhabha Fund, using colleagues from the UK and India, to support development of a more research-based pedagogy in Indian universities and colleges. The Workshops were developed from a pilot in Pune in March 2016.

The UK partner was a team from the Centre for Science Education (CSE), part of the Centre for Development and Research in Education (CDARE) located in the Sheffield Institute of Education at Sheffield Hallam University. CSE has extensive experience in student-centred and inquiry-based curriculum development and professional support in the UK and across the world. Supporting CSE in India were colleagues from IISER, Pune and the British Council.

In total, over 150 university lecturers attended the two Workshops and participated in three days of training and development. The detailed programmes are given later in this report but the Workshops' intended outcomes were to support Indian teachers as they:

- explored the nature and purpose of Research-Based Pedagogical Tools (RBPT)
- considered implementation opportunities and issues for RBPTs at their own colleges
- acquired RBPT-development skills
- created a draft of an RBPT suitable for their own college
- linked with other teachers facing similar challenges

The facilitators from SHU also looked for potential candidates for the Level 2 courses to follow later in 2017. This course would train people to develop the initiative further in India and act as trainers of further teachers as required.

2 Generic activities

These activities looked at general issues related to pedagogy and learning theory rather than particular aspects of subject disciplines. Delegates worked in mixed discipline groups to tackle the activities which included reviews of the characteristics of a perfect student and a situational audit which grounded the proposed initiatives in the delegates [personal and professional contexts.

The perfect student

The delegates were asked to create a simple poster to show the characteristics of their 'perfect student'. This was to encourage delegates to consider not simply the content to be covered in the courses but also the skills and attitudes that saw as fundamental to being an effective scientific researcher and learner. This helps to 'reset' the discourse of the Workshop slightly from students as 'passive receivers' of knowledge into students as 'active researchers' in their own right with skills and motivations that can be helpful to teachers.

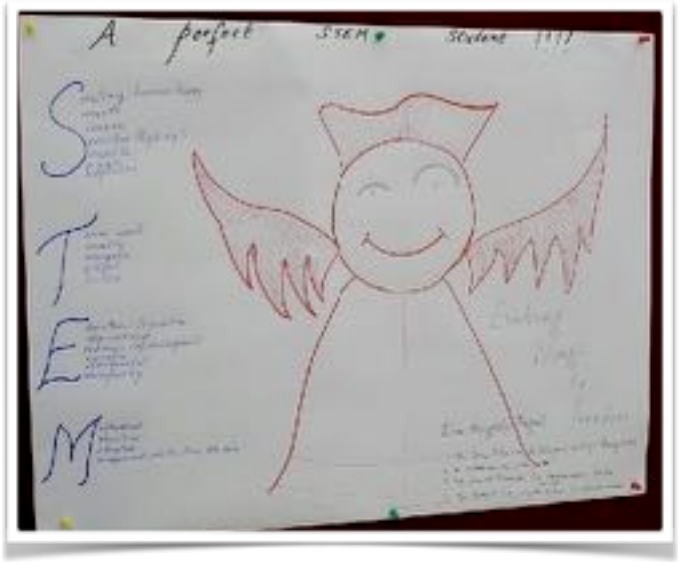
The posters were characteristically humorous yet thoughtful and had obviously been produced as a result of some discussion. The key points to draw out were:

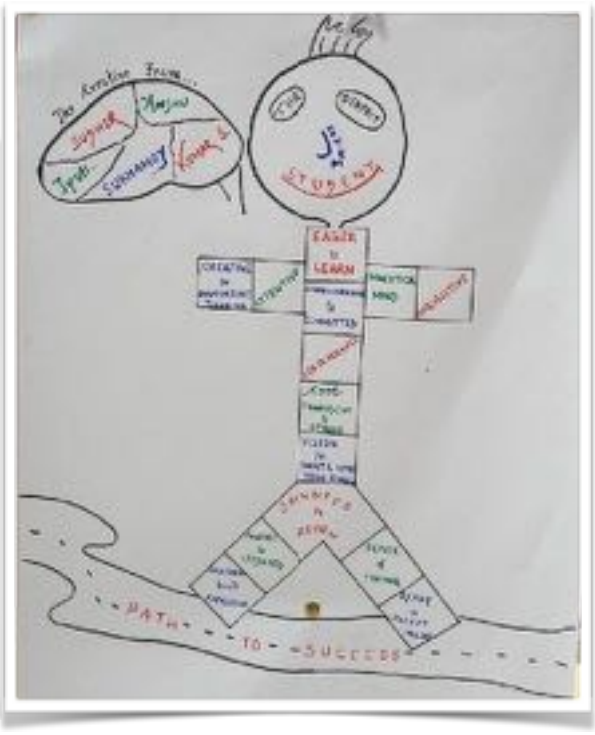
- 'Curiosity' was highly valued. Many posters described the perfect student as being curious/ inquisitive / enthusiastic with it often being the most significant aspect. This aspect of the 'perfect student' was also repeatedly emphasised by teachers during discussions with the facilitators.
- 'Hard-working' and 'punctual' also appeared ion the posters often - the traditional virtues all teachers hope for in their students. It was clear that teachers had high expectations of their students in terms of effort and behaviour. More than one poster included the phrase 'eager to learn'.
- More rarely mentioned, but still present in a significant number of posters, were words like 'innovator' or 'creative'. This seems to imply that teachers recognise that the 'perfect student'

will do more than simply turn up on time and complete the set work. This is an encouraging attitude given the close link between creativity and research.

- Other skills that were mentioned regularly included teamwork, social skills and communication skills. Clearly while much of the discussion in the Workshop concerned the ever-present demands of the curriculum and the content to be covered, when teachers have chance to reflect a little more freely they do value these 'soft skills' highly.
- A feature of a wide range of posters was the inclusion of skills and activities beyond the traditionally 'scientific'. One talked about 'lots of hobbies' and being 'a good reader of books' while others included graphics showing artistic and cultural activities. The 'perfect student' is clearly a more rounded and complete character than simply a focussed, proficient laboratory technician.
- One particularly noticeable poster was produced by 'Team Naughty Angels' which recognised, amongst other characteristics, that a scientist and researcher sometimes needs to be a bit 'naughty' to push things forward and develop new ideas!

While the characteristics of the perfect student are not surprising they do reveal the eventual aim of teaching and learning - to create well-rounded, confident, skilled young people who can actively engage with research rather than simply covering the list of content prescribed in the curriculum documents. The posters were referred to during the rest of the Workshop both in terms of our 'aim' and also to help us think whether the activities and tasks we were asking students to engage with would support the development of the curiosity, creativity and self-discipline that we had identified as the characteristics of the perfect student. On more than one occasion we asked 'What would the perfect science teacher look like from the point of view of our students?'

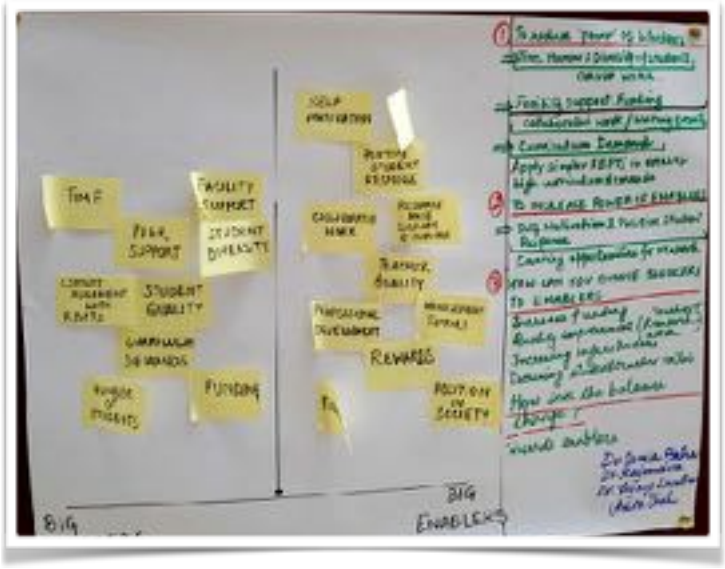




Blockers and enablers

If the perfect student posters allowed delegates to consider the purpose of teaching unencumbered by reality the blockers and enablers activity sought to fix their thinking in everyday reality. The task required delegates to consider factors that would affect their progress towards a college that routinely produced 'perfect' students. These factors could then be split into two groups: blockers which impeded progress and enablers which promoted progress.

These blockers and enablers could then be shared in small groups to look for commonalities and to explore ways to reduce the impact of blockers or increase the effect of enablers.



Typical blockers included:

- Lack of resources - including laboratory space and learning resources.
- Management disinterest, interference or obstruction.
- Strong assessment focus in students and on the course - there is little appetite to take risks introducing something new.
- Heavy content demands - too much to cover in the time available.
- Student diversity - the wide range of ability and commitment in the student body

Typical enablers included:

- Activities which were fun which could motivate students and teachers.
- Rewards for achievement - if targeted at research-based activity rather than completing the course content.
- Recognition - by peers and management.
- Working in teams - this appeared often amongst the enablers alongside collaborative work.
- Professional development.
- Management support.
- Resource base: library, e-journals.
- Positive feedback from students - particularly where this manifested in improved attitudes, efforts and achievements.
- Increased funding.

Summary insights

The list of blockers is depressingly predictable and matches similar lists produced by equivalent teachers in the UK and elsewhere. The lack of appropriate resources (both physical lab space and

learning materials) is a serious problem for many delegates and the heavy content demands of the curriculum (both absolute amounts of material to be covered and the time available to cover it) is, and is seen as, a powerful block on the development of more research-based teaching. The size of teaching groups was also cited by a number but this seemed to vary considerably across the delegates - for some it was clearly a major problem whereas for other the group sizes were manageable (even if a reduction in group size is generally desirable). All these factors tend to push teachers to a more didactic approach to teaching in the belief that it is easier to manage and 'safer' (in terms of content coverage) than more exploratory and active approaches.

Reducing the impact of the blockers is not easy as many of the factors are outside the control of the teachers. One delegate suggested in their evaluation form that CSE should run a workshop for people who plan curricula to ensure content demands were reduced! While this is clearly beyond the CSE team's remit and we suspect the delegate added the comment more in hope than expectation it may be worth Indian colleagues revisiting science and mathematics curricula at undergraduate level. A shift to overt coverage of research skills would provide a powerful message to all teachers and encourage the minority who have been lucky enough to attend RBPT-style courses.

Conversely, the wide range of enablers reported is encouraging and demonstrates that teachers see each other as potentially major supporters. Teamwork, collaboration and the recognition by peers figured in a number of posters. While the blockers tells a difficult task the enablers speak of a potential community of teachers who could work together to push change forward. Support from management and increased funding would help with this and were mentioned repeatedly but it was impressive to see the general tone of the comments - that teachers are planning to move forward rather than waiting for circumstances to change. The response of students was also seen as a potential enabler. Where students respond well to new approaches teachers will feel more confident and push further into research-based pedagogies.

Increasing the effect of the blockers depends less on reducing barriers (content load etc.) and more on empowering teachers to collaborate and support each other. Workshops like the ones in Mohali and Tezpur have the double benefit of bringing teachers together and providing professional development in an environment where they have time and space. Any opportunity to link delegates through online networks (formal and informal) which could offer support, further training and eventually learning materials would be invaluable.

3 The workshop programmes

Thursday 10th March 2016
Both Workshops were designed to support lecturers as they move towards a greater involvement of research-based pedagogies in their day-to-day practice.

Both Workshops followed the basic structure given below. They began with an evening session including a welcome from the host institution and a keynote talk looking at the the nature and potential of Research-Based Pedagogical Tools.

Day Two continued by exploring hopes and concerns about the coming Workshop and sought to identify the characteristics to develop in students. It then looked at what teachers can do, or stop doing, to make this development more assured.

Days Three and Four were devoted to creating first drafts of teaching and learning approaches based on the identified best practice. By the end of the Workshop delegates had an initial draft of projects and a range of contacts with supportive colleagues who are developing complementary resources.

Day 1

Time	Activity	Format
6:00	**Introduction** Opening remarks by Director, IISER Pune and Sponsors of the Workshop.	Talk
6:15	**Formal Inauguration** Remarks by IISER Mohali/ Tezpur University	Talk
6:30	**Remarks from British Council** Welcome from British Council	Talk
6:45	**Research Based Pedagogical Tools** An introductory talk showcasing the characteristics and applications of Research Based Pedagogical Tools.	Presentation
7:30	**Dinner**	

Day 2

Time	Activity	Format
9:00	**Introduction and 'three in three'.** Why are we here? A review of what we all hope to get out of this workshop. Creating our 'top three' ambitions for the next three days.	Discussion
9:45	**The perfect student** In groups, prepare a poster to showcase the perfect student - their interests, attitudes, work habits and ambitions. What are we, as teachers, working towards?	Workshop
10:30	**Poster review and plenary** Delegates review the posters of the perfect student to agree the key characteristics and suggest the things teachers can do to help this person develop - or restrict their development. What are the common issues?	Discussion and poster review
11:00	Coffee	
11:30	**Blockers and enablers** Delegates work in groups to review the factors that will help in the creation of the 'perfect student'. Sorting these factors into 'blockers' (they make progress more difficult) and 'enablers' (they make progress more likely). Grading these blockers and enablers into large and small importance.	Discussion and poster review.
12:30	**What works?** A showcase of the strategies that have been used across the world to implement RBPTs.	Presentation
1:00	Lunch	
2:00	**Existing resource review (1)** Reviewing a range of RBPTs from different countries and disciplines to gather ideas and approaches that contribute to effective RBPTs.	Workshop.
3:30	Tea	
4:00	**Existing resource review (2)** Reviewing a range of RBPTs from different countries and disciplines to gather ideas and approaches that contribute to effective RBPTs.	Workshop.
5:00	**Plenary** Drawing together insights to create success criteria from the day and setting up the tasks for Day Two.	Plenary
	Free time	

Day 3

Time	Activity	Format
9:00	**Introduction** A brief review of issues and insights arising from Day One. A structure to develop new RBPTs presented. Delegates put into groups for the RBPT writing task.	Presentation
9:30	**RBPT workshop (1)** Delegates work in groups to produce RBPTs suitable for their particular circumstances. These will be produced as a display which grows throughout the day. **INPUT**: What makes a convincing context?	Workshop and display creation.
10:30	Coffee	
11:00	**RBPT workshop (2)** Delegates work in groups to produce RBPTs suitable for their particular circumstances. These will be produced as a display which grows throughout the day. **INPUT**: Codifying problems - what works (and doesn't)?	Workshop and display development.
12:30	Lunch	
1:30	**RBPT workshop (3)** Delegates work in groups to produce RBPTs suitable for their particular circumstances. These will be produced as a display which grows throughout the day. **INPUT**: The (teaching) principles for the(learning) job - what can you do to help them understand?	Workshop and display development.
3:00	Tea	
3:30	**RBPT review** Delegates critique work from all the groups and collate any good ideas and approaches while offering feedback to others. **INPUT**: Assessment - which approaches are suitable for RBPTs?	Discussion.
4:30	**Plenary** Drawing together insights from Day Two and setting up the tasks for Day Three.	Plenary
5:00	Free time	

Day 4

Time	Activity	Format
9:00	**Introduction** Drawing together insights from Day Two and presenting the tasks for Day Three.	Presentation
9:45	**RBPT workshop (4)** Delegates work in groups too finalise their RBPTs drawing in insights from the previous day's feedback. **INPUT**: Considerations when implementing change - how can you embed these proposals in your situation?	Discussion and poster creation.
10:30	Coffee	
11:00	**Exhibition** Delegates present their finished resources to ensure all participants benefit from the work.	Presentation and discussion
12:30	Lunch	
1:30	**Action planning** Delegates consider how the RBPTs will be developed and deployed in their own situation. Collaborative groups created for future development as appropriate.	Workshop.
3:00	Tea	
3:30	**Closing session** Summary of key insights from the workshop. An opportunity for delegates to ask questions of the trainers and peers.	Workshop.
4:30	Finish	Plenary

4: Reports from subject-specific subgroups

The following brief accounts give details of the work in the subject specific groups.

Biology 1 (Julie Jordan and Gareth Price)

The Biology groups were collapsed to form a single group which was supported by both Gareth Price and Julie Jordan. In both Mohali and Tezpur the delegates' work was of a high standard although they did seem to find it a little difficult to distinguish between research and the operation of a laboratory procedure. Often the initial suggestions involved operating a procedure (e.g. testing for chicken DNA, assessing microbial load of food, surveying trees in an area etc.) rather than identifying a rigorous research question (e.g. what factors affect the growth of mushrooms on kitchen and food waste?). However, with support both groups moved away from a 'procedural' to a 'research' focus and the suggested RBPTs at the end of the Workshops were of high quality. Particularly notable was the way delegates very quickly developed compelling and convincing contexts for their projects which the facilitators feel bodes very well for their approach to working with students.

Chemistry (John Walker)

The Mohali group comprised fifteen chemists with varying backgrounds and interests. The group came together on the afternoon of the first day for a discussion about suitable contexts for use in the forthcoming RBPTs which they would produce. A variety was suggested, with a definite preference shown towards ones in which pollution or environmental contamination featured, reflecting perhaps some of the themes which preoccupy the regions from which the group members came. A process of elimination was carried out to narrow down these contexts, followed by grouping of individuals into sub-groups of three to four for the RBPT production. The following morning examples of RBPT-style resources were provided for the whole group to spend some time looking at and getting a feel for, and in particular to practise applying the 5R model. Following this the sub-groups devised suitable problems as the basis for their RBPT, and began the process of creating their summary posters, with periodic tutor input for guidance on matters such as pedagogy and assessment. Towards the end of the day a process of peer review was carried out so each sub-group could receive feedback and suggestions to improve their RBPT poster prior to the marketplace activity the following morning.

The Tezpur group also comprised fifteen chemists and the workshop followed a similar pattern to the Mohali group, with some minor changes in workshop sequence. This group had perhaps more varying ideas for contexts, ranging from toxins in cosmetics to the generation of useful antioxidants from tea-plantation waste. As in Mohali, a process of elimination (using a technique of giving each participant five ticks to use to vote for their favourite contexts) was carried out to narrow down the contexts, followed by grouping as before. As with the Mohali group, the participants were very positive about the prospect of using research based methods in their teaching, and embraced the opportunity with plenty of enthusiasm and energy. The quality of the posters produced by each group was very high.

Physics (Diana Bracewell)

The Mohali Physics group had a gender split of about 1:4 female to male, and an average age somewhere in the 40s.

The group worked well together on the given tasks and produced some outstanding work. For this workshop, I stuck with the traditional order of getting them to consider curriculum topic first, then map contexts/problems on to them. This resulted, initially, in some very curriculum oriented topics with some tricky discussions had about integrating the context, problem and skills, rather than just bolting bits on to existing curriculum plans. However the groups responded well creating projects that would allow students to generate original data to at least some extent and in a compelling context with an obvious real world application. Of note was the group where they suggested the students report their research, in part, in the form of information plaques around their city, this was a new form of reporting for this course. Another individual created an interesting infogram showing the RBPT process and how it fit into society, linking teachers, students and community.

The Tezpur group was slightly smaller with a little higher female:male ratio possibly because the Earth Science lecturers were added to the Physics group. This time we started looking at context before discussing content (in distinction to the standard model used in Mojhali of curriculum content first then context). Delegates listed significant local and national issues and the science content and skills relevant to this issue was discussed. In this way, by the end of the first two sessions together most of the groups had very good contexts which would generate original data which could be used in original applications. From then on progress was rapid with RBPT posters being 95% complete by the end of Day Three,

Mathematics (Chris Olley)

Across the two courses in Chandigarh and Tezpur, 17 mathematicians engaged with RBPTs and developed their own examples. A large majority of the participants were qualified to doctorate level with one professor. All but one had post graduate qualifications in mathematics, the exception being in mathematics education. Specialists in pure mathematics and applied mathematics were split roughly equally. The delegates were very able to explain specific mathematical concepts of a high level of sophistication, very successfully. However, it was clear that teachers of undergraduate mathematics have had very little experience exploring unseen mathematics problems independently. When challenged to do so, some were uncomfortable at being put in a position of insecurity. However, this could be overcome in most instances. The response in Chandigarh was noticeably better than that in Tezpur. There is considerable difficulty in designing a problem to be solved in mathematics and many groups struggled to match up a sophisticated problem with sophisticated mathematics. However, with input in problem posing, some good examples emerged, notably from Chandigarh, where an analysis of the requirements of online taxi Apps to optimise in a city with a grid pattern of streets like Chandigarh, was the clearest example.

5: Evaluation data and tentative responses

The evaluation sheet was changed slightly from the pilot to better reflect the nature of the Workshop. This means the data cannot be directly compared although the general messages are clearly applicable.

A Your top three ambitions

This question was intentionally open to allow delegates to consider what they wanted from the workshop rather than simply asking them to respond to the trainers' plans. For this reason their answers are quite varied. The categories below summarise the hopes from the most common to rarest.

- Learning about RBPTs and novel teaching approaches.
- Professional development.
- Meeting other practitioners.
- Seeking to change existing practice and support others to do the same.
- Adopting a more student-centred approach.
- Others.

Learning about RBPTs and new teaching techniques was the most common ambition. This is unsurprising given the publicity for the Workshop but does suggest that the people who attended were the right people. Another very common ambition revolved around professional development which encouragingly emphasises the willingness of Indian teachers for professional development. This second category is distinguished from the first when the comments were general rather than mentioning RBPTs specifically. Meeting other practitioners was the third most common hope for the Workshop followed by a collection of desires that focussed on changing their own existing practice (typically moving to a more student-centred or active teaching style) and helping other people make the same change. In the, very small, 'others' category were a few remarks about wanting to improve their research capability, learn about funding agencies and even get a chance to see more of Tezpur town. Given these varied ambitions it is encouraging to see that 97% felt the Workshop had helped at least to some extent.

Table 1: How well did the Workshop meet your ambitions? (%age)

A: Your top three ambitions				
How well did the course help you to meet your 'top three' ambitions for the Workshop?	To a great extent	To some extent	Partially	Not at all
	66	31	3	0

Section A also asked delegates to identify the most useful aspects of the Workshop. Delegates found the preparation of the RBPTs in their subject groups most useful despite valuing the more general aspects of the first day's work (Blockers and enablers were mentioned often) and a large minority mentioned the group work and poster-making generally as enjoyable and useful.

B About the course delivery

This section looked at general delivery of the course, Table 2 gives a summary of responses.

Table 2: Course delivery (%age)

B: About the course delivery				
Please tick in the correct column for the statements below.	Strongly Agree	Agree	Disagree	Strongly disagree
The facilitators displayed a high level of knowledge.	58	39	3	0
The facilitators were responsive to people's needs.	71	28	1	0
The Workshop was well organised and planned.	62	36	1	0
The content was relevant and useful.	56	42	2	0
I would recommend the Workshop to a colleague to attend.	71	27	2	0
The Workshop was the right length of time.	43	45	10	1
	Excellent	Good	Poor	Very poor
How would you rate the overall quality of CPD?	55	41	2	0

The results in Table 2 are very encouraging with all being very positive. Particularly pleasing is that 99% of the delegates felt the trainers were responsive to their needs. The relatively low result for the Workshop length is discussed below.

Section C: Your attitudes and beliefs

This section attempted to explore the attitudes of the delegates at the end of the Workshop. This gives a useful indicator of how likely they are to implement the recommendations and insights they gained during the Workshop.

Table 3: Beliefs and attitudes (%age)

C: Your beliefs and attitudes					
Please tick in the correct column for the statements below.	Strongly agree	Agree	Don't know	Disgaree	Strongly disagree
My understanding of the use of RBPTs in teaching has increased due to the Workshop.	66	31	2	1	0
I can now identify the key characteristics of a good RBPT project with more confidence.	58	39	1	1	1
I can identify the key benefits of the use of RBPTs in my teaching.	60	38	1	1	0
I can identify drawbacks in RBPTs and situations where they may be inappropriate.	31	52	10	4	2

C: Your beliefs and attitudes					
Please tick in the correct column for the statements below.	Strongly agree	Agree	Don't know	Disgaree	Strongly disagree
I believe that RBPTs will contribute more to teaching and learning in my department as a result of this Workshop.	64	33	2	1	0
I believe that my students will enjoy learning using RBPTs more than listening to lectures.	62	34	2	1	1
I have learnt about a number of teaching and learning approaches that I will seek to embed in my practice.	50	45	2	2	0
The Workshop helped me to gain skills to develop RBPTs to use with my students.	59	38	1	1	1
I can assess student progress when they are studying with RBPTs.	46	50	3	0	1

The responses are positive or very positive in all aspects which is encouraging. One statement that draws more negative responses is 'I can identify drawbacks in RBPTs and situations where they may be inappropriate.'. This may be due to a misunderstanding of the statement and a desire on the part of respondents to speak of RBPTs in unremittingly positive terms - they do not want to see where the approach may be inappropriate. Indeed, looking at the wider comments in respondents that marked this statement more negatively they do appear to be very supportive of RBPTs. It may be that they just cannot conceive of a place where RBPTs would not be appropriate. However, an alternative analysis is that they are currently somewhat unfamiliar with RBPTs and cannot distinguish easily between 'good' and 'bad' implementations.

RESPONSE: In future Workshops it may be wise to devote more time to exploring 'quality' and 'appropriateness' in the draft RBPTs they produce.

The other statement that attracted a marginally more negative response was 'I can assess student progress when they are studying with RBPTs.'. This suggests that more time spent on techniques for assessment of student progress would be a useful addition to the next Workshop.

RESPONSE: We will develop the assessment component of the Workshop slightly and provide exemplars of assessment techniques delegates might like to explore with their students.

Section D: Your thoughts

This section was left internally open to allow delegates to communicate any thoughts not covered in other sections of the evaluation form. Analysis of roughly 150 comments (almost everyone contributed some thoughts) is difficult but the general tone was very positive. The quotes below are indicative.

'Everything is just perfect!'
'The entire workshop is very good and fruitful to me. lectures were very perfect and to the point. Thanks to the entire team of the British Council.'
'It was very motivating.'
'Would recommend it for my friends attending.'

'Workshop was near to perfection and I hope my other colleagues also get the opportunity to learn.'
'Excellent resource persons! I thoroughly enjoyed (I worked as well!) each session.'

RESPONSE: This is very encouraging and even allowing for the fact that evaluation forms are often an opportunity for delegates to be 'nice' to the trainers they have been working with over the last few days the positive comments are very heartening. Of particular note are the comments that emphasise the willingness of the trainers to respond to delegates' issues and the obvious enjoyment people derived from being actively involved in the Workshop.

The applicability of RBPTs in the Indian context exercised a number of delegates. No-one claimed that they were inappropriate or unrealistic but a number mentioned the tensions of working within a content-dominated system. A closer link to existing syllabi would be useful with one suggestion that the people responsible for creating these syllabi could benefit from exploring alternative approaches to syllabus construction. The desire for more local experts was also evident. This was partly due to language issues but also because local experts will inevitably have a better understanding of relevant tensions and opportunities.

'Please do focus on curriculum provided for undergraduate course (which is almost overlapping for different universities).'
'Please organise training specifically for Board members in syllabus framing in universities.'
'Please include local resource persons for better connect with the participants.'
'Real world examples or case study should also be discussed.'

RESPONSE: While taking on these comments it is difficult to see how the course can be significantly improved given the existing timescale before the Pune Workshop. As the Level 2 trainers become available many of these issues will be addressed. We will also modify the pre-workshop task slightly to encourage delegates to come to the Workshop with an example of material they have to cover in their particular syllabus that they could then work on to develop an RBPT. Reflecting on the RBPTs produced, many delegates did this anyway.

The workshop duration excited some comments - mainly to suggest more time would be useful and that the extra time should be devoted to refining and optimising the RBPTs. A number of comments mentioned expanding the reach of the initiative to other schools and education sectors.

'It should be a week instead of 3 days so that participants can extract maximum benefit from this.'
'Kindly increase the duration of the program and incorporate more activities in order to have in-depth understanding of RBPTs.'
'Please make it a 5 day workshop.'
'Spread the RBPT in other areas also, basically in primary schools because it automatically drives to higher Ed.'

RESPONSE: While an extended workshop may be desirable the delegates all worked hard during the three days and the return on an extra day or two may be minimal. No-one complained that they had not been given enough to think about and a number mentioned they were returning to their colleges to further develop their draft RBPTs. We suggest the workshop is probably the correct duration as it stands.
The suggestion that other sectors (schools and even primary schools) might benefit from RBPT-style workshops and approaches is one we would draw to the attention of Indian colleagues.

Practicality was more than simply curriculum-matching. Some delegates mentioned that they would like some more examples of teaching techniques to enliven their work with students.

Certainly during the group work the discussions during the development of RBPT drafts returned again and again to activities that the students could engage in.

> *'A little bit more about mentioning some classroom strategies that can aid easy implementation of RBPTs.'*

RESPONSE: We will prepare a handout that illustrates a variety of teaching techniques that may be useful to delegates.

The organisation and administration of the Workshop was well-received. One issue involved making the resources available online.

> *'Kindly give handouts of presentations so that we can take notes in an orderly manner so that we can go back to them when in doubt.'*

RESPONSE: This issue is now solved. Any resources produced for the Workshop can be freely distributed to delegates or others as seems appropriate.

SECTION E: Consent

All but two delegates provided their email addresses and consented to be contacted for further feedback or data collection.

Appendix 1: Pre-workshop task and survey

Pre Workshop Tasks

Task 1 involves producing a poster to share with others at the Workshop through an exhibition. Task 2 is essential preparation for your own work at the Workshop and need not be shared more widely. Both tasks can be tackled in groups if that is helpful.

Task 1: What is out there?

This task will encourage you to think about the issues that arise when educators start to use Research-Based Pedagogical Tools (RBPTs) in their programmes. The document *Case studies* provides a simple overview of a range of RBPTs used across the world in a variety of subjects. Using the descriptions in the *Case Studies*, your own literature research and teaching experience draw out some of the key characteristics of RBPT approaches. Prepare a poster to summarise your thinking. The poster must be no larger than an A1 (594 x 841 mm) sheet of paper and must contain fewer than 200 words.

Issues you could address when looking at the case studies:

- How long do the RBPTs last? A term? A week? 30 hours?
- How are the RBPTs assessed?
- What is the role of the teacher/lecturer while students are following RBPTs?
- How do students seem to like RBPTs? A lot or not very much?
- How efficient are RBPTs in covering the material needed? Do they take more time than traditional approaches?
- How does laboratory work fit in with RBPT approaches?

These are some of the issues that might be significant. Add in any other thoughts you have as you prepare for the Workshop. The poster will be shared with other delegates at the Workshop.

Task 2: What could we use RBPTs for?

RBPTs are only one way to structure student learning. Other techniques (e.g. lectures or seminars) can work just as well in certain circumstances. However, RBPTs do offer special advantages in certain areas. This task asks you to consider where RBPTs might help you with your teaching. Consider the topics you have to cover in your normal teaching program. Reflect on which topics might benefit from an RBPT-led approach. Produce a list of suitable topics for converting into RBPT-led projects.

Choose one that you want to develop an RBPT around. You will be develop this topic in the Workshop. Make sure you bring along details about the content, skills and activities that you need to cover in this topic.

You must be able to answer the questions below but there will probably be other issues you need to address when describing your topic.

- What are the key learning objectives for this topic?
- What detailed content must be covered? Knowledge? Skills?
- How much time is available to cover this material? How is it organised?
- How much of the work is book-based? How much practical work?
- How much teacher support is available to the students?
- How will the students be assessed? How often?

Appendix 2: RBPT keynote

Research-based Pedagogical Tools

Jan 27th-31st, 2017
Tezpur, India

Welcome

- **People**: Diana Bracewell, Julie Jordan, Chris Olley, Gareth Price, John Walker.
- **Purpose**: to explore the use of RBPTs, develop **initial** drafts of RBPTs for your colleges and to **share** good practice.
- **Product**: a selection of shared RBPT drafts and a **network** of colleagues to **support** you in your **teaching** and **learning**.

What's in a name?

- **Research-Based Pedagogical Tools** have many other names: Research-Based learning (RBL), Problem-Based learning (PBL), inquiry, project learning, Science in the Real World etc.
- This workshop emphasises how **research** as a **pedagogical tool** helps develop **research skills** and **deep content understanding**.
- So what **is** 'research'?

Is this research? Science?

- I'm going to talk about **atoms** … and **restriction enzymes** … and measure things with an **ammeter**…
- I'm going to write reports about the effect of **nitrogen levels** and **blue-green algae** in **rice paddies** on the growth of **rice cultivars**…
- I'm going to explain **why** the reactivity of Group I metals increases as you go down the group.

Is this research? Science?

- I'm going to generate an **idea,** a **hypothesis**.
- I'm going to **identify the evidence** that I need to collect to check my idea.
- I'm going to **collect** that evidence **carefully** and **rigorously**.
- I'm going to **judge** how **good** my idea is **using that evidence**.

Research - a hypothesis

- Research involves three dimensions:
  - **cognitive** skills: creating hypotheses, controlling variables, designing inquiries
  - **technical** skills: using equipment safely to gather data - sometimes very complex equipment
  - **personal** skills: collaborating, keeping going (and even meeting budget!)
- If these things are present what you are observing **must be research**.

Research in a domain

- When we use **scientific models** to generate ideas and explain data it becomes **scientific research**.
- In **mathematics** the skills may be different and some of the 'equipment' may only exist in our heads.
- In sociology … in geography … in history and economics …

What do scientists think?

> "Actually, science is simply **the systematic accumulation of knowledge based on evidence**. In fact, we are all born scientists, and are intensely curious about the world around us, constantly making deductions based on data."

Venki Ramakrishnan, President of the Royal Society and deputy director of the MRC Laboratory of Molecular Biology in Cambridge

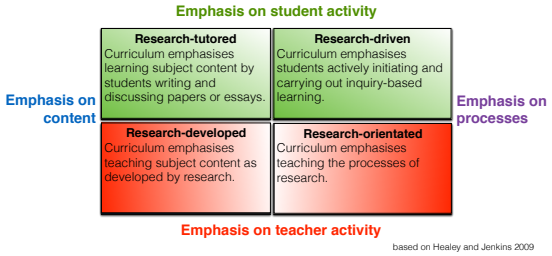
What is an RBPT?

- RBPTs are pedagogical tools that **require** research**, refine** research**, reward** research and **report** research activity.
- They are **pedagogical tools**. They exist to **teach** science and mathematics although authentic research will occur.
- Through RBPTs, students develop their **research experience and skills** and acquire **relevant domain knowledge**.

Require …

- RBPTs are not the **only** way to teach.
- Lectures, practical labs, discussions, text-based activities can all work **without** students engaging in research.
- However, **only** RBPTs **require** research - a strategic step into the unknown rather than simple recall or identification.

Researching and knowing



based on Healey and Jenkins 2009

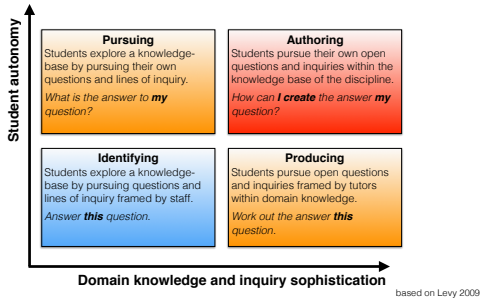
Refine …

- Everyone is born with **very simple research capability**.
- RBPTs should help students to refine their research skills: **cognitive**, **technical** and **personal**.
- Everyone is born with a **very simple understanding** of the world.
- RBPTs should help students to refine their understanding to build **resilient**, **powerful** and **predictive** understanding.

A Chinese proverb?

- If you **tell** me, I'll **forget**.
- If you **show** me, I'll **remember**.
- If you **involve** me, I'll **understand**.

What is my involvement?



based on Levy 2009

Reward …

- RBPTs should **identify** and **reward** the key features of research - even where the research has shown simply that we do not (yet) know the answer.
- Assessment can be **formative** or **summative**.
- Assessment can be **periodic** or **terminal**.
- Assessment can be operated by the **system**, **tutor**, **peers** or **self**.

Report …

- **Most** research is collaborative. **All** research is shared - or lost.
- RBPTs should require an appropriate reporting activity specifying **purpose**, **audience**, **format** and **specifications** for the report.

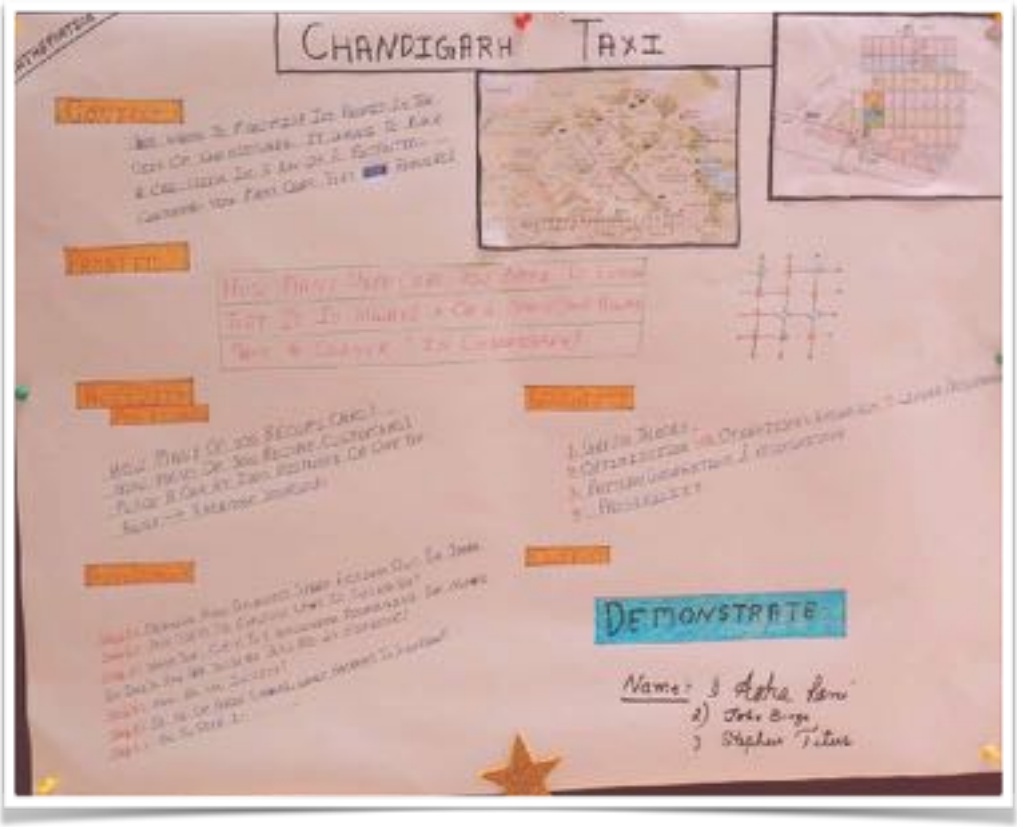
And so …

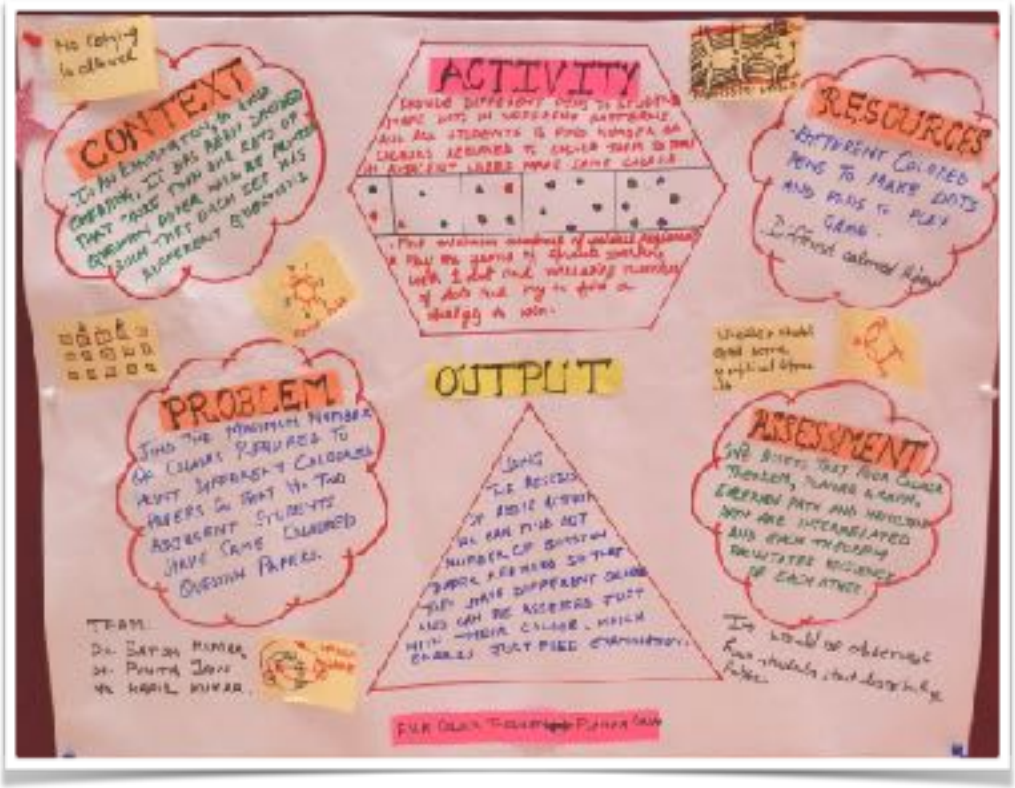
- RBPTs are pedagogical tools that **require, refine, reward** and **report** research activity. If they are doing this with science content we should be able to **recognise** *both* the science *and* the research.
- And in mathematics? Many (but not all) of the same rules apply. And the domain knowledge in use is mathematical.
- Together, we are going to work on **developing RBPTs** that match your needs and the needs of your students.

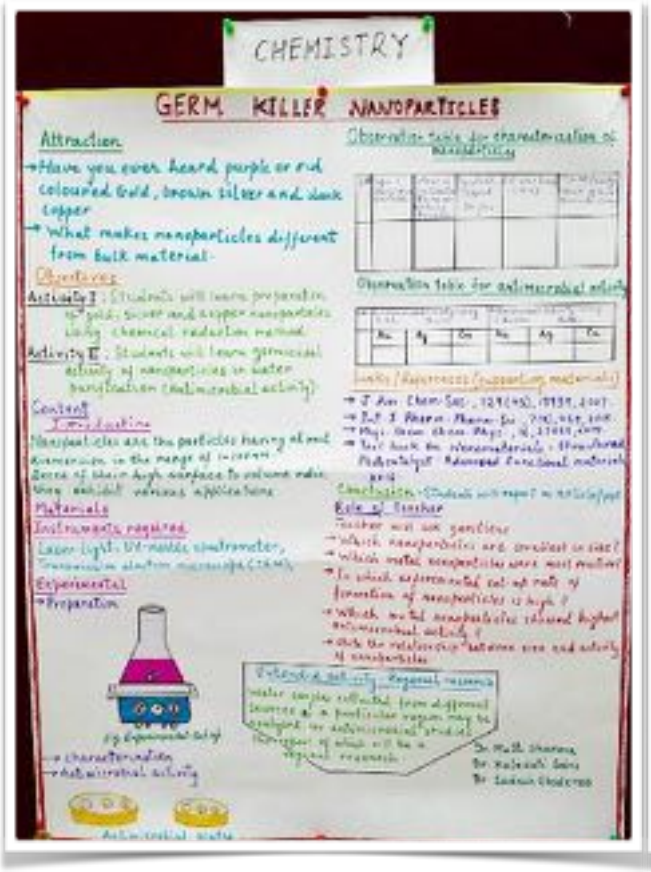
All presentations and learning resources are available from IISER or British Council/Newton Bhabha Fund.

Appendix 3: RBPT exemplars

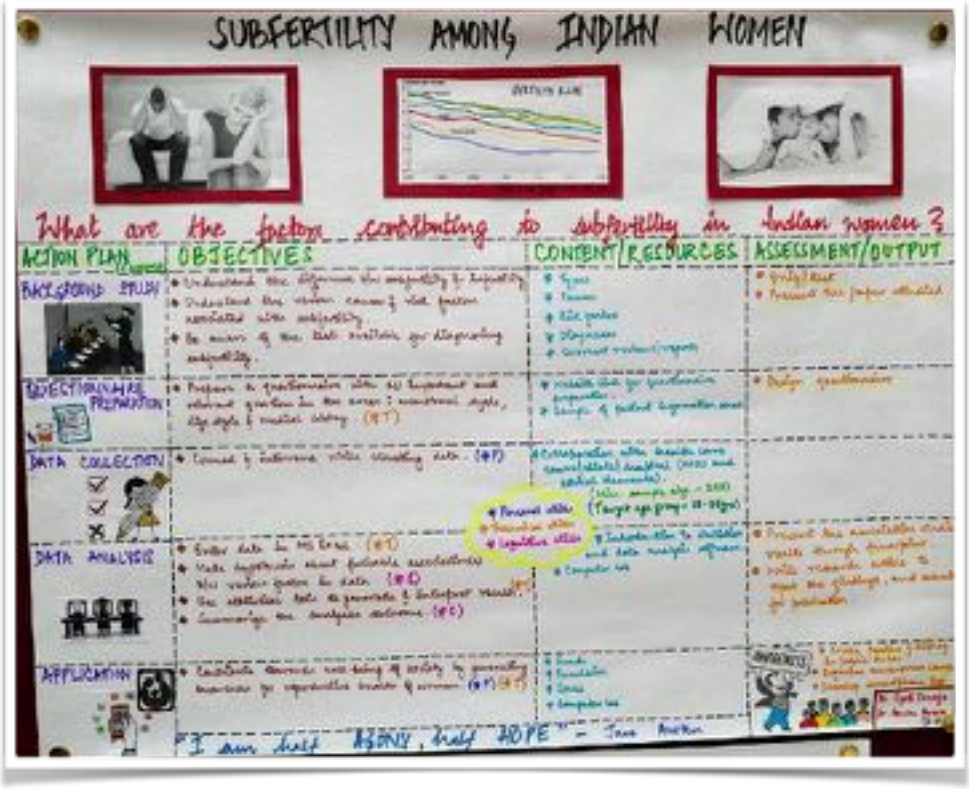
The following pages give some examples of the RBPT posters produced during the Mohali and Tezpur workshops.

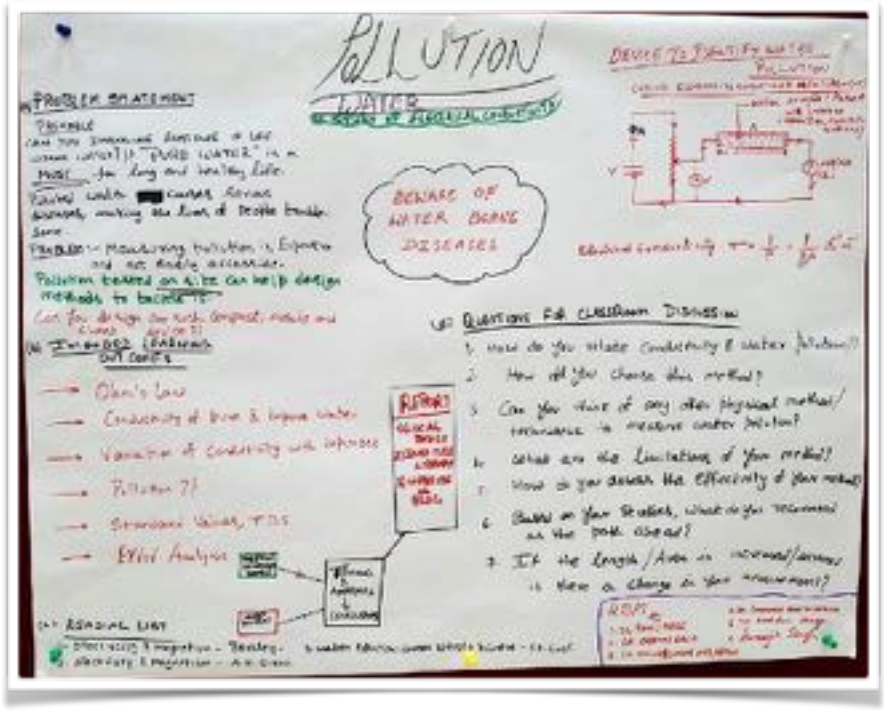




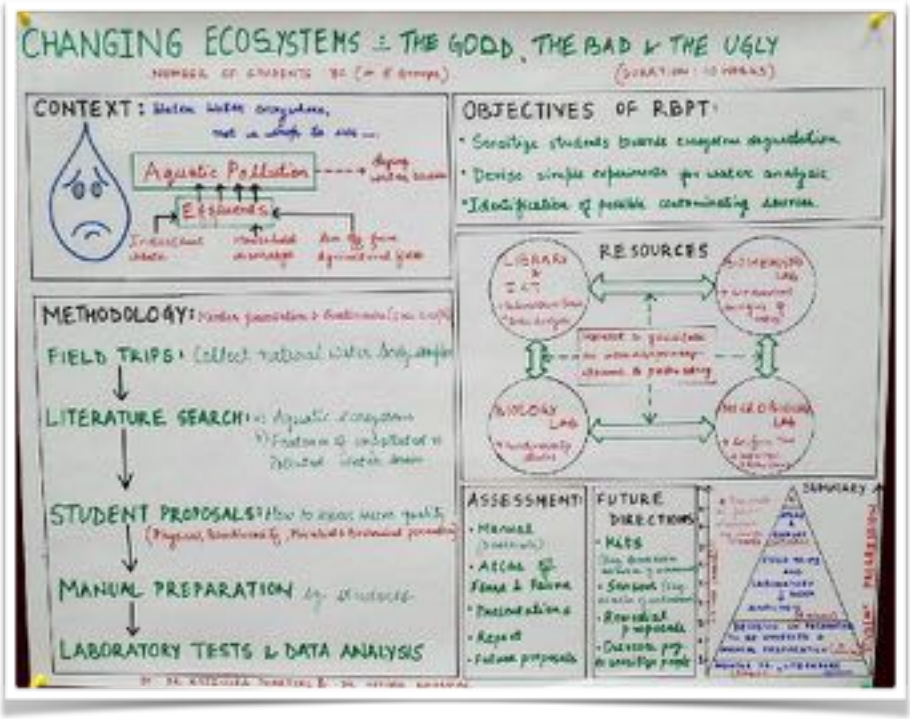

CHEMISTRY
GERM KILLER NANOPARTICLES
Attraction
Objectives
Content
Materials
Instruments required
Experimental
Preparation

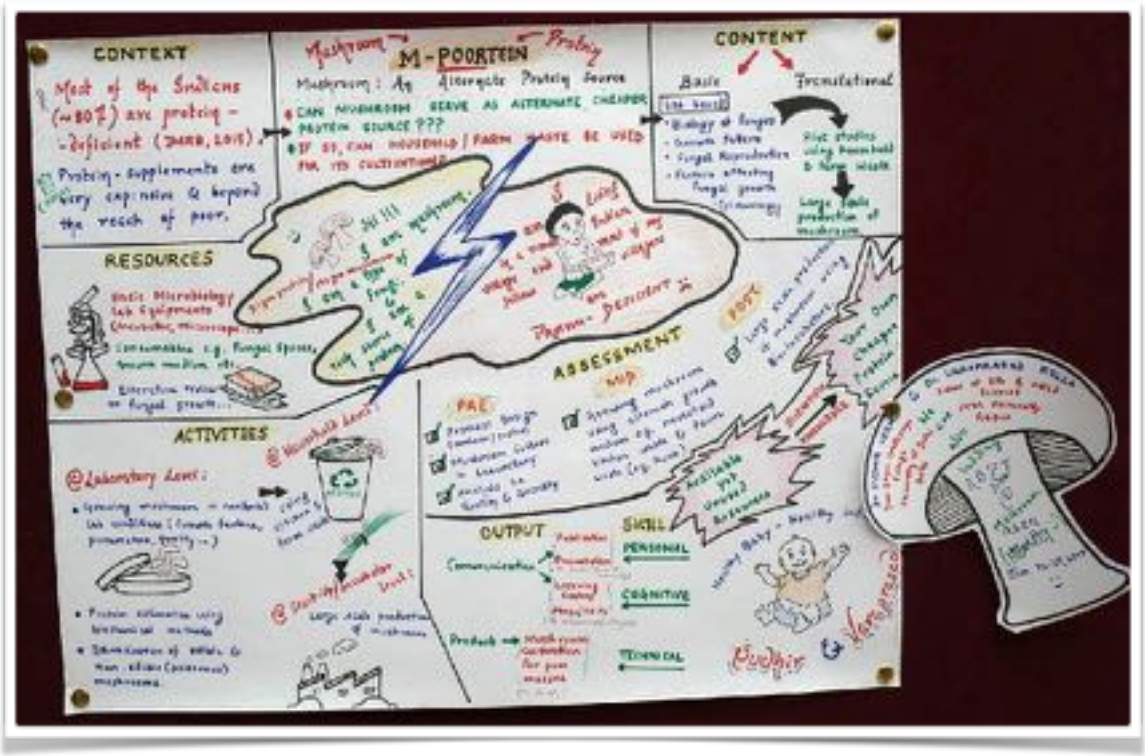

IDENTIFYING PLANT SPECIES IN FAKE AYURVEDIC MEDICINE


SUBFERTILITY AMONG INDIAN WOMEN
What are the factor contributing to subfertility in Indian women ?
ACTION PLAN
OBJECTIVES
CONTENT/RESOURCES
ASSESSMENT/OUTPUT
BACKGROUND RESEARCH
QUESTIONNAIRE PREPARATION
DATA COLLECTION
DATA ANALYSIS
APPLICATION
"I am half SONY, half HOPE" - Tara Antara


POLLUTION
PROBLEM STATEMENT
BEWARE OF WATER BORNE DISEASES
QUESTIONS FOR CLASSROOM DISCUSSION
Ohm's Law
Conductivity of pure & impure water
Variation of conductivity with salinity
Pollution ??
Statistical Values, TDS
Error Analysis
REFERENCES


CHEMISTRY
ARE WE EATING 'CRAP'?
COURSE STRUCTURE


CHANGING ECOSYSTEMS : THE GOOD, THE BAD & THE UGLY
CONTEXT :
Aquatic Pollution
Effluents
OBJECTIVES OF RBPT :
RESOURCES
METHODOLOGY :
FIELD TRIPS :
LITERATURE SEARCH :
STUDENT PROPOSALS :
MANUAL PREPARATION
LABORATORY TESTS & DATA ANALYSIS
ASSESSMENT :
FUTURE DIRECTIONS :
SUMMARY


CONTEXT
M-POORTEEN
CONTENT
Basic
Translational
RESOURCES
ACTIVITIES
ASSESSMENT
PRE
POST
OUTPUT
SKILL
PERSONAL
COGNITIVE
TECHNICAL

Appendix 3: Personnel

IISER Team
Prof. L. S Shashidhara
Dr. Apurva Barve

Newton Bhabha Team
Shruti Jain
Manjula Rao

CSE Team
Diana Bracewell
Julie Jordan
Chris Olley
Gareth Price
John Walker

Delegate list

The delegate list is sorted by subject.

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Dr. Satish Kumar	Dept. Applied Sci. Mathematics, Panjab Univ. SSG Regional Centre, Hoshiarpur
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Sheikh Bilal Ahmed	Shere Kashmir Univ. of Agri. Sci. and Tech. Srinagar
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Dr. Kumar Shantanu	Dept. Of Botany, Deshbandhu College, University of Delhi
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Dr. Anshu Bhardwaj	Dept. Of Bioinformatics, AcSIR, CSIR, Chandigarh
Dr. Neetu	Dept. Of Zoology, MCM DAV College for Women, Sector-36, Chandigarh
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Dr. Ramvir Singh	Dept. Of Phy. Univ. Of Rajasthan, Jaipur.
Dr. Pius Augustine	Dept. Of Phy. Sacred Heart College, Kochi- Kerela
Dr. Shashidhar D. Maradi	Dept. Of Phy. Govt. P.U. College - Karnataka
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Dr. Hemant Kumar	Dept. Of Physics, Govt. College Theog, Shimla
Pooja Goyal	Dept. of Physics, Modi college Patiala, Punjab
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Dr. Sham Singh	Dept. Applied Science, Chandigarh Engineering College, Landran, Mohali- Punjab
Dr. Shiva Kumar Malapaka	Dept. Of Physics, IIIT Bangalore
Dr. Vijay Kumar Lamba	Dept. Of Physics, Global College of Engineering & Tech. Dist. Ropar Punjab
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Manila Seth	Dept. Of Phy. Natural Sciences , GNA University – Phagwara - Punjab
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Dr. Sharada Pasricha	Dept. Of Chem. Sri venkateswara College, Delhi University
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Dr. Malti Sharma	Dept. of Chemistry, Miranda House, Univ. of Delhi
Dr. Jasvir Singh Kanwar	Dept. Of Chem. Institute of Engineering and Technology, Bhaddal , Ropar- Punjab
Dr. Sunaina Bhasin	Dept. Applied Science, CGC Technical Campus, Jhanjeri Mohali. Punjab
Dr. H. A. Tirpude	Dept. of Chem. Shivaji Mahavidyalaya, Udgir Dist. Latur, Maharashtra
Prof. L. K. Tiwari	Dept. of Chem. , Regional Institute of Education (NCERT) Shyamla Hills, Bhopal
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