Comments on the Graduate Programme

(Most of the following comments have been previously sent through emails and presentations.)

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27 January 2015

General Comment

Improving the Graduate Programme requires improving communication at all levels. We need to encourage (rather than discourage) innovative, new ways to increase communication through direct - regular as well as irregular - meetings (both formal and informal, emails sent to larger (rather than more exclusive) groups of people, bulletin boards, posters, paintings, photographs, graphs, setting up more comfortable meeting places inside and outside under the trees, outings, seminars, fieldtrips, etc.

Redefine a PhD in Science Education

We need to redefine the meaning of a PhD in science education as per the needs of the people of the country. I think this could mean: (1) allow primary focus on research, development, outreach, OR policy/advocacy (e.g. students could develop new teaching/learning material OR do participatory action research OR more traditional research as the primary focus of their PhD), and (2) more explicit discussions on what the needs of the people are vis a vis science education, and how this relates to research; (3) less fear in veering from the western path of science education.

Thus, we should seriously analyse on a case to case basis what makes for adequate publication, rather than sticking to the strict need for a foreign publication before submission of the synopsis. We should be capable of analysing whether the standard of the research is reasonable (and is also relevant and important for the country), rather than relying on foreigners to evaluate the worth of the research. Perhaps there should even be a formal requirement for publishing in Indian languages, and in places which are accessible to teachers, educators, students, and other people in India.

Decision Making

Members of HBCSE who are higher on the hierarchy do carry more authority, and they could be given the responsibility to make certain kinds of decisions (which could be spelled out), but most decisions could be made through wider discussions. Of course anyone can object to any decision and there should be simple ways to make their complaints known.

The Subject Board

I have an objection to the way the Subject Board functions. Since the institute is quite small (the number of faculty as well as the number of students being less than 20), I see no reason to have an exclusive, restricted number of people appointed to a Subject Board which conducts closed meetings. Such opaque, old-fashioned structures have to be broken, and I am sure that this is one structure that would be relatively easy to improve upon. I suggest that all the functions which are carried out by the Subject Board can be carried out in meetings which are open to any and all interested members of HBCSE - including faculty, students, and others. Decisions can be made without recourse to any formal voting or decrees or time-wasting collections of signatures.

Guiding

It is not ok for the Subject Board - or anyone else - to try to force any particular two faculty to work together (e.g. to be the co-guides of a student) if the two do not both agree to it.

It is a waste to prohibit faculty from guiding students as they approach retirement age - if they are at the peak of their careers, as expected of 60 year old researchers. In case a faculty gets an extension or two, the wastage is even more extreme. Both senior and junior faculty are certainly able to be full guides (otherwise they should be fired). Rules disallowing this need to be changed - or in case the bureaucracy cannot be immediately changed, it can be dealt with as bureaucracy, not as guides for how research is to be done (i.e. let anyone sign the forms, but let it be clear who is guiding, so that the student does not suffer).

Proposals

Certainly it is neither fair nor profitable to discuss a student's Proposal without the student or their guide being present in some cases - and with the guide being present in other cases, as is presently being done. I suggest that meetings in which the Proposals are discussed (as well as all other meetings) should be open to all interested members. I have not heard a good reason for closed meetings - they only inhibit communication and transparency.

Courses

While rigidity has to be guarded against, the curriculum has been too haphazard and unplanned. The courses which are offered can best be worked out through meetings with all interested faculty and students (as well as any interested staff, etc) - in other words, through meetings which are open to anyone who is interested. However, communication and coordination between all interested members is necessary and has not been sufficient. Perhaps a general framework can be worked out in open meetings, and can be modified from time to time. Within this framework, required courses can be offered. Discussions in the interested group can be carried out to determine who will teach the courses - certain members might offer courses, certain members might refuse to teach certain courses, reasons and justifications can be discussed, etc. Required courses need not necessarily "follow a standardised structure" - this can be decided through discussion with all interested.

I think it is a shame that the students have not been learning more about science and the philosophy of science in India from ancient times until the present.

I am a little aghast to see that quite a few students at a centre FOR science education are having very anti-science views. It indicates that they are not understanding the nature or history of science, or the potential for pro-people science. They do not see the existence or the possibilities for science which is not mechanically reductionist. Perhaps this is because until very recently, they have had virtually no discussions of political economy or the historical development of capitalism in relation to science in their courses. They are correct in objecting to science for profit, but they are confused by the prevailing post-modern relativism which leads them to say that any 'way of knowing' is as good as any other 'way of knowing' (and therefore, e.g. magic or superstition is as good or as bad as science! (yes I have heard students saying this!)), They seem to deny any possibility of a progressive role for science. We need to recognise this pitfall and do something about it.

All students should be required to complete a certain number of months of full-time teaching before they complete their PhD (this requirement could be satisfied before joining or after joining).

Self and group assessment should be a major part of the formal summative and formative assessment for all students. Assessment (including any viva voce and any discussion about the student) can be done in open meetings where anyone interested (for whatever reason) can attend.

Courses need to be conducted through less of lecturing and more of constructivism.

Faculty (including myself) need to learn and be encouraged and motivated about what to do with students - how to teach, how to motivate, how to encourage, how to work with multiple students

in group research projects, how to critique research papers, how to encourage student mentoring, etc. This - doing actual research - should all be part of course work if we really believe in learning by doing. What this means in practice is that actual fieldwork should begin in the first semester, and be fully integrated with the courses.

Reading Literature

I suggest that all of us could use the same software to read and annotate all journal articles, so that whenever we read any paper that someone else in the institute has already read and commented on, we can (by one click) see (or hide!) the comments another person has made. Such software is available.

We can also all be encouraged to participate in email discussion groups in which we actually comment on and critique articles (not just send urls). Critical analysis can only be learned through practice and example.

TAC

I see no need for a TAC unless it will be actively involved in helping the students in day-to-day research. And there is a need for more faculty involvement in actually guiding students in their research. Simply setting time limits and checking to see if deadlines are met is no use. A number of students have been floundering, without adequate guidance from faculty and other students. Perhaps the faculty need more cooperative support in learning how to guide each other and their students. More communication - both formal and informal - and more regular communication (e.g. through a weekly faculty/student tea, among other things) will be useful.

The student (and the guide) should decide who should be on this type of functional TAC.

Defining Research Topics and Questions

I think a lot of improvements need to be made in the way research topics and questions are defined and I have written some of my ideas on this in a number of emails. Copies are included as Appendix A.

We need to proactively define research, development, & outreach projects - through analysis of the relevance and importance of the problems and the probable impact - and through an effort to escape from research that is just building upon or tweaking research that has already been done in the west.

Promote and do action research, participant research, and insider research with ourselves, teachers, students, and other people - especially those who are disadvantaged

Cooperative and Coordinated Working

A lot of improvement is needed here, both within groups and between groups. It may be advisable that guides help students to work out research proposals which overlap, so that the students can work together on the same project for their PhD. This will make it easier for faculty to guide more than one student (or project staff) at a time as well as students, and result in more critical analysis which includes more points of view.

'Raw Data' Discussions

As I have suggested previously, we would all benefit by open meetings in which we all view, analyse, and discuss each other's 'raw data'. People who are working in diverse areas often have interesting inputs on areas outside their expertise. Besides, such meetings will add to the community life of the Centre.

Project Staff

The work the is done by Project Staff is closely connected to (and needs to be coordinated with) the work done by PhD students. Now that corrections have been made in the salaries of the project staff, we should make more effort to improve the quality of work they do, making sure that they are making meaningful contributions to the research, outreach, and development, and also making sure that they have help in following meaningful career paths.

Time Limits

Time limits need to be flexible since students come with varied backgrounds and needs, usually without previous study or courses in science education. Students with government teaching jobs, families to support, or various other situations need special consideration. Therefore it does not make sense to have a strict 5 or 6 year limit on their fellowships.

On the other hand, limits and deadlines have to be adhered to if they are in the interest of the student. In case students are having difficulties meeting deadlines, the reasons have to be discussed with the students and faculty, and rather than just placing blame, innovative ways to work out the problems have to be suggested and tried.

Admissions procedures

Having had quite a bit of previous experience in this area, I have previously written extensively on this. See Appendix B.

I suggest that faculty can take a more active role in recruiting individual candidates to work with them - probably the written test is not even required.

An interview in which applicants are grilled about "subject knowledge" is anti-science and does not help in selection (and are anyway already tested for in numerous tests the candidates would have already been through). We should all realise that this sort of factual knowledge is easily forgotten by one and all. So why do we require it? What could be checked instead is whether the candidates have some basic training in how to find information in books, journals, and on the internet - but even these skills can be acquired after admission. Motivation and point of view (concern for science education and concern for the people who need science education) are most important and most difficult to teach later on.

Now that Project Assistants are getting good pay, this could be acknowledged as a good path for recruiting students for the PhD programme. It could even become a normal way to begin. It would allow us as well as them to make informed choices before beginning.

Appendix A (previously sent by email)

One Way to Decide upon a Research Problem in Science Education

In some PhD programmes, students are assigned research topics, or they work out topics which are closely related to other research that is going on in the group in which they are working. Sometimes students are selected in order to work for particular guides. In other cases they select their guide (and/or the guide selects them) during their initial year of so of joining.

However, it would be best if PhD students get some experience in choosing research topics, and in learning how to figure out what research is worth doing. This is something that they will find particularly useful if they continue on in a career in research. They should be ready to analyse why particular research topics are more or less worthwhile, and they should eventually have a say in choosing research topics rather than blindly following in the footsteps of their mentors or X-mentors.

Some students start with the assumption that they must work on some research topic related to physics, or biology, or magnetism, or photosynthesis, or whatever, because that is what they are interested in and that is what they have experience in. Then they select an age group. Then they read the literature in science education in that area in order to help them think of a good research question. This can lead to a very good research project, but for some if may be too limiting. It may be worthwhile for students to analyse WHY they are interesting in something rather than just being interested in something for some unexamined reasons. Therefore, I suggest a slightly broader approach which is based on analysing the basic problems in science education in order to arrive on a specific research question.

(1) Investigate the meaning of science and the meaning of education and the meaning of science education (through reading, discussion, analysis). Actually, this should anyway be part of any programme in science education.

(2) Investigate the reasons why science education is important to society, to communities, to groups of people, and to the individual student (through reading, discussion, analysis).

(3) Identify problems and reasons why science education, in the sense you have defined it, may be inadequate or problematic (primarily through your own experience and observation, but also through reading and discussion).

(4) Analyse what are the possible solutions to these problems and brainstorm on research questions which are needed to help understand and solve the problems.

(5) Analyse which of these research questions are most relevant and why they are relevant, and also analyse whether the questions are too simple or too complicated, too broad or too focussed, and whether the answers are probably too obvious or too complicated. In order to do this, a search of the literature is needed. A thorough literature search can be done only after the possible research questions have been narrowed down. Perhaps different students could do literature searches on different research questions, and then all the students can discuss in order to figure out which research questions are most relevant and doable.

(6) As this is being done, try to figure out methods that could be used to answer the research questions (through reading and discussion). Compare and evaluate the appropriateness of different possible methods.

(7) Keep asking why the research question is relevant and, now that you understand more about the kind of effort that will be required, whether this is really the best research question.

If we think that science is a method, not just a list of “facts”, and the scientific method is what we need to teach so that people will use a scientific method in questioning, observing, and finding answers - throughout their everyday lives - then this approach to finding a research question may make more sense. Otherwise, we may spend years figuring out what Class XI students

understand and how they learn about photosynthesis, and then realise that actually they don't really need to understand photosynthesis - they need to do science.

Perhaps rather than starting with something like "ecology for middle school children" it will be better to start with an analysis of a particular problem in doing the method of science. For example, suppose we observe classrooms and find that children are not asking questions based on detailed observations. If we think this may be a basic thing that they need to do in school, then we can analyse why they are not doing it, why it is needed and how it might be done. We could do research in order to establish whether or not this is an important problem. We could do research to figure out ways to alleviate the problem. We could do research to investigate how students observe plants or magnets, or maybe both.

Other possible types of Research Problems for a PhD

Besides doing a PhD research project in order to understand how students learn, how teachers teach, or how to improve teaching and learning, why not do a PhD in order to analyse a particular aspect of science policy? Or why not do a historical study of a particular aspect of science education? Or why not concentrate on developing a method for teaching? Or why not do a project to classify and make available certain types of resources for schools or science teachers? Or how about a project to develop a science exhibition?

Coursework for PhD Students

Coursework could be better designed keeping in mind the goals of the program, which need to be better defined. If we believe in "learning by doing" rather than just "learning by listening to lectures" then courses can be improved with this is mind.

Maybe students can learn to do research by working together in one group to do a small research project. This might be combined with a practical course on "Learning to Teach", such as we have just done. A number of the teaching experiences the students had in this class could easily be extended into small research projects. This makes it more likely that the fieldwork they do is more directly related to real classroom problems - if that is a desirable goal. Also, working together in a group on one project is something that is lacking from the experience of many students at HBCSE, and would make for heightened learning as well as for an improved social atmosphere between both students and faculty.

Addendum after talking to Nagarjuna:

Nagarjuna was suggesting that perhaps new graduate students could engage in a group research project when they first come, even before coursework is begun. He suggested an initial 6 month period for this purpose, after which classes would begin.

After my experience with the "Learning to Teach" class this semester, I can see the use of this order. I had initially planned the practical course to follow a "theory" course on science pedagogy. But since no such course had been planned, my students came and were plunged into teaching even though some of them had done very little reading and did not understand much or have much exposure to different teaching methods. Now in retrospect I see that maybe this was good. Now, after the classroom experience perhaps they are more motivated to learn "theory".

Addendum after talking to Geetanjali:

I mentioned to Geetanjali the idea of having new students do projects in a group, and she thought I meant that new students would work in a group that includes some senior students. Thinking more about it, we both thought that this would be a very good idea for all the students, because they would be then able to teach and learn from each other.

- Karen, 7 May 2013

Appendix B (previously sent by email)

What kinds of students do we want?

Before we design an admissions procedure we should be somewhat clear about what kinds of students we want, and why this is what we want. We should keep in mind that our over-all objective is to teach students about science education (and mathematics education, technology education, and related areas). It is important to note that science includes social sciences as well as natural sciences, and that science cannot really be divorced from other subjects for education to be meaningful.

Beside the degrees, what are the other requirements for admission?

Here is my suggestion, in order of importance.

(1) Interest in science education

Students should be motivated to work in science education. They should not just be coming because they did not get admission to do a PhD in the hard sciences elsewhere. Work in education requires a different kind of motivation, which is hard to inculcate if the students keep wishing they could be somewhere else doing a PhD in science, or earning heaps in a company.

(2) Scientific temper

While it is possible to inculcate scientific temper even after joining the program, it will be easier for us if the students already have some minimal level of scientific temper. It is <u>not</u> necessary that they are good at remembering word definitions (it is easy to look up the meaning of a word when needed). It is not necessary that they are good at memorising things, as is needed to score high in a traditional exam (remembering the so-called 'facts' or 'concepts' of science). These things can be easily looked up when needed, and as we all know, these 'science facts' are easily forgotten when they are not needed. However, if students do not <u>practice</u> science in their lives, they will have difficulty doing a meaningful PhD in science education. We need students who ask questions and question the answers - rather than just answer the questions. We need students who work with their own hands to do experiments. We need students who are keen observers of physical reality. Therefore, a written test of science 'concepts' is to be avoided.

(3) Critical thinking and analytical skills

We need students who do more than just read and comprehend a paragraph. We need students who critically analyse and question whether what they read is true, and search for reasons and evidence why a statement may be true or false. We need students who consider various sides - pros and cons- and then make decisions and form opinions based on well thought-out reasoning, evidence, and observations.

(4) Interest in children

It will be best to find students who are already motivated to work with children and who are curious about child behaviour and how children learn. It may be difficult to change the mindset of a student who tends to underestimate children, who does not have faith in their abilities, or who just does not enjoy being around children.

(5) Group work

We need students who are good at working cooperatively in groups - not being too passive or too dominating, encouraging each other, etc. In any kind of work they may do in science education, either at HBCSE or afterwards, they will need to be able to work in groups.

(6) Skill in english should <u>not</u> be prioritised

Before admission, the students must have a basic ability to communicate in english. However, we should try to de-emphasize the degree of proficiency in english as a criterion for selection, so that we can attract less-privileged students.

(7) Teaching experience

Teaching experience may not be required, but it will help. In case a student comes without any teaching experience, a minimum amount of teaching experience should be required before the PhD is granted. Without teaching experience, it is very difficult to understand much about education. We believe in learning by doing. So learning about science education should require teaching science.

(8) Creativity, innovation, and appreciation for art/books/music

It will be best if students are avid readers (of fiction and poetry, as well as newspapers and non-fiction). It will be best if students already know how to search for answers to questions on the internet, or at least are motivated to do so. Since performance art (theatre, music, dance, etc), visual art (illustration, making and analysing diagrams and graphics) are important components of science teaching, we need students with interests and skills in these areas.

(9) Caste, class, gender, unprivileged should be considered

We should try to attract students who are unprivileged - by either formally or informally having some system of reservation. Justification: we are against the caste system, and we believe in equity in education.

(10) Social commitment

Basic social commitment may be hard to learn or teach, so it will be easier to find students who already have a point of view, an understanding, and a commitment towards progressive social change. Without social commitment, their work in science education will not be as meaningful or productive as it should be. Students should come with strong beliefs in the relevance and importance of science education for society.

(11) We want to avoid students who have very regressive ways of thinking

Why should we be afraid of stating an obvious truth: we actually do not want students who are fascists, or fundamentalist/communalists, or terrorists, or have very regressive political views. We want progressive, forward looking students who believe that change is possible. Otherwise, what is the use of science education - or any education? Students need to realise that the purpose of science education is to make the world a better place for all.

How can we select the kinds of students we want?

If we agree that these are the kinds of students we want, then we can figure out the best ways to insure that these are the kinds of students we select.

Here is a possible way to select, based on the items towards the top of the above list:

A. Procedure to look for candidates (the most important step):

(1) Publicise HBCSE as a centre for science education - in which the goals of the institute are publicised. This is a long-term ongoing task, but it can be initiated now so that it will help in the present recruitment of students.

(2) Send emails and make phone calls to people and organisations that may be in contact with possible students. We can start by having a meeting in which we brainstorm on a list of such people and organisations. I suggest including some institutes of design; CIE, DU; ngo's like Chirac, Eklavya, etc.

(3) Publicise the existence and goals of the graduate program to all visitors and participants of Olympiads, NIUS programs, outside users of HBCSE spaces, etc. I do not know if this is already being done.

(4) Brainstorm on a list of email groups, blogs, and facebook sites on which the ad can be placed.

B. The selection procedure

Send a letter containing the following to each candidate who expresses interest (perhaps several hundred will express interest):

We are looking for PhD students who... (discuss in detail the above points that are agreed upon - also discuss the reasons for these points being important).

We would like you to apply only if you are seriously interested in pursuing science education as your first option. We do not want you to come here and then find out that you would rather be elsewhere doing something else. How do you know if this is what you really want to do? We have designed an application process which will help you decide if this is the right place for you. The process will involve a lot of hard work on your part, and there is no point in applying if you are not ready to do so. The process is as follows:

(1) Do research to find out as much as you can about HBCSE. You can do this through reading the above description, searching through the internet, through friends and contacts, or any other way you can invent. Then write the following:

> (a) Summarise in your own words what you understand are the general goals of the PhD program at HBCSE.
>
> (b) List 5-10 reasons why doing a PhD at HBCSE will be a good idea for you, personally. Explain the reasons. (For example, maybe you are interested in education because of a particular workshop on astronomy you once attended and in the workshop you found out ... and you think this is inline with the goal of HBCSE to do ...)
>
> (c) List 5-10 reasons why doing a PhD at HBCSE may NOT be a good idea for you, personally. Explain the reasons. (For example, maybe you have a doubt because you hated biology classes, or because you are hard of hearing, and this may conflict with the goal of HBCSE to do ....)

(2) Propose a project that you might do as part of your PhD work in science education at HBCSE. The document can consist of written matter (in whatever language you are most comfortable), pictures, diagrams, an outline, a rough sketch, photographs, video, sound recording, or some combination of the above.

You probably will not actually do this project if you come here. We are asking you to propose a project just in order to find out if you are the kind of person who we should select. We will analyse your proposal to see if it is a relevant important project that will help advance the field of science education. We will read it in order to indirectly find out whether you are innovative and creative, whether you have good reason to be seriously concerned about science education, whether you already have a fairly good scientific temper, and whether you are socially committed. Submit your own ideas. Do not cut and paste from any other source. Do not submit what someone else tells you to say. It will be extremely embarrassing and detrimental for you if you do so, and when we talk to you it will be obvious to us if the ideas are not your own and if you cannot defend your ideas.

We are asking you to spend at least a few days preparing your proposal. The length and content of the proposal should reflect the time and thought you have put into it. If the idea of spending so much time on this proposal does not appeal to you, then maybe this is not the right place for you.

In case you are selected to come for an interview, this is what will happen at the interview:

(a) You will be asked to discuss and defend your research proposal.

(b) You will be asked to work in groups with other candidates to carry out a small exercise related to science education. During this exercise we will get to know you and you will get to know us. During this exercise we will discuss with you whether this is really the best place for you.

My guess is that we will get less than 50 candidates who complete this application. Even if we get 200 candidates, it will not be difficult to select 20-40 out of the set to come for an interview.

If we have 100 submissions, and if we have 10 faculty members helping, each can review 10 submissions. Each faculty member will look in particular for students who they think may they like to work with.