

# Deepening conceptual understanding

Neeraja Raghavan

Teachers are expected to be up-to-date with all that is happening in the education sector: well, if not *all*, at least the significant developments. Given the packed day of a teacher, however, there is scarcely any time to browse through the literature and cull out the valuable findings of researchers and educators. Thinking Teacher is launching this series with the intent of bridging this gap: we will bring to the readers of *Teacher Plus* the essence of one research paper in each article. Along with the gist of the paper, we will also suggest ways of putting into practice the main import of the paper through some strategies that can be implemented in the classroom. We invite your responses – if and when you do practice any of these strategies at < [thinkingteacher22@gmail.com](mailto:thinkingteacher22@gmail.com) > .

Before setting out to transact the day's lesson, have you ever confronted your students' prior ideas about the concepts that you are about to teach them? If you haven't (indeed, even if you have!), here is a research paper that will be a sheer delight to read.

I am assuming that you have read the classic paper of the fourth grade teacher, Deb O'Brien – when she confronted her students' prior ideas about heat and temperature.\* For a long time, I had fallen back on that paper whenever I wanted teachers to see how to probe students' prior ideas before launching into lesson transaction.

However, I recently read Esther Zirbel's *Teaching to promote deep understanding and instigate conceptual change* and was simply bowled over. The author goes far beyond Deb O'Brien's work – as she delineates an entire roadmap for the teacher to effect a change in the understanding of students. Most of us – as teachers – would acknowledge wanting precisely this: to put it as eloquently as Esther Zirbel: "The ultimate goal is to promote deep learning in the students' own minds." However, it is no secret that we are often so overwhelmed by the enormous

volume of content, that we have little or no time to first delve into the prior (mis)conceptions of students. Our Boards and Examinations effectively rule out that possibility – *or so we believe*.

For a moment, I implore you to park that assumption. Just for a moment, please. [At least, until you are done reading this piece. You can freely revert to that belief right after you finish!]

Zirbel begins by defining what concepts are: *mental representations, which in their simplest form, can be expressed by a single word, such as 'plant' or 'animal'*. What is meant by 'deep understanding', then? Zirbel declares that this is the *manner in which concepts are represented in the student's own mind, so as to form connections*. These representations could take the form of images, words, smells or sounds – even models, in complex cases. Zirbel goes on to clarify that 'deep understanding then means that the concepts are well represented and well connected.' Deep thinking allows further connections to be made, *by building upon what the student already knows*. It now becomes obvious that unless basic concepts are deeply understood, further thinking will be based on shaky understanding and therefore unlikely to be more than superficial.

Given the limitations of the human brain, 'chunking' of information seems to allow the brain to remember

\* [If you haven't, please get down to it right away (it is a must read for every teacher): <http://wolfweb.unr.edu/homepage/louisl/Teaching%20for%20Conceptual%20Change.pdf>]

far more concepts – than if they were stored individually. Chunking also allows inter-connections to be easily made between seemingly disparate chunks, thus allowing the mind a broad overview from a different vantage point. This sort of data-organization also lends itself well to meaningful *associations*, another tool for easy recall.

In Zirbel's paper, I found the biological explanation of neural connections to be utterly fascinating. Right from birth, our brain cells have been storing information through our neural networks – and this process will continue until we die. Each time we pick up something new, the brain searches for existing circuitry that can accommodate this new piece of information. If such wiring already exists, 'fitting in' also occurs immediately. If it does not, then additional connections between neurons need to be made. Naturally, this demands time, effort and some experience.

It is thus *biologically clear* why we are prone to staying in set thinking patterns and instinctively resist changing them. As teachers, though, isn't the latter *precisely what we aim to do* – especially if our students hold incorrect or inaccurate concepts that impede their meaningful engagement with the world?

Well, here lies the heart of this paper: *challenging students' existing ideas about the world*. The process of confronting alternate concepts that the student holds is inevitably confusing: and **no one likes to be confused**. However, the author asserts that this is a necessary step in the unfoldment of deep

**Title of Paper:** Teaching to promote deep understanding and instigate conceptual change  
**Author:** Esther L Zirbel  
**Journal:** Science Education Review, 2008  
**Link:** <http://cosmos.phy.tufts.edu/~zirbel/ScienceEd/Teaching-for-Conceptual-Change.pdf>

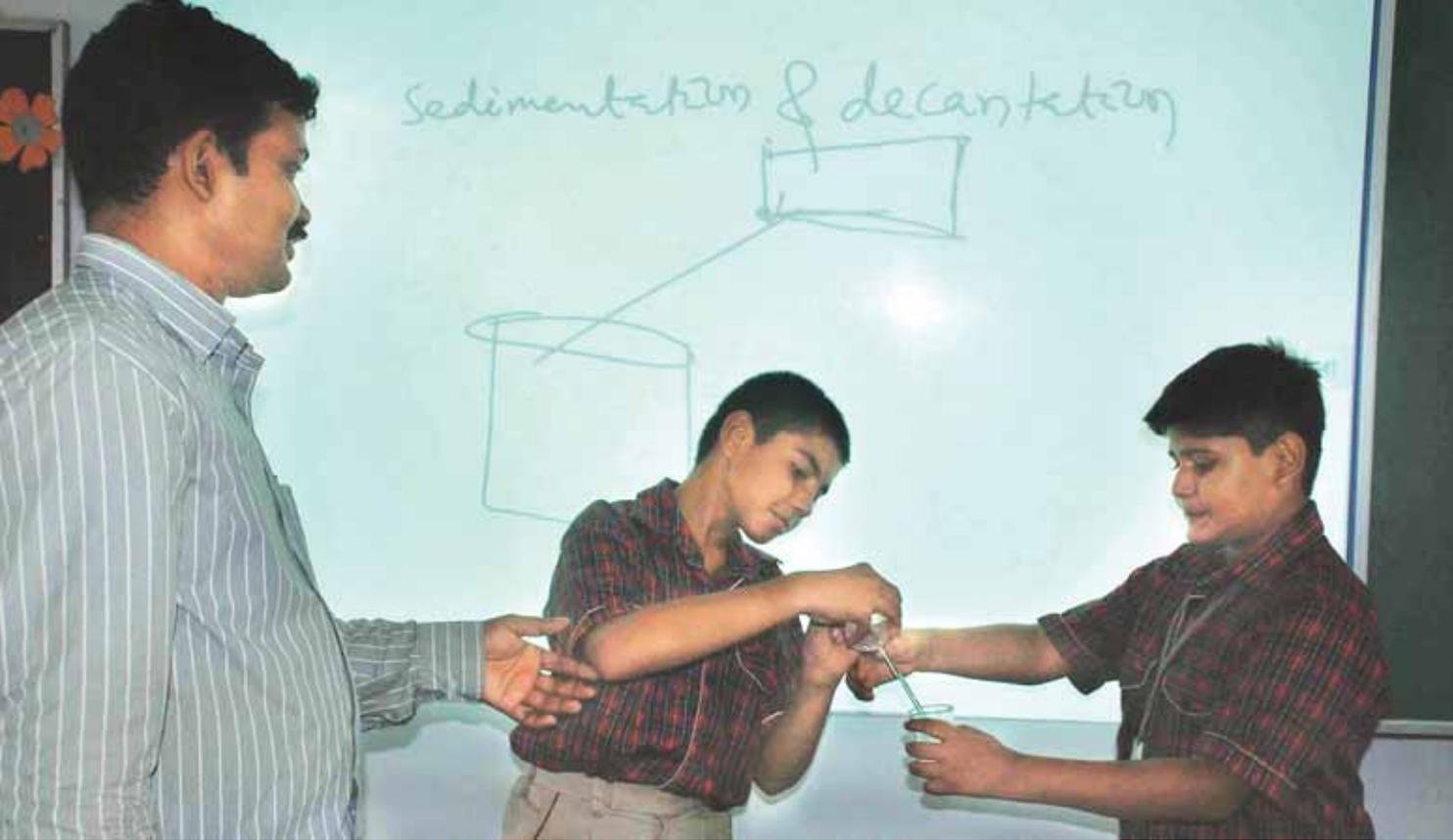
understanding. I love the following sentences in this paper:

The problem is that as soon as students get told the "correct" answer, they like to accept and adopt it – in other words, as soon as the answer is articulated, in most cases, *the process of thinking through a problem is stopped*.

This is because the above demands far less effort than does the exercise of thinking one's way through the problem. I found an interesting twist at this point in the paper: where the author refers to misconceptions *in the teacher's mind: about how students learn*. Unlike what is often (unconsciously?) assumed by many teachers, students do not just take in new information – because *they seldom come to class with blank slates in their minds*. They almost always hold some pre-conceived ideas about what we are going to teach them: some of them wrong and some of them partially/completely right. These ideas are based upon the student's own experience and private logic, and are – as already described above – **very resistant to change**. Unless teachers invest efforts in unearthing these ideas and laying them open to unbiased scrutiny, students will simply develop a



Photos: Sakti Prasanna Mohanty  
Courtesy: DAV Public School, Pokhariput



superficial grasp of whatever is being taught, as they steadfastly cling to their prior beliefs – even as they appear to parrot out whatever we are trying to teach them. [Even little children quickly gauge what we want to hear them say!]

So what, then, is a teacher to do? The author describes Posner's (1982) framework, which outlines the following steps in effecting conceptual change:

1. **Dissatisfaction:** the student must realize that the

existing theory/understanding is not adequate

2. **Intelligibility:** the new explanation must be within the grasp of the student so that (s)he is able to explain it to a fellow
3. **Plausibility:** this new explanation must make *more sense than the old one* that the student held
4. **Fruitfulness:** the new theory should do more than just explain the situation at hand; it should *open up new areas of enquiry*.

## Discipline through punishment? Teachers in response...

*Teacher Plus* would like to thank its readers who have been writing in to share their views on the article Discipline through punishment? which was published in its February 2017 edition. We give the responses here in brief. Please do visit [www.teacherplus.org](http://www.teacherplus.org) for detailed versions of these responses.

Everyone acknowledges that teachers know what is best for their students, but as rightly pointed out in the research paper teachers sometimes are so bogged down by their own problems, and trust me there are many, that they sometimes resort to techniques which are non-yielding. Human resources are the most valuable assets for a school and they need to be preserved and cultivated for best returns over the teaching lifespan.

**Sonia Kalra**  
Bal Bharati Public School, Pitampura

My natural response to an act of indiscipline has always been relationship-based which involves dialogue and reasoning with my students. This is a time-consuming job that requires patience from us teachers. But, students respond to love and affection and not to instructions that are forced down their throats. Effective classroom management and emphasis on moral values have helped me inculcate discipline in my students thereby reducing their acts of indiscipline and improving the learning capacity of the class. My own teachers believed in and successfully carried out these very methods when we were students to curb indiscipline.

**Saroj Bhasin**  
Headmistress, Bal Bharati Public School, Brij Vihar

In order to bring about the above steps, the paper then describes various non-traditional teaching methods like constructivist, inquiry-based, hands-on methods and critical exploration. The common thread in all of them is the *demand placed on the student to participate actively*. The author then outlines the following roadmap for a teacher to effect conceptual change in his/her students:

1. Hooking the student: By catching the attention of the student, the teacher ensures that the new idea gets noticed by the student.
2. Suggesting bridges: By giving the student useful tools like chunking information and/or meaningful connections that will render the new concept as 'sensible', the teacher can enable the formation of new neural connections in the student's brain.
3. Querying and confronting the student: By confronting the student's currently held beliefs, prior assumptions surface and can only then be uprooted. The teacher has to help the student see *why these are inconsistent with existing reality*.
4. Practicing and constructing: By going beyond mere regurgitation of the existing problem, the teacher must now empower the student to apply this *new learning in unfamiliar contexts*, so as to gain a robust understanding.

Different ways of carrying out each of the above steps are then described. Without going into them (as they are best read for oneself), I would like to point out a very important observation made by Zirbel: *that most teachers tend to stop at the point where they have presented clear and logical arguments,*

I believe that if a class is well-planned there won't be any space for indiscipline. But despite your best efforts ensuring incident free classes all the time is not possible. So when I do face an act of indiscipline I try and identify the student(s) responsible and give them group activities to do. When doing such tasks even the most disinterested or indisciplined child understands the importance of working together and learning cooperatively. But if my strategies don't work then I do send these students to the principal. Although that is always my last option, for I remember when I was a student I always appreciated those of my teachers who were loving, affectionate and understanding of me.

**Swati Gautam**  
The Peepal Grove School, Sadum, AP

and also added meaningful examples to help embed the concept in the student's mind. 'In other words,' says the author, 'the student has now been "optimally spoon fed", but until now, he has not been doing any thinking of his own.' The author points out that research has shown that simply listening and doing experiments is not enough to promote deep understanding in the student: *he/she will have to think through the problem on his/her own*. It is critical that this vital step is carried out: and the paper suggests many different ways of doing this.

The description of the role of the teacher in such a process is so beautiful that I don't wish to spoil your fun by telling it to you here: do read the original paper! All I will say is that the author has taken care to factor in the possibility of large classes and *has therefore suggested ways of doing this exercise even when student numbers are large*. I especially loved the section which deals with *the demands placed upon the teacher by this new way of teaching – actually, facilitating* – and the assurance that this new way can be learned by any teacher.

Above all, what I loved most about this paper was the way in which it addresses typical everyday concerns of many teachers: like the impracticality of going deep into each and every concept that is to be taught, and therefore *always* choosing depth over breadth. While many of us would love to do this, we know how near-impossible it gets – especially as we teach the senior classes. It also keeps addressing the issue of large classes, without assuming that every teacher has a small class. Too often, one reads highly idealistic papers that exhort the reader to do

There is no single technique that I use when I face an act of indiscipline in class. But I can confidently say that the one strategy that I least use in such situations is aggression and threats of punishments. This is because punishments can hamper the bond that exists between the teacher and her students. I understand that effective learning can only happen when the students share a good relationship with their teacher. Handling situations of indiscipline by understanding and involving myself in my students' problems I find that I am a more relaxed and confident teacher. This is a bit surprising for me though as when I was a student the teachers who were seen as most efficient were those who were strict and did not tolerate the slightest act of indiscipline. Punishments were a part of school life then.

**Sunita Gehani**  
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things which we know for a fact *cannot* be done in most school environments.

Here is a paper that balances realism with idealism, and suggests very do-able ways of nurturing the critical thinker in the student.

### Now bring it into the classroom!

- Can you recall instances of teaching a concept and feeling satisfied that the students seem to have grasped it well – then, after a worksheet or test, being puzzled at their obvious gaps in understanding?
- If yes, can you recall stopping at the point where the concept has become clear to the student – but *not going beyond to have the student think it through* in an unfamiliar context?
- If you can recall such instances, can you *now think of ways of extending the lesson so as to carry out the omitted step above*?
- What are the ways in which you can hook your students into the next lesson that you are planning to take?
- How can you ‘chunk’ information so as to render the chunks easy for students to inter-connect?
- What can you do to allow students’ existing ideas [about the concept that you are going to teach] to (a) surface and then (b) be examined in a non-threatening ambiance?
- How can you help them see the inconsistency (if any) between their currently held beliefs and the actuality?
- Can you provide your students with a new context or situation in which they can apply this learning so that they now have to think through the problem *on their own*?

Please do share your responses to these suggestions at [thinkingteacher22@gmail.com](mailto:thinkingteacher22@gmail.com).

#### Reference

Posner, George J., Strike, K.A., Hewson, P.W. and Gertzog, W.A. (1982), *Accommodation of a Scientific Conception; Towards a Theory of Conceptual Change*. *Science Education* 66 (2), 211-227

The author is Founder Director of Thinking Teacher ([www.thinkingteacher.in](http://www.thinkingteacher.in)), an organization that networks with teachers across the country. Thinking Teacher aims to awaken and nurture the reflective practitioner within each teacher. By taking (action) research out of the classroom, Thinking Teacher develops the (action) researcher in the teacher. And then, by bringing research into the classroom – as in this series – Thinking Teacher’s goal is to help build deep inquiry and rich learning into the teaching process. The author can be reached at < [neeraja@thinkingteacher.in](mailto:neeraja@thinkingteacher.in) > .

#### RESOURCES

# Full attention,

Manaswini Sridhar

When I attended a funeral recently, I occupied the quieter part of the room so that I could think of the departed in silence and not be part of the inane chatter of the people who had come to offer their respects. As a spectator, you witness people coming in, you don’t hear their words but what you see is how they move, how they use their body...in essence, body language. It then struck me how as teachers we have failed to infuse any sense of body language in ourselves; the facial expressions of 90 percent of the people were neither sympathetic nor solemn. Some had an embarrassed smile plastered on their faces even as they said, “I am sorry....” When they were leaving, there was still that smile lingering on their faces which was in stark contrast to the expressions of the immediate family. Even young people had the same mismatched expressions on their faces. Their bodies were lax or relaxed and not stiff and respectful, as it ought to be. So when we are teaching role-plays in school, what are we teaching? Are we still looking at grammar, vocabulary and pronunciation like the textbooks, or are we looking at other and perhaps more important aspects of language? Is role-playing then only another aspect of the syllabus that has to be dealt with or should it be a more exhaustive analysis of how one is perceived when communicating, especially in real life situations?

There is a plethora of resources on the Internet aimed at different levels, so finding a topic or a situation is simple. <http://socialskillscentral.com/free-samples/> is a website that helps develop social skills through role-playing.

<http://busyteacher.org/7824-top-10-role-plays-for-your-speaking-class.html> is a site that looks at everyday situations to help students master their language skills, and more importantly, their social skills.