

How Can Action Research Sustain Systematic and Structured Thinking in Participating Teachers?



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Abstract Action Research has been used worldwide as a professional development tool, especially for teachers. The fundamental premise of this work is that the Action Research Framework (Lewin in *J Soc Issues* 2:34–46, 1946) of Plan-Act-Observe-Reflect is aligned with systematic and structured thinking, lending itself as it does to enquiry, analysis, hypothesis and problem-solving of organisational issues. It has been legitimated as science by Susman and Evered (*Sci Q* 23(4):582–603, 1978), and this paper begins from the position that Action Research (AR)—in terms of the thinking that AR demands and generates—calls for a scientific approach that is contextual, and generates relevant knowledge that is located in the experiential field of the action researcher. Since critical thinking and analytical skills are at the heart of a scientific approach, such an approach is important for teachers—regardless of the subject that they teach. As teachers enable their students to develop these skills, it is important to ask—how far do they refine their own thinking, and/or examine it so as to render it more critical, analytical and probing? Do they? And if they do, how does this manifest in their own classroom practices? If they do not, how can they be empowered to do so? Through structured interviews with four teachers (three Mathematics, one Science) who had engaged in AR approximately a year prior to this research, this paper serves to explore possible outcomes of AR by posing questions such as: When teachers have conducted AR to address one or more of their day-to-day practices, does (or how can) their engagement with AR enable teachers to think systematically about and analyse critically any other issues—for a significant period thereafter? Does/how can the engagement with a sequential framework like AR empower them to sustain this structured way of thinking and acting a year or so after their AR is completed? The purpose behind asking these questions is to explore if (and how) AR can serve as a tool to make teachers veer towards greater/deeper observation of their school processes as well as their own thought processes; and enquiry, analysis and verification of their initial hypotheses in classroom processes, especially since (Science, Mathematics and even Social Science) teachers are expected to draw out these skills from their students. A set of recommendations for teacher professional development through AR is finally proposed.

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Introduction

Teachers in Indian schools who aim to develop systematic and structured thinking in their students are implicitly expected by their Principals and the parents of their students to possess this ability themselves. However, since schools seldom invest efforts in gauging the extent to which teachers are themselves honing or making use of this ability, there are even rarer instances of schools actually working towards refining this ability in teachers, in more than just a sporadic manner.

An Indian school teacher's day is usually packed with multiple tasks that include lesson planning and transaction, event planning (like school assemblies, school excursions, exhibitions, cultural programmes, sports events, debates, quizzes, etc.), assessment planning and implementation, administrative tasks (like timetabling, documenting minutes of meetings, mentoring other teachers, etc.) and attending parent-teacher meetings and staff meetings. With such varied and multi-level engagements, there is little scope for a teacher to allot a separate time slot in order to develop structured and systematic thinking. It is therefore *within this very paradigm* that such a development needs to be sought: if it is to be at all meaningful.

Action Research: A Professional Development Tool for Teachers

Teachers in a school, like the members of any organisation, need to solve organisational problems on a day-to-day basis. Apart from the all-important issue of pedagogical content knowledge that every teacher needs to equip herself with (Shulman, 1986), there are a myriad of issues spanning a wide spectrum that are repeatedly encountered by any teacher—such as managing classrooms, meeting cultural differences between students of varying backgrounds, confronting a perceived lack of synchrony between the school's stated philosophy and actual practice, transitioning from the role of a teacher to that of an administrator or mentor, and so on. In dealing with issues like these, teachers have to draw upon their existing beliefs and assumptions to devise strategies that seem best suited to the given context. While doing so, if teachers can identify their assumptions, examine their biases, verify their guesses and analyse the reasons for their success or failure, then a certain structure and systematisation of *their thinking* will emerge, the importance of which cannot be overstated.

In this work, Action Research (AR) is seen as a means of generating knowledge that is situated in the field of practice of the action researcher, and is therefore not necessarily value free. Unlike positivist science, which draws evidence 'from sense data that can be directly experienced and verified between independent observers' (Susman & Evered, 1978), AR provides a mode of enquiry that is located in the *subjective* experience of each researcher, and is therefore *not* value neutral—yet it is meaningful, in that it generates new knowledge even as the researcher solves the

problem under study. The degree to which knowledge generated through positivist science is value neutral is also questionable, as explored by Susman and Evered (1978). These researchers assert that when organisations limit themselves to methods that emerge from positivist science, believing them to be value-free and relevant to organisational problems, they unwittingly employ only those methods that actually work well in systems that are *not* affected by human purposes and actions. However, since organisations are populated by human beings and are affected by their purposes and actions, AR is a far more relevant and contextual way of encountering organisational issues. In organisations, as Susman and Evered (1978) declare, ‘means and ends are guided by values’ and therefore, ‘empirical observation and logical reconstruction of organisational activities are not sufficient’ for understanding and tackling problems. AR allows the researcher to explore and arrive at the *most appropriate solution* to the problem under study, without referring to general laws or organisational practices.

Such a problem-solving process will empower a teacher who teaches *any* subject—not necessarily only a Science teacher. This paper examines if and how four teachers (one Science teacher, three Mathematics teachers) who had conducted AR on a specific issue can be supported in their efforts to use AR as a means of continuing to think scientifically about *other* day-to-day issues that a teacher normally encounters. The reasons that AR has been taken as the backdrop of this work are as follows:

- The author of this work has been engaged with facilitating AR by teachers across schools, and has found this to be a very effective way of awakening the reflective practitioner from within the teacher (Raghavan & Sood, 2015; Raghavan 2018).
- While the success of AR in triggering structured and systematic thinking in the action researcher has been remarkable, there has not yet been any significant effort to investigate the *sustained impact*, if any, on the thinking of the action researcher.
- Since AR has, in itself, proven to be effective in turning around the thinking of the action researcher with regard to the *particular AR problem* that the researcher chose to work on, it is now meaningful to explore if and how this result can be built upon further so as to keep alive the enquiry, analysis, reflection and problem-solving processes that were initiated in the teacher-researcher.
- If such processes emerge through this exploration, they can then be tried out with other teachers so as to examine their efficacy in refining the systematic and structured thinking of teachers.
- If teachers can be empowered to systematically examine their day-to-day experiences, this could bring them out of the commonly experienced maze of problems that appear to defy solution, both in their number and complexity. This, in turn, could allow them to anchor more convincingly the development of enquiry, analysis and hypothesising in their students.

Background

AR has been used worldwide as a reflective process that allows enquiry into one's daily practice. Instead of being theoretical, AR draws the researcher and practitioner into a systematic examination of day-to-day practice so as to address concerns unique to the researcher and thus bring about change. The distinctive element in AR is *praxis*: practical diagnosis complemented with the reflective element (Elliott, 1991; Schon, 1983). It is this element that demands the iterative reflection-in-action that has been described so eloquently by Schon (1983). In so doing, AR naturally empowers its participants even as it demands collaboration and reflection. AR has been employed worldwide as a professional development tool for teachers and school administrators (Corey, 1953; Elliott, 1991; Glanz, 1999; Nunan, 1997) and it presents exactly such a possibility, providing as it does a systematic framework for examining and working one's way through *every day issues that pose as problems*. For a comprehensive literature review of AR, the reader is referred to Raghavan and Sood (2015) which also carries an overview of the use of AR across different domains.

Vocabulary

Since there are currently multiple usages of several words that will be used throughout this paper, it is meaningful to explain their usage here, right at the outset. The term *action research* is used in this paper, as it was defined by Lewin (1946), where the act generates critical knowledge even as it brings about a change. According to Rapoport (1970), AR has five phases: diagnosing, action planning, action taking, evaluating, and specifying learning.

Systematic and structured thinking, as used in this paper, refers to enquiring, analysing, planning and acting to solve identified problems that *arise out of the researcher's experience*. On occasion, this is also referred to in this paper as *scientific thinking*—especially if it means the identification of a bias, assumption or conclusion that has been drawn without back up of authentic data. Since this work is placed in the context of the teacher, the 'laboratory' is the teacher's groundswell of experience, with the 'experiments' being the teacher's strategies to address the issues that arise from this experience, after having examined and analysed them so as to diagnose likely cures.

The stark contrast, therefore, between positivist science and AR is the inevitable interdependence between researcher and system that exists in the latter and is absent in the former. The important processes that are under scrutiny here are enquiry, analysis, planning, implementation of strategies, evaluation of (and reflection on) their impact.

Impetus

This author began adopting AR as a tool for facilitating teacher development after several years of employing workshops as the main mode of engagement with teachers. While the latter proved to be somewhat impactful in the short term, this author was left highly dissatisfied by the lack of sustained impact on the teachers who participated in these workshops. Among the multiple reasons for this lacuna, the most significant was the fact that the themes of the workshops were seldom aligned with each participant's unique needs. This resulted in a one-cap-fits-all approach, something that the teachers themselves were discouraged from adopting in their own engagement with students! It was, therefore, inevitable that this author anchored a research study in 2014 with several teachers of a semi-urban school in North India, wherein AR was explored as a tool for engendering reflective practice. The success of this project resulted in the book *The Reflective Teacher* (Raghavan & Sood, 2015) and the strengthened conviction in this author of the power of AR. Presently, this is the main mode of engagement employed by this author, with teachers across schools in India.

Methodology

The AR conducted by these teachers was facilitated by this author over a period of 2 years and their work is currently under publication as a book (Raghavan, in press). In order to reduce subjectivity, the exploration of its sustained effect, if any, after the completion of research was not carried out by the same person. Instead, another teacher educator and researcher—who had *not* played any role in facilitating the AR of these teachers, and had, in fact, not engaged with them at all until this exploration—undertook to interview them and audio record the interviews. The author was acutely aware of the possibility of steering the discussions towards her desired conclusion, so this division of tasks helped greatly in reducing unconscious bias in the tone and structure of the interviews.

The interviews comprised the following questions:

1. How much time has elapsed since you completed your AR?
2. During this time, have you noticed any potential AR problems that emerge from your daily life? Professional or personal?
3. If you have, can you spell them out now? If you haven't, go to Questions 6 to 7.
4. Can you analyse one or two of these problems now? How would you identify strategies for these?
5. Did you try and implement any strategies to address any of these issues? If yes, describe what you did. If not, describe the impediments to doing so.
6. Can you recall instances when the major learnings from your own AR popped up in your mind, after you completed it? If yes, describe each of these triggers in detail. (What happened to make you reflect on your learning from AR, how it affected your thinking about the situation that triggered it, etc.)

7. If you can't recall any such instance, how (if at all) would you say that AR has affected your thinking?

In a sense, this was the process that Schon (1983) terms 'reflection on reflection-in-action'. Transcription of the recorded interviews followed by an analysis of the findings was carried out by the author.

School Setting

The teachers in this study worked in two alternative schools in Bangalore, Karnataka. In order to interpret the term 'alternative' schools in India (Vittachi & Raghavan, 2008), it is important to first understand what these schools are *an alternative to*, by comparison with mainstream schools in India. Most mainstream schools in India are geared towards ensuring high student achievement in the final examinations and securing high positions so as to allow their admission into the best colleges. Therefore, teachers in these schools are hard pressed to 'cover the syllabus' and maximise their students' performance in examinations. By contrast, the focus in alternative schools is less on exam scores and more on learner-centric pedagogies which empower a child to learn at his/her own pace.

Kanchana Suryakumar worked in Poorna Learning Centre (www.poorna.in) while the other three teachers worked in Prakriya Green Wisdom School (<http://www.prakriyaschool.com/site/>). Both schools are atypical of mainstream schools in India, in that they do not encourage competition or comparison, do not have school uniforms (which mainstream schools in India do), maintain small class sizes (less than thirty students to a class) and encourage their students as well as teachers to reflect on teaching-learning processes through various means such as collaborative work, enquiry-based explorations like AR and Reflective Writing. It was therefore against this background that the present investigation of the lasting effects, if any, of AR on the thinking of the teacher-researchers was carried out.

Sample Selection

The sample of teachers was small and selected purely on the basis of time elapsed since completion of AR. Four teachers who had conducted action research (with facilitation by the author) were approached for this study. They had all completed their AR about six months to a year before they were approached. Given the small sample, none of the findings generated herein can be generalised or statistically validated. However, they can provide leads on possible ways of keeping alive the systematic and structured thinking that AR triggered in teachers, post-AR.

Action Research was not familiar as a professional development tool to any of these teachers prior to their embarking on it. This facilitator, therefore, had to first initiate them into AR, and then facilitate their individual research, as below:

- A one-day workshop was conducted for all the teachers of each of these two schools, which explained to them the steps involved in AR, showcased a few case studies and afforded an opportunity to participating teachers to brainstorm on 'action-researchable' issues in their own schools.
- Following the above, certain teachers of each of these two schools opted to undertake AR, and were supported to do so by their school principals. This support manifested in these teacher-researchers being assigned certain time slots during the teacher's workday to meet the facilitator, read research papers, think through their AR and eventually, to document it.
- The facilitator met with each Action Researcher for an hour every month, and remained in electronic correspondence with them through the periods between meetings.
- The process adopted for facilitating AR by this author has been described in detail elsewhere (Raghavan & Sood, 2015) and so it is not being detailed here.
- On an average, each of these teacher-researchers completed their AR in a period of seven months (Raghavan, 2018), with the collaborative AR taking three years.

All of the above was done prior to the work that is described in this paper.

While the action research of all four teachers is currently under publication (Raghavan, in press), a summary of their AR is presented here for the purpose of completeness.

Radha Ravi completed her AR eighteen months prior to this study. She had been a corporate trainer prior to joining a school in Bangalore as a Mathematics teacher. In her third year at this school, she was asked to don the role of mentor to some teachers. Faced with this daunting task, therefore, she opted to conduct AR on *finding and meeting challenges in her new role of mentor to other teachers*.

Geetha Nadarajan was in her sixth year of teaching at the time of writing this paper, and she completed her AR twelve months prior to this study. Increasingly, she had begun to feel discontented while teaching Science in a school, as she found that the human qualities of each child were not being nurtured in their attempt to excel in the subject. In Geetha's worldview, *this is not science*. Unless it is a humane effort, the learning of the subject is incomplete, she asserted. So she conducted AR on *bringing together the head and heart in the teaching and learning of Science by fifth, sixth and seventh graders*.

Sudha Ravi had been a teacher for over two decades at the time of this study, and she completed her AR seven months prior to this study. Since Sudha was a Mathematics teacher as well as an administrator (Headmistress), her role empowered her to plan and implement several far-reaching interventions during the AR. Noting, with concern, the compromise of rigour in order to make learning fun, she conducted her AR on *bringing a balance between rigour and flow in the Primary Section of the school*.

Kanchana Suryakumar had been a Mathematics teacher in a school for six years at the time of writing this paper, and she had completed her AR six months prior to this study. Being a Mathematics teacher, she noticed the struggle that students faced while meeting the demands of a uniform curriculum for each age. She carried out collaborative AR (along with two other teachers) on *allowing students to learn Mathematics at their own pace through a mixed age group (MAG) setting, rather than a single age class*.

Data Analysis

Since this exploration consisted largely of probing teachers' thinking and practice through structured interviews, the data analysis did not require more than a compilation and comparison of responses. While scrutinising each teacher's answer to the specific question that was asked, similarities and differences across this sample were also gleaned. Each response was viewed against the backdrop of the time period that had elapsed since that teacher completed her AR. Emergent findings like what could perhaps have been done in order to sustain the momentum generated by AR were noted, along with the results that the questions directly yielded. Sometimes, the respondents talked about issues that the interviewer did not overtly raise as questions. For instance, the importance of documentation was articulated by some of the teachers, even though it was not pointedly asked as a question. These responses were also recorded exactly as they were received. While subjectivity and bias were minimised (by having another person ask the questions, as already mentioned), no claim to complete objectivity is being made here. Given the likelihood of human failing in recall, subjectivity in perception and therefore, a certain tentativeness in conclusions that were articulated, the results nevertheless did yield some valuable learnings for sustaining thinking and reflection in the teacher-researcher.

Results

Radha Ravi has been using the main learning from her own AR as she continues to play the role of mentor to different teachers. Her AR proved to be of great value in that she started by donning the new role with a high level of diffidence and tentativeness, and by the end of her AR cycle, expressed satisfaction at her increased self-confidence and comfort in that role. However, she admitted candidly that her conversation with the interviewer made her realise that she had completely neglected using AR as a tool in her daily life, save vis-a-vis mentorship—her specific AR problem. She realised through this conversation that she could have benefitted greatly if she had tried applying the AR framework to different issues—even without a facilitator—and confessed that while she has retained her ability to identify a problem, she has not

gone beyond that. She now sees the value in doing that, instead of regarding her AR as over and done with, now that she is a successful mentor.

Geetha Nadarajan acknowledged that her science teaching has become more holistic after her AR as she works to 'bring together head and heart'. Although she had initially intended to focus on the students in her class, to see if they were balancing head and heart during learning, the AR drew her attention to her own situation and she realised that she was herself prone to exhibiting more heart than head, and this biased her observations of students. She continues to catch herself even in personal relationships, where she admits that she needs to balance her head and heart. She recalls distinctly how—when she was called upon to furnish quantitative data about children who were 'not exhibiting enough heart'—she actually found only one-third of the class was so! All the while, she had imagined the number to be far higher. This is something that she remembers with great force. It has made her revisit statements where she freely used the word 'everyone'... she reminds herself that sweeping generalisations are not accurate. She also recalls the effectiveness of story-telling in science classes, and how she discovered that she, too, was good at telling stories. She is still trying to strike a balance between her own head and heart, and she questions herself and consciously brings herself back to the middle path every now and then. She notes with pleasure that she is no longer 'stuck' as she used to be. Her earlier block towards documentation has now vanished. She now finds it easy to document and has realized the importance of documenting cultural aspects as well as classroom processes. She thinks her documentation habit will stay with her as it is giving her a lot of clarity. AR has enriched her by making her recently assigned role of mentor very meaningful; she declares that she is able to play the role authentically. She also finds that she is able to convey with conviction to other teachers the way that she began looking at science, post AR. She has been able to identify her time management skills as a very potent area for her to do AR, but this was a problem that had been suggested by her facilitator. She could see that a possible strategy for this AR would be for her to lay out a schedule and stick to it. She has slowly started making such efforts by making schedules.

Sudha Ravi regards the AR modality as an approach that helps her look into factors connected to day-to-day concerns, something that she liked, especially the emphasis on *hard data*, not just based on feelings and whims. The step-by-step approach of AR through facilitation enabled her to join certain dots, which had been missing, on occasion, in the past. She used this approach with children even after completing her own AR. Her paper was on balancing rigour and flow, and that has remained very close to her focus thereafter. It has percolated into her personal life also, where she sees such a balance now. She finds that many problems that come up are potential AR problems. An example is the recent Government ruling to make the use of the language, Kannada, mandatory from Grade I. This ruling throws up approaches that are in contrast to the school's approach to Language learning, and Sudha sees this as a potential action-researchable issue. At the time of writing this paper, it is currently being studied by using AR. Not all teachers have been introduced to AR, but those who have done AR are able to facilitate the others to use this framework for this issue. Using the modality of AR, the group is not hastily

arriving at decisions, but is looking for hard data first. AR has taught her not to *assume* things, but to substantiate her assumptions with hard data, and she found it interesting how the solutions that AR led to were not in any way extreme or unusual. They were simple solutions which were actually all around her, but were being missed, for some reason or the other, and AR helped her to get in touch with them. AR has sensitised her and her colleagues to the native wisdom of the RtE¹ children and as a result of the AR study, she and her colleagues include this perspective in their transactions. She will continue to value rigour and flow both in others as well as in herself, and she will demand this balance from her context. She feels that AR helps her in seeing the whole picture—looking at multiple factors that impact a situation—and also in gathering hard data to substantiate a conclusion, instead of relying on feelings and opinions alone.

The facilitation of **Kanchana Suryakumar's** three-year-long AR (by the author of this paper) came to a close six months prior to carrying out this study. Coming from a corporate space, she found too many parameters to deal with in education and could not clearly see what to do and how to go about it, even though she sees herself as a structured person by nature. However, the AR framework gave her clarity, as it helped her realise that something like this can be done on a small scale to bring in tangible results which she can show as evidence for what has worked/not worked. Collaborative AR gave a platform for her and her peers to discuss and work together in a structured manner, which they all benefitted from enormously. What seemed like a huge and insurmountable problem became something that could be tackled as the AR framework was steadfastly adopted. Through the first year, facilitation helped in pruning the 'action' from the 'research', and this helped the efforts pan out in the second year so as to render the research meaningful. Now ending the third year of AR, she has been motivated by this to begin working on another research project: error analysis, based on data that she has already collected over this three-year period. She has also been advocating the AR framework to her peers, whenever they come up with issues. Doing it formally with a facilitator makes a huge difference, she acknowledges. She is willing to don the role of facilitator for her peers. She cannot recall any enhanced ability to identify a problem as a consequence of doing AR. She regards AR as a framework that helps her work through a problem, rather than help her identify it. The documentation process helped greatly in reflection. For the first one and a half years, documentation was informal, in the form of minutes or short notes. When she and her co-researchers began formal documentation and the numbers actually reflected their gut feeling, it was an 'aha' moment for them. It even changed some of their strategies for the next year. She finds AR to be *one kind* of scientific framework. It could also be adopted in a non-scientific domain, for example, the personal domain in dealing with such things as anger management. The AR framework can be used there, too, she declares. She liked summarising her work

¹Right to Education Act (RtE) was passed in 2010 and necessitates that 25% of admissions to schools draw from the underprivileged section of society. Urban schools face the challenge of integrating children from widely disparate backgrounds as a consequence, and Sudha Ravi works in an alternative school that is actively addressing this issue.

in the form of a paper, and found it very exciting. She would like to keep such a goal on an annual basis so that she can continue to share her work with her colleagues on a regular basis. She is confident that something will keep coming up where she can use her structured, scientific manner of documenting.

Discussion

All four teachers continued to use the main learning from their specific AR problem, for instance, Radha Ravi continued to be alert to the challenges that she faced during mentoring, Geetha Nadarajan was consistently alert to balancing head and heart in teaching and learning Science, Sudha Ravi was acutely aware of balancing rigour and flow and Kanchana was conscious of the modality and effectiveness of mixed age groups in teaching and learning Mathematics.

However, since the intent of this study was to explore if their learning from AR went *beyond their specific AR issues*, so as to lend greater structure and systematisation to their thinking, the above findings are now examined further in that light. It is evident that a range of conclusions can be drawn, as the power of the AR framework emerged for one teacher, only, *during* this exploration, while it inspired some others to adopt it in their work long after they completed their specific AR.

For ease of reading, recommendations are stated *after* the conclusions from which they flow. The conclusions are listed as follows:

1. All four teachers acknowledged the power of the AR framework to help them work their way through day-to-day issues in a systematic and structured manner.
2. Reflection on the nature of science and science pedagogy was triggered in one teacher-researcher, as a consequence of her AR on bringing together the head and heart in science teaching and learning. For another teacher, the need to examine multiple factors that affect a single event emerged with great force, thus making her realise the complex nature of seemingly simple issues. Yet another saw in the AR framework a powerful way of working her way through issues in the personal as well as professional domain.
3. One teacher-researcher was struck by the simplicity of solutions that she adopted and implemented during her AR and noted that they had, in fact, been all around her, but had somehow escaped her notice until she began doing AR.
4. As long as a *facilitator was engaging with these four teacher-researchers*, they were all feeling empowered to use the systematic framework to think systematically. Having completed the AR, however, only two of the four teachers entertained the possibility of continuing to use the framework to their advantage.
5. The skill of identifying a problem—the first step of AR—appears to have stayed with all four of these teacher-researchers, although one of them stated that it was *not* a new skill for her. This is a valuable skill as, most often, teachers are plagued with numerous problems which they find hard to pin down and articulate

- in a clear and researchable manner. This often precludes the possibility of their emerging free of the tangle.
6. Two of the teachers adopted this framework to solve new problems that they later identified. Significantly, *these were the two teachers who had completed their AR most recently*, out of the four in this sample. The ability to diagnose and analyse a problem in depth has been used by two of the teachers for Teaching Kannada and Error Analysis.
 7. The need to support one's claims with hard data came through forcefully for at least two of these four teacher-researchers. The awareness of avoiding making sweeping generalisations without sufficient data impacted these two teachers' day-to-day functioning thereafter. The significance of this cannot be overstated as a teacher's interventions are frequently steered by certain assumptions, often untested for validity. This is also valuable, especially if teachers are to demand the same rigour from their students in Science classes.
 8. Documentation of their AR-enabled these teacher-researchers to step back and look at their work, even as it opened up some new areas for a couple of them. When a teacher begins to see value in documentation, a doorway to objectively examine her day-to-day work opens which, in turn, allows critical analysis and, eventually, problem-solving.
 9. Another interesting consequence of AR was the opening up of new roles for teachers. One of these teachers began facilitating AR by her peers, while observing that this framework prevented them from slipping into a habitual tendency of spontaneously arriving at unsubstantiated conclusions. Another felt equipped to don the role of facilitator of AR by her peers, which may well happen in the future.

These four cases illustrate the possibilities that lie embedded in AR: for igniting, nurturing and sustaining a systematic and structured way of thinking in teacher-researchers. It also shows the critical role played by a facilitator. Teacher development necessitates the periodic engagement of an in-house mentor with teachers, who are experienced and can initiate reflective thinking in teacher-researchers. Certain processes need to be put in place if teacher education is to be meaningful and contextual, processes that enable teachers to identify and then question assumptions, support their own conclusions with hard data, demand such data from their peers for their conclusions, and articulate day-to-day issues as researchable problems.

The importance of AR as a professional development tool was acknowledged and experienced in tangible ways by each of these teachers. However, the lasting effects of this tool depend significantly on the School Heads supporting and sustaining the process. There is immense value in Heads of Schools or Senior Teachers engaging periodically with teacher-researchers to explore the impact of the AR on their day-to-day functioning, long after they complete their AR. This can keep open the minds of the teacher-researchers to the possibility of using this framework *without the presence of an external facilitator* or even inspire them to don the role of facilitator for their peers to conduct AR. Tapping into each other's expertise, a rare practice amongst teachers in most

Indian schools will be only one likely consequence of such role change. Just as one teacher–researcher was struck by how she had missed noticing the availability of solutions to her AR problem, such interactions between teachers may well make them note skills in their own peers that had thus far escaped their attention. The shift in dynamics between colleagues that is likely to ensue, as a result of such role changes, can do far more to initiate *organic* teacher development than the customary teacher-development workshops that schools typically organise annually—mostly conducted by external resource persons. Further, by encouraging regular, reflective documentation of their pedagogy as well as classroom processes, in-house mentors can aid teacher-researchers in using AR as a tool for opening up avenues of critical analysis and self-reflection. In-house mentors for documentation can bring about dramatic changes in the way teachers perceive themselves, their pedagogy, as well as the subjects that they teach.

School principals can build on the above to keep alive the spirit of enquiry, critical analysis and problem-solving in their teachers, without which they cannot truly envision the same skills being honed in their students. When scientific thinking in teachers extends beyond a laboratory or science class, and they even begin to examine their own thought processes, there is far greater chance of teachers nurturing the same in their students.

Acknowledgements The author wishes to acknowledge, with gratitude, the efforts of Padmini Nagaraja in interviewing the four teacher-researchers and audio-recording her exchanges with them. She also wishes to thank the four teacher-researchers for giving their time towards this study. The author also thanks to the principals of Prakriya Green Wisdom School and Poorna Learning Centre, Bangalore, for permitting her to carry out this study with their teachers.

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