
Information Technology and Teacher Education: focus on student learning or on teacher change?

BETTY COLLIS, Guest Editor
*Faculty of Educational Science and Technology,
University of Twente, Netherlands*

There is a compelling simplicity to the idea: identify aspects of information technology (IT) use that have a positive effect on students' learning and then show how this identification could and does inform teacher education. This was the task of this Special Issue. Figure 1 illustrates a first schema for the task.

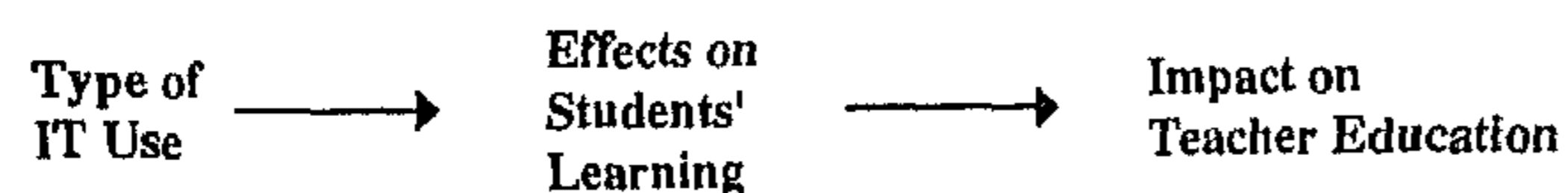


Figure 1. Original framework.

Such a framework was suggested to the authors of the articles in this Special Issue of the *Journal of Information Technology for Teacher Education*. The results, as reported in the following eleven articles, indicate the task to be much more complex in execution than this framework would suggest. What are the overall trends about IT use, effects on student learning, and changes in teacher education in the eleven articles, representative of teacher education research and practice in nine countries? What are the recommendations for pre-service and in-service teacher education that emerge from a synthesis of the eleven articles? What are the inherent difficulties in the task as originally presented, in its "compelling simplicity"? These are the questions addressed in this reflection.

Perspectives on the Task in the Articles

There appear to be two major areas of difference among the articles, as well as three common conclusions. The first area of difference is the way in which the authors interpreted the above three-step framework; the second area of difference is the methodology they employed in coming to their conclusions.

Variations in the Perspectives

Only one of the articles might be said to fit rather directly to the original three-step framework (see Figure 1). The article that matches this approach most clearly is that of Kanselaar. He discusses in detail the design motivations for a certain IT product (a CD-ROM of coordinated resources for English as a second language), basing those design decisions on both theory and methodological principles of second language instruction. He then, in an experimental framework, compares the results of students using the IT resource with matched students not using the IT resource. The effects considered were mainly: the appropriateness with which students chose options in a multi-option IT resource to fit their goals, the students' affective reactions to the use of the IT resource, and the comparative learning results between the IT using and non-IT using students relative to knowledge of vocabulary and reproductive skills. From his observations, he then makes recommendations for teacher-education practice.

The article by Knezek, Miyashita & Sakamoto could also be said to fit into this general framework, although their focus on "type of IT use" was either highly general ("use" or "no use"), or related to broad categories of software. The effects they studied were mainly two types of attitude toward computers: computer importance and computer enjoyment, as well as the relationship of these two types of attitudes with various psychological characteristics, such as motivation/persistence, creative tendencies, degree of empathy, and study habits. Rather than studying the result of an experimental intervention, such as was done by Kanselaar, Knezek and his colleagues chose a non-interventionist survey approach. Where they broadened the general framework was by adding the aspect of cross-cultural variation (see Figure 2).

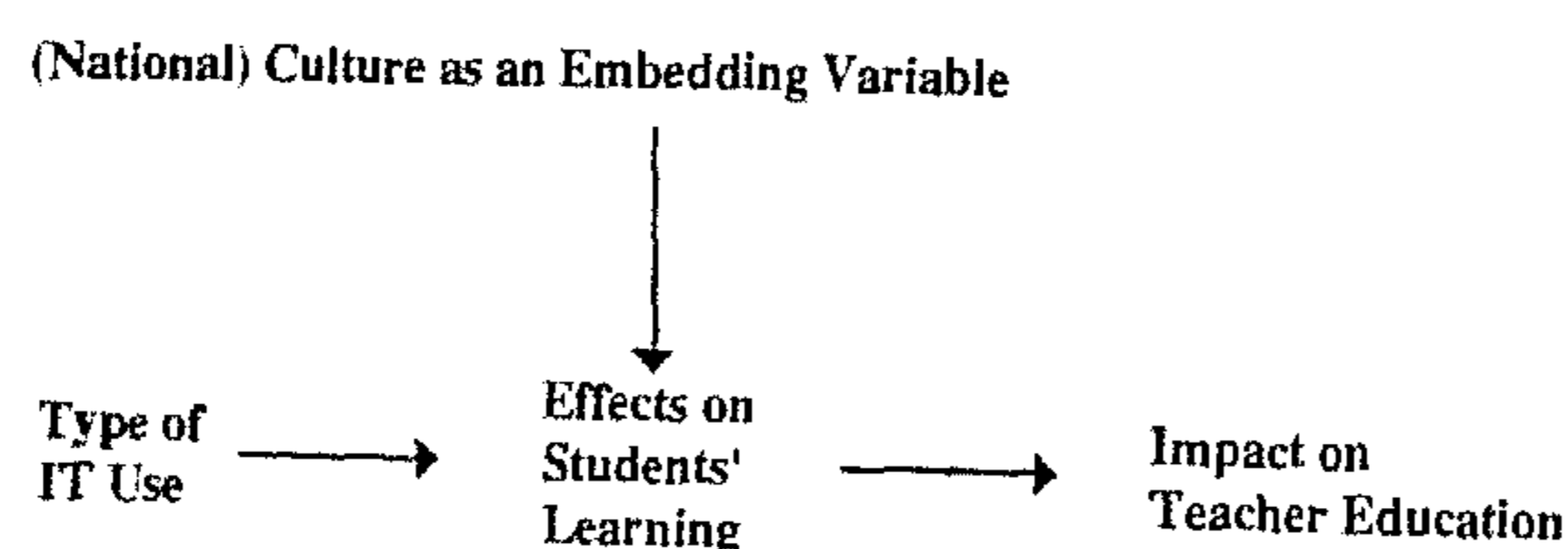


Figure 2. Framework, interpreted according to Knezek, Miyashita & Sakamoto.

In their conclusions, they did not find national culture, as represented by the three countries out of which their 3000 subjects were sampled, to affect differentially the attitudinal effects of interest in their study.

Heppell explores the nature of culture in a different way in his article. He develops the idea of the evolution of a technological culture and focuses on learners as products of an emerging “information generation”, a culture with its own “signifiers, cues and clues”. He also explores the culture of traditional pedagogy and considers its relation to the emerging information culture. He pays considerably more attention to the evolution of types of IT use than do any of the other authors in this Special Issue, and relates this evolution to the evolution of pedagogy that he sees as necessary in order that the effects of IT use in society be exploited in schools. Unlike Kanselaar and Knezek and his colleagues, Heppell gives no specific data about student learning effects, other than his reflections (and some anecdotes) based on his experience and his syntheses of others’ experiences. Thus we could identify Heppell’s view of the task for this Special Issue as one that starts with the position of Figure 3.

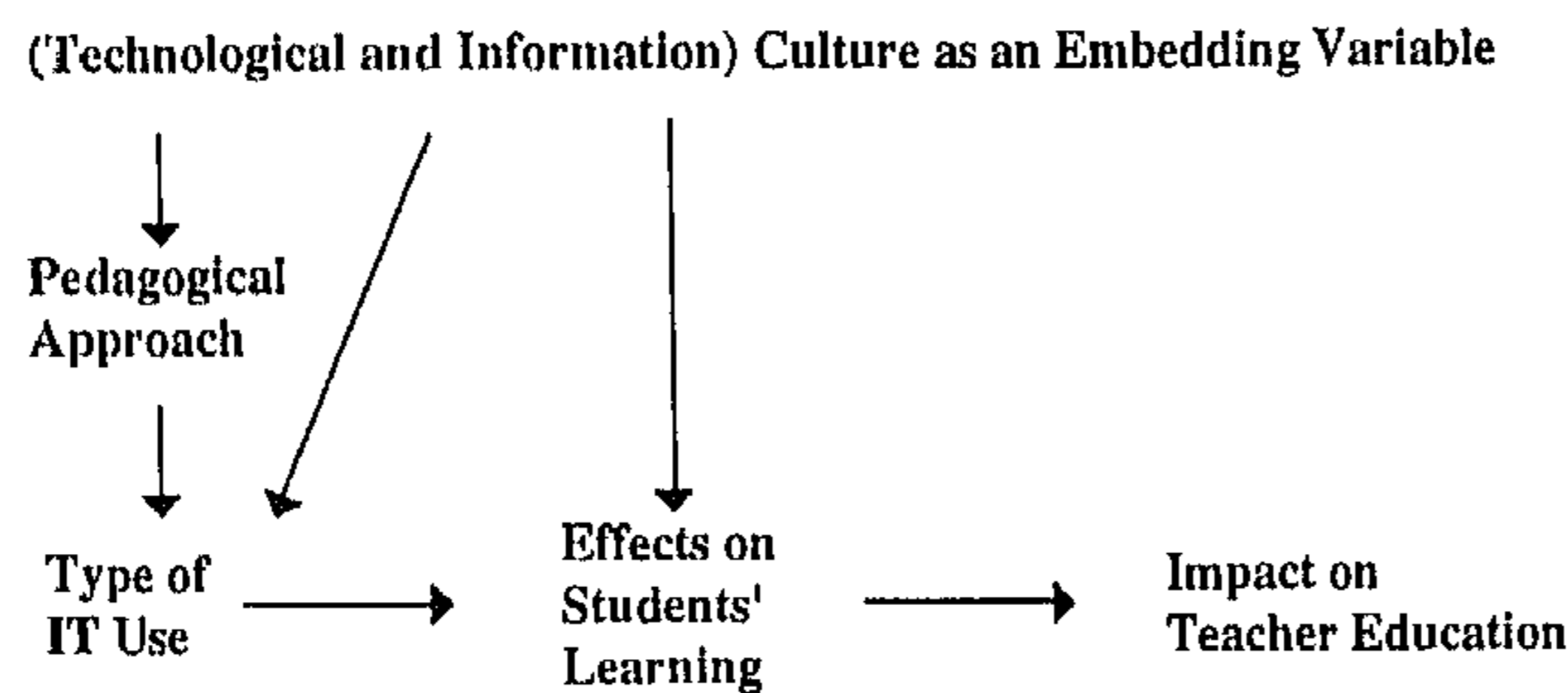


Figure 3. Framework, current situation, interpreted according to Heppell.

But Heppell also looks to a time when the direction of influences (Figure 3) will change (Figure 4).

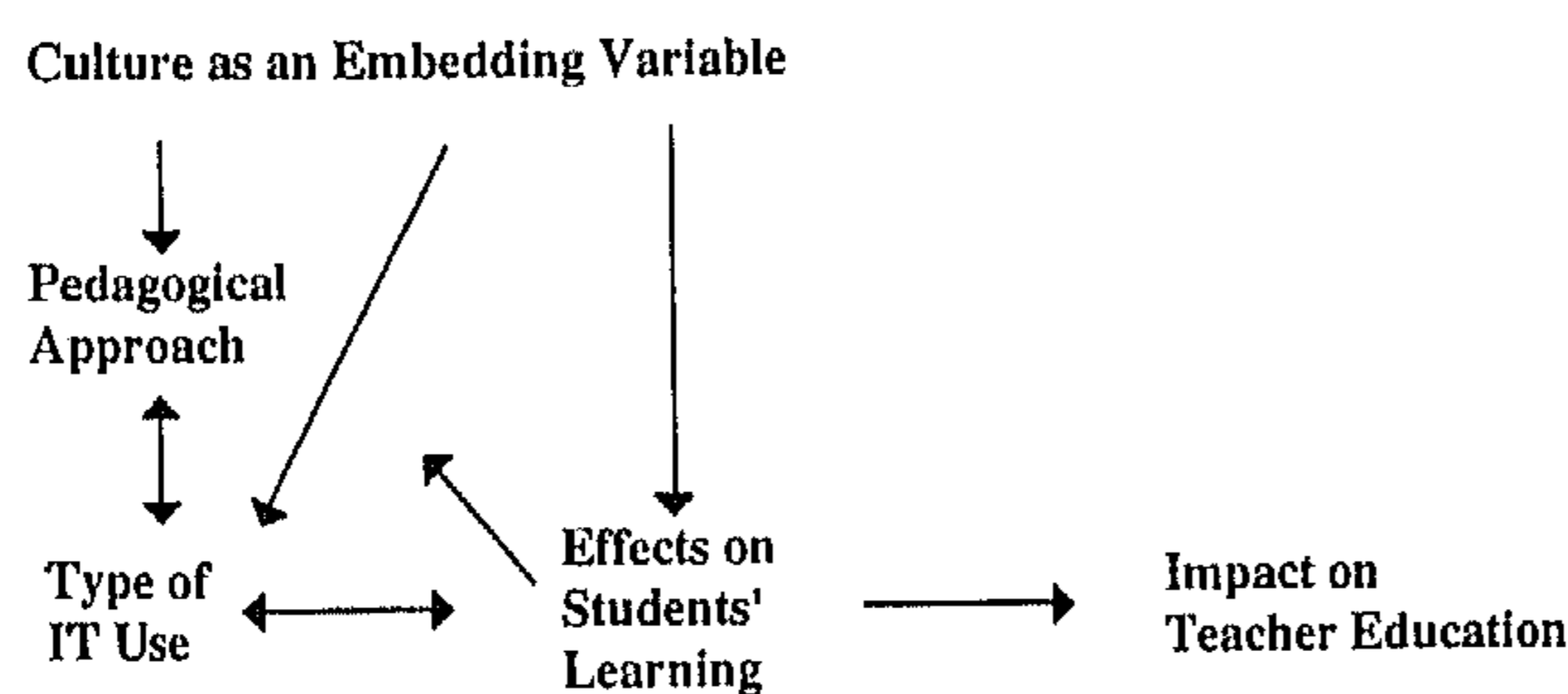


Figure 4. Future framework, based on Heppell’s analysis.

The rest of the authors more explicitly add another variable to the framework: the teacher, as selector and executor of pedagogical approach. Lai’s article takes the explicit stand that a pedagogical approach based on

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constructivism is essential to IT use in a learner-centred environment, because it is this type of environment that will best foster higher-level cognitive effects in learners. Thus Lai might add another component to the framework (Figure 5) where the culture that is of most direct interest to him is that of the professional educational community.

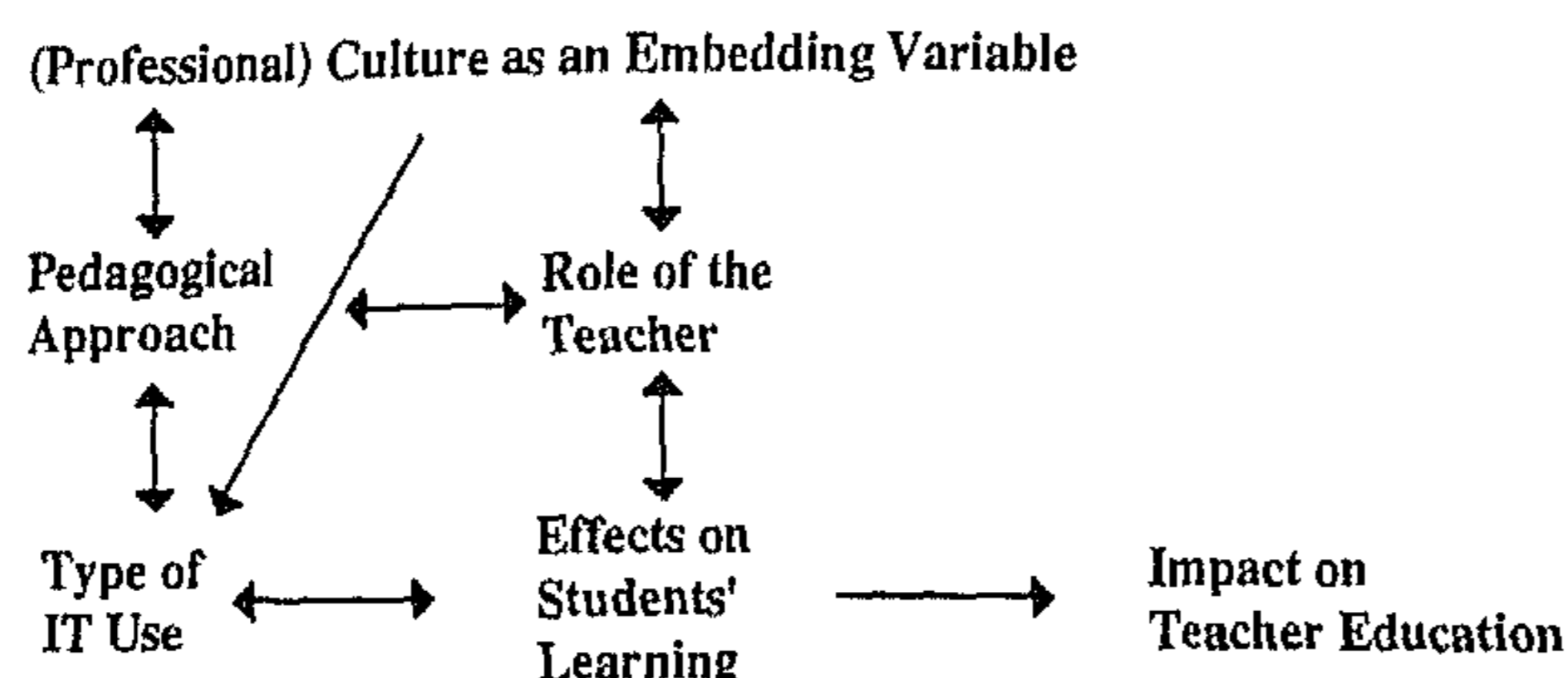


Figure 5. Framework, interpreted according to Lai.

Lai cites two studies, both using a particular type of IT (Lego-Logo materials) but focusing on the problem-solving environment in which those materials were used. He indicates meta-cognitive development as well as attitudinal gains as student effects, although specific data are not given. However, his major focus seems to be on the changing role of the teacher and the way that this changing role relates to the larger professional community of which the teacher is a member.

Owston's analysis is similar in type to Lai's, although different in particulars. The type of IT use Owston focuses upon is word processing and other electronic writing supports; the culture in focus is that of the classroom rather than that of the professional community of the teacher. Changes in teacher and student behaviours and roles over time are an important part of his orientation. Thus he might add two more vectors to the framework, relating to classroom climate and how it is influenced by the interaction of technology, students and the teacher (see Figure 6).

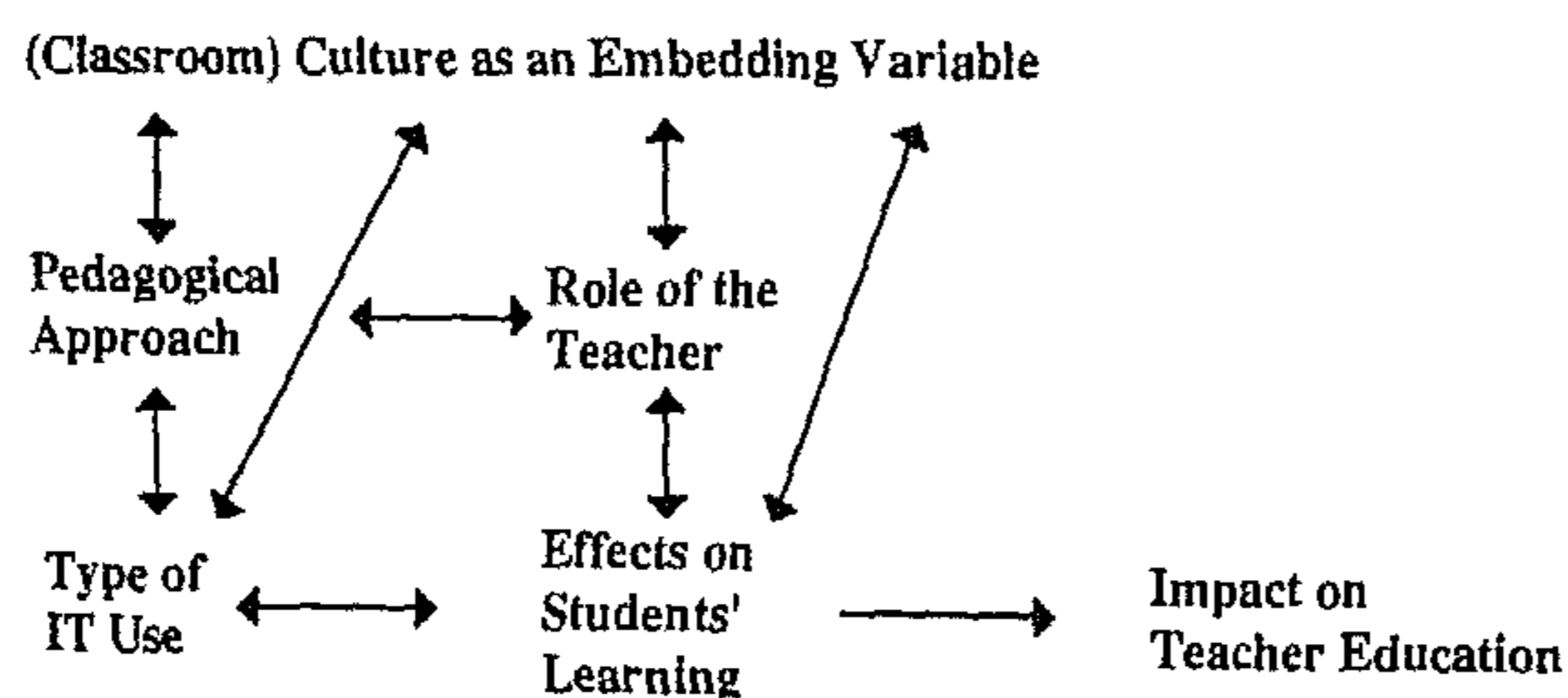


Figure 6. Framework, interpreted according to Owston.

Wellburn, Francis, Riecken & Farragher could be represented by the same diagram, but with professional culture and school climate as the overall embedding variables, and the role of the teacher as a reflective action-researcher as the key focus. In their study, three teachers and their respective classes, all from one particular school in the midst of an innovative

transition, use a variety of types of IT in a variety of ways, but based upon the teachers' employment of an action research approach and philosophy. Some student results are indicated, but the focus is on the professional development of the teacher.

In the remaining five of the articles, effects on student learning are not directly indicated, nor (with one exception) is the type of IT use a particular focus. Instead, the teacher him or herself becomes the explicit central focus of the study, on the implicit assumption that student learning effects via IT use will not eventuate if the teacher first is either not facilitated in his or her efforts to investigate the use of IT in instruction, or even more fundamentally, if the teacher does not change his or her beliefs and pedagogical habits. The article by Veen illustrates the latter focus most clearly. In his analysis of four teachers over more than two years, he observes the central importance of teachers' beliefs relative to effective and appropriate pedagogy for their subject areas and relates these to the likelihood that the teachers will adopt innovative uses of IT for instruction. Thus Veen's framework could perhaps be illustrated as in Figure 7.

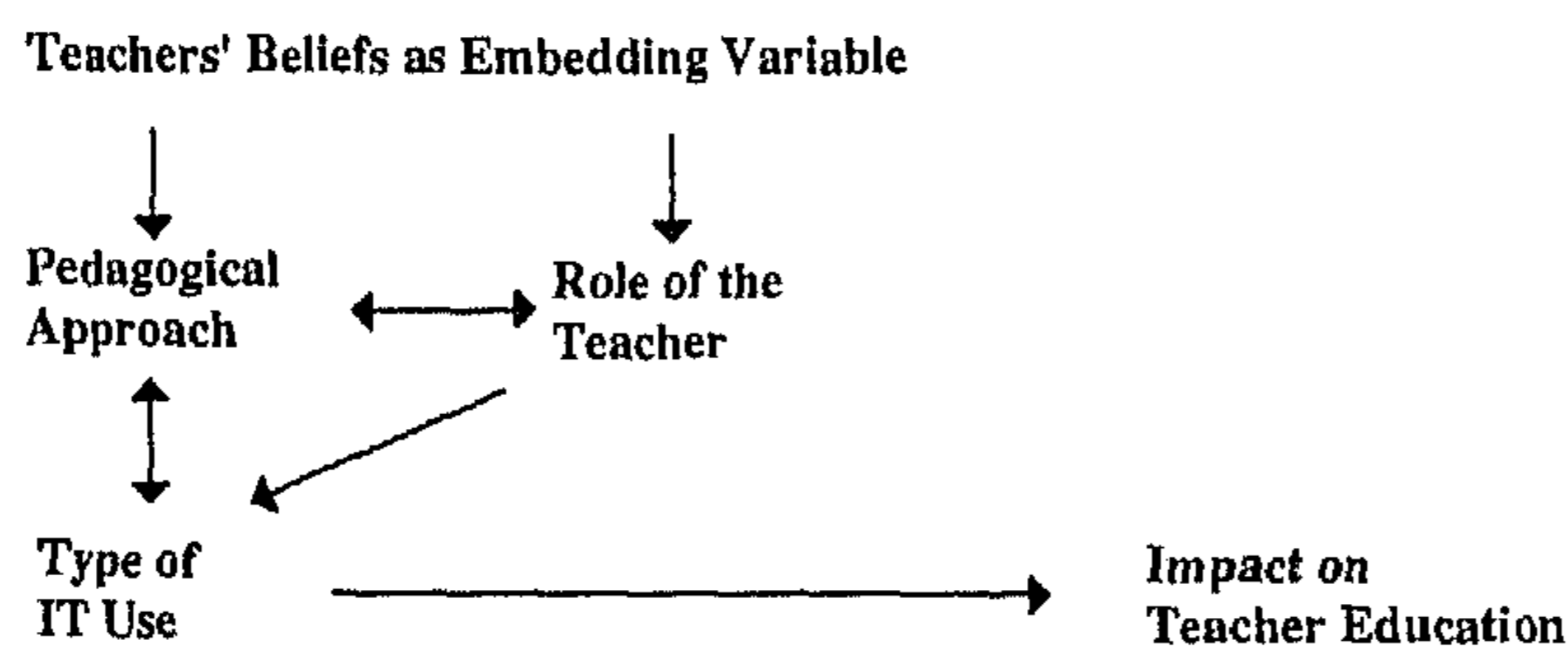


Figure 7. Framework, interpreted according to Veen.

Carey & Sale studied 21 teachers, for a much shorter time and with a much more specific focus than Veen; they wondered if these teachers would demonstrate more facilitative behaviour, believed to be fundamental to students' higher-level learning with IT, when working in a computer environment, than they might in their traditional classrooms. Might age or gender be correlated with the likelihood of this more facilitative behaviour? Thus they investigated the possibility of IT use influencing the pedagogical approach and the role of the teacher. They did not find this relationship in their sample, although they did find some age and gender relationships.

Sherwood's perspective was broader, but still teacher focused. In her study, she reports on a national survey of computer-using teachers in Australia and supplies an overview of what types of IT use are being employed, what types of teacher education had been experienced, and what teachers saw as their needs for better support of their IT use. She also is able to report on what the computer-using teachers see as major changes in their teaching because of IT use. Thus her data show some of the changes that many of the other authors hope will occur – changes in pedagogical habits, changes in perception of the role of the teacher, after some period of IT use

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in instruction - but these changes appear to be more influenced by the interaction of the teacher him or herself as an individual, over time, with the technology, rather than being influenced by variables such as teacher education, national culture and policy, or specific types of software or software-use philosophy.

Fonseca (at the national level, in Costa Rica) and Grandbastien (at the regional level, in France) base their articles more directly within the framework of teacher education itself: how can it be organised and deployed to bring about teacher support and change? In their examples, the focus is on teacher education strategies themselves. In Grandbastien's study the focus is on the training of teachers as resource persons, to serve as resource professionals within schools, with a close examination of what such a role entails. Fonseca's study also relates to a complex situation, perhaps the most explicitly complex of all those described in the articles, in that she reports on a national plan, whereby over 140,000 elementary age students are using IT, and in particular, Logo, in the context of a project which is not only shaped by its culture but intends to in turn reshape that culture itself. It is also a project aware of the need to change teachers' beliefs and behaviours, so that teachers become constructivist learners along with their students. Thus the framework might be represented as in Figure 8.

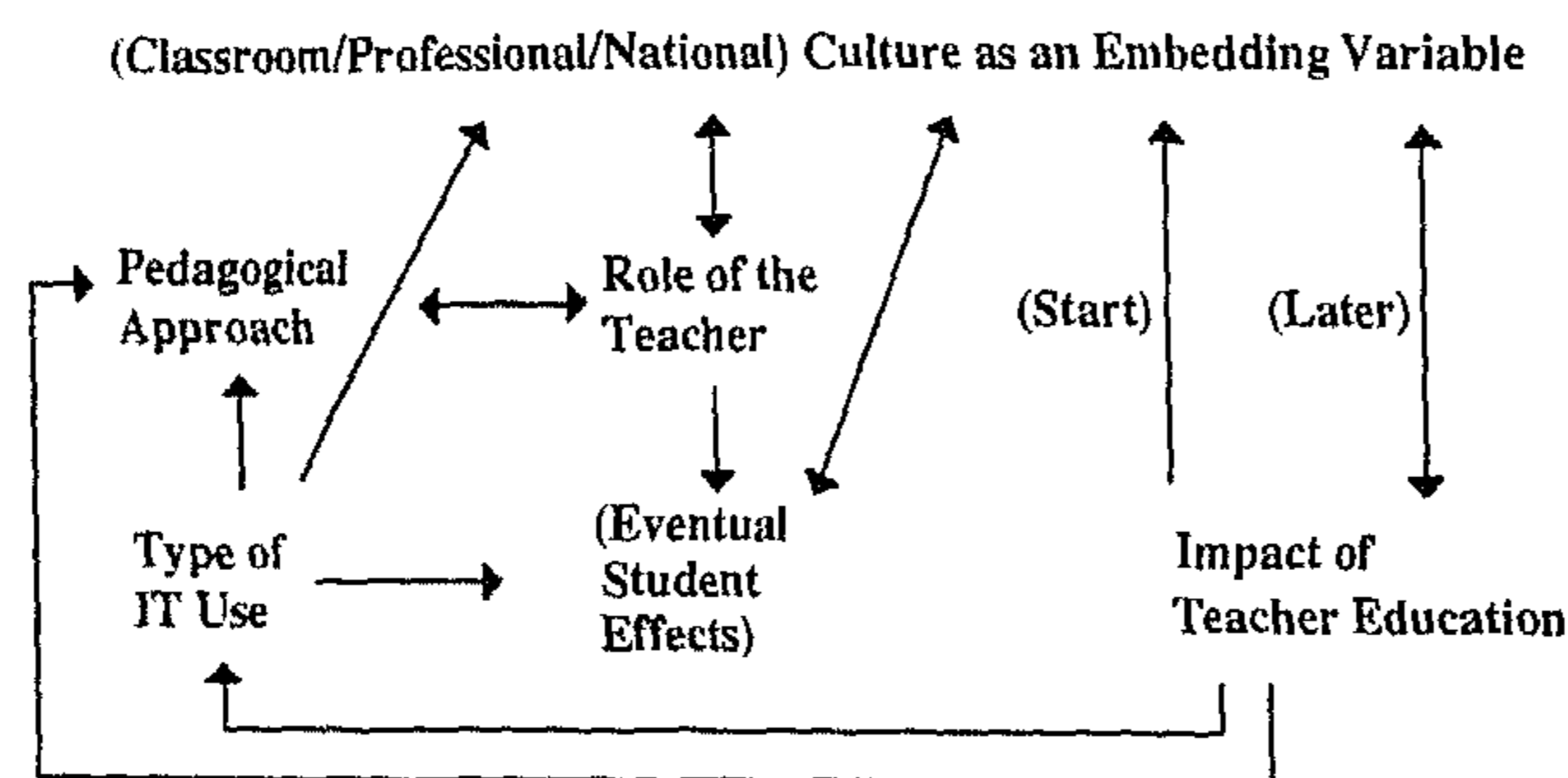


Figure 8. Framework, interpreted according to Fonseca.

The articles of Sherwood, Grandbastien and Fonseca (as well as those of Veen, Carey & Sale) give no explicit reference to student learning results; the preliminary steps of understanding, supporting and changing teacher behaviours are taken as necessary before student effects can occur, or before those student effects could have an impact on the subsequent practice of teacher education.

Thus the original task (Figure 1) when put to a group of experienced teacher educators, becomes far from simple in its implementation, and was translated by the majority of the authors as an interrelationship of contextual (cultural) influences, teacher characteristics, teachers' perceptions of appropriate pedagogical behaviours, and selected IT characteristics and experiences. It may even be that for a number of the authors the task was

redefined as depicted in Figure 9, but where the “Effects on Student Learning” is taken as implicit once teachers’ role change occurs.

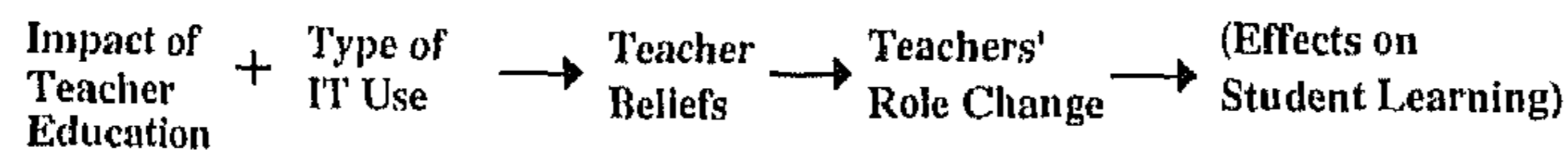


Figure 9. Modified task framework, based on synthesis of interpretations of authors.

Variations in the Methodologies

With such a wide range of interpretations of how to approach the basic task of this Special Issue, it is not surprising that a wide variation in research methodologies is present in the articles. Some of these variations include:

- variation in time over which the study refers, including one-shot surveys, studies involving student activities over two lesson periods, during two series of lessons and eight weeks of lessons, to periods of time ranging from two to five years, and even longer when the full range of experience of the researcher is brought into the analysis;
- variation in the number of students involved in the studies, including one, two and four classes, a sample of 3000, or implicitly as many as are in a country or in the range of experience and reflection of the researcher;
- variation in the methodological style dominant in the study, including action research and reflection, but also including experimental methods, various methods of data collection during naturalistic observations, participant observer methods, interviews, surveys, self-report questionnaires, video coding, journals, samples of student work, and various classifications of teacher and student behaviours;
- variation in the involvement of the researcher in the events being reported, from minimal to strongly and centrally involved.

This points out clearly that there is no ‘typical’ methodology for studying complex questions such as the relationships among IT, student learning and teacher education.

Common Conclusions

Given the variety of perspectives taken on the task, and the variety of methodologies employed, there are nonetheless certain common conclusions that seem to emerge from the studies. I suggest the following, related to the need to change the role of the teacher, the need for time and support, and the consequence that teacher education as a profession must change in response to these needs.

Changing Role of the Teacher. At least eight of the studies explicitly call for a change in the role of the teacher as a critical pre-requisite and co-requisite for realising the potential of IT for student learning. Lai indicates that the teacher’s value and belief system must change from one which

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values teacher-centred behaviours to one which values learner-centred behaviours (where the teacher can also be in the role of the learner). He sees this as being embedded in a constructivist view of learning, wherein the teacher becomes a planner and manager, a participant, and a guide. Wellburn and her colleagues and Carey & Sale also call for this shift to a learner-centred approach, a change of roles for both the student and teacher, where the role of the teacher as a guide is stressed. Fonseca emphasises the constructivist approach, for teachers as well as for students, and examines the implications of changing the teachers' role to that of a participant and co-learner. Sherwood gives encouraging evidence of this change in teacher's role already occurring among experienced computer-using teachers in Australia, but Veen cautions from his experience that time and appropriate experiences are necessary before this kind of role change will occur.

And in addition to the role of the teacher changing within the instructional process itself, the teacher's role must also change in terms of his or her level of abstractive and theoretical examination. Owston and Wellburn and her colleagues argue that not only should the teacher become a guide and facilitator and co-learner, but also that the teacher should become an action-researcher, systematically involved in reflection and collegial exchange of experiences, as part of this overall role change.

Time and Support. Just as the majority of the authors called for a change in the teacher's role as a priority, many of the authors agree on the need for time and ongoing support in order for such a role change to occur, and following this, to expect to see substantial impact on student learning to occur. The time dimension is prominent in the studies of Owston, Veen, Grandbastien, Fonseca, Sherwood, and Heppell. Quick results will not be forthcoming; expectations of large-scale, measurable payoff relative to student effects must be realistically realigned. If and when change occurs, it will occur over considerable time, with patience, and with various forms of ongoing professional support. The idea of ongoing professional support, rather than one-shot sorts of blanket in-service sessions, is clear in many of the articles, particularly those of Sherwood and Fonseca.

Teacher Education Must Respond. All of the authors agree: teacher education must respond better, differently, earlier, in order to meet the challenge of more effective use of IT in education. The recommendations the authors give for teacher education are summarised in the next section.

Recommendations for Teacher Education

The articles speak for themselves in terms of their recommendations for teacher education and each author presents recommendations that are well grounded in the evidence and/or theory that he or she has presented. However, taken as a group, the differences in the recommendations are

interesting. A major dimension of difference relates to the degree to which the suggestions could be integrated into teacher education as it now generally occurs, in comparison to suggestions that would require more of a radical shift in teacher education, either philosophically or in its methods.

Some of the authors, in particular Kanselaar, Grandbastien, Sherwood, Veen, Fonseca, and Knezek and his colleagues, specifically give recommendations which could be implemented in existing teacher education practice. Kanselaar indicates the importance of sensitising teachers to the didactical assumptions in IT resources and to the need to examine the fit of those assumptions to their own views on teaching. Grandbastien calls for the design of teaching units involving IT as a strategy not only to develop better instructional materials but to generate models of good practice. Both Grandbastien and Sherwood note that teacher educators face the same problems of handling an innovation as do teachers, and therefore that more opportunity for teachers to learn from peers who are having profitable experiences with computer use in their teaching is of importance. They and Fonseca note the importance of teachers being able to see models of teaching involving IT use in actual classrooms from actual practitioners. Knezek and his colleagues note that teacher educators can tell their students that they need not be over anxious about finding 'a' best type of software, that they can have a significant influence on their students relative to their self-confidence and attitudes toward computers, and that students whose mother tongue is not the language of instruction in a school setting may be particularly good candidates for IT experiences. Veen notes the value of school-based in-service training and the importance of starting with the existing didactic practice of the teachers.

The authors also call for more substantial changes in teacher education. Lai, Owston, Wellburn and her colleagues, Carey and Sale, Fonseca, Veen, and Heppell, for example, all indicate more fundamental changes in the philosophy and practice of teacher education are necessary. Heppell indicates the need for better research on the "emergent capabilities of children of the IT generation", for better understanding of the relationships between teachers' patterns of thinking and student outcomes, and for more insight into "edutainment" media common to learners outside of the school setting. Lai, Owston, Wellburn et al, and Carey & Sale all call for teacher education to become more of an immersion into a reflective community of practice, where observation skills, experiences of sharing one's reflections with colleagues, and strategies for action research become dominant paradigms. Fonseca sees the need for inter-relating networks of professional and community involvement in IT use, based on a sense of wide social mission for IT use in education. Veen makes perhaps the most radical suggestion of all, when he speculates over the strategic wisdom of much of the pre-service IT experience that is already occurring in teacher education, and argues that at least one major aspect of it could perhaps be profitably postponed.

Reflections on the Task of this Special Issue

Was the task of the Special Issue reasonable? Yes and no. The first two blocks in the original diagram (Figure 1) suggest that a direct relationship can be found between some sort of IT application and student learning. Research and experience, however, have already made it clear that no such direct and clear relationship can be found; learning (with or without IT) is a complex mix of interacting variables, interacting in what Salomon calls a systemic inter-relationship, where the value of each of the component variables both influences and is changed by the values of the other variables (Salomon, 1992; see also Moonen & Stanchev, 1993). Thus a straightforward statement of 'Type of IT Use - Effects on Students' Learning' is not likely to be found in the research literature in general, and thus is not likely to be found as a preamble for changes in teacher education.

However, because relationships are complex does not mean that we do not know a substantial amount about the relationships. Two of the aspects that have been determined in study after study are: (a) the central role of the teacher in whatever impact IT use has in schools (see, for example, Watson, 1993), and (b) that change in education is slow and complex but can be influenced (see Fullan, 1991). Thus the central task of the Special Issue is appropriate relative to a results-based approach to changes in teacher education, but perhaps the focus on student learning results in the original framework is premature. The focus on the teacher rather than the student, which emerged in many of the articles, is a reflection of the centrality of the teacher in the school-IT use environment, and given the limited state of actual teacher use of IT in subject-area instruction in most countries of the world (see Pelgrum & Plomp for an international survey, 1991), a focus on teacher change rather than student outcomes is a reasonable choice for teacher-education strategists, at this stage of technological and pedagogical evolution. The time may come when an intensive swing toward more reflective teachers participating more actively in a community of practice will have occurred and will need to show itself paying off in observable and socially valued measures of change in student behaviours, but for the time being we can proceed with the reasonable assumption that more insightful and reflective teachers, willing to change their roles from givers of lessons to facilitators and guides of student-centred learning, is a desirable goal in itself and is also a necessary condition for subsequent student effects.

However, as a number of the authors pointed out, teacher educators face the same needs for role change as do the teachers or teachers-in-training that they serve. How can teacher educators themselves, as a professional community, move from a lecture/research/syllabus centred approach to a process-oriented constructivist approach? How can strategies such as action research and reflective dialogues be accommodated in the tight timetables of university courses or short-term in-service courses? How, realistically, can the sorts of changes in teacher education called for by some of the authors

occur? Fonseca's example in Costa Rica shows that large-scale systemic change is possible, that teacher education and teacher educators can change, and can lead the way for teacher change. Yet Fonseca's example also shows that an enormous, integrated effort must occur for this to happen, involving not only teacher educators but many other groups from both the professional community and the larger social and political community in which education is embedded. So it is possible, but complex, to change teacher education, just as it is possible, but complex, to change teacher behaviours.

Fortunately, one thing does not appear to be so difficult: student response to IT use. Perhaps, the future will be easier, as Knezek, Miyashita & Sakamoto suggest and Heppell probably would support: when today's children become tomorrow's teachers they may bring with them a naturalness in their use of IT, a fluency at translating its signifiers, cues and clues, so that much of our current distress with respect to teacher change and pedagogical revolution will no longer be as relevant.

Thus the Special Issue has tackled an important task, and has also shown that no straightforward answer can emerge. The articles together form a valuable contribution to the ongoing task. Each article in its own way contributes particular insights; taken as a set they complement each other and suggest both short-term and long-term goals for increasing the effectiveness of teacher education relative to IT and learning.

Correspondence

Betty Collis, Faculty of Educational Science and Technology, University of Twente, Postbus 21, NL-7500 AE Enschede, Netherlands. Fax: 31 53 356531. Email: COLLIS@EDTE.UTWENTE.NL

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