

Technology for Curriculum And Teacher Development: Software To Help Educators Learn While Designing Teacher Guides

Susan McKenney
University of Twente

Abstract

This article describes research on the quality of a computer program designed to help secondary level science teachers in southern Africa create exemplary paper-based lesson materials. Results of this study show that the content, support, and interface of the program combine to form a tool that is considered by both users and experts to be valid and practical. Findings further indicate that it has the potential to help users create good quality materials while learning from the design process, but that this potential depends primarily on how the program is implemented. (Keywords: ICT, curriculum development, teacher professional development.)

Within the last few decades, many southern African countries have achieved independence. Among other changes, this has often brought about new curricula for basic education, new subject syllabi, and reform with regard to teaching methods (such as a call for more learner-centered teaching). Although post-independence reform efforts carry promise and optimism, they require immense investments with regard to the development of expertise in order to reach fruition. To complicate matters, many countries in this region of the world have to make due with an un(der) qualified teaching force (Caillods, Göttelmann-Duret, & Lewin, 1996). This already grave problem can be compounded when educational change demands the inclusion of subject matter completely new to practicing teachers and/or the adoption of a new (usually unfamiliar) teaching methodology. This is often the case when more equitable access to education is part of the reform agenda. For example, when Namibia gained independence in 1995, non-white teachers—many of whom were not permitted to learn about science under the South African apartheid regime—were suddenly required to teach it. Furthermore, they were to do so in a learner-centered fashion, a notion totally foreign to most teachers. Although there is little argument regarding the inherent value of developments such as this, the resulting challenges and problems presented by these changes must be carefully addressed if there is to be any chance for successful implementation (cf. Ottevanger, 2001).

One useful approach to helping teachers cope with large-scale curriculum reform is the design and sharing of teaching materials among regional or national colleagues (Gray, 1998; Ottevanger, 2001; Van den Akker, 1998). The process of developing materials can be supported in many ways, including through the use of information and communications technologies (ICT). Previous research on the added value of ICT during curriculum development has produced promising results (Nieveen, 1997), particularly with regard to the creation of

classroom materials (Nieveen & van den Akker, 1999). These findings, together with recommendations from the field, provided the impetus for the creation of a computer program called CASCADE-SEA (Computer Assisted Curriculum Analysis, Design and Evaluation for Science [and mathematics] Education in Africa). By guiding users through an iterative process of analysis, design and evaluation, CASCADE-SEA helps secondary level science and mathematics teachers create paper-based teacher guides. Because these teacher guides offer commendable examples of how certain curricular innovations can be carried out in practice, they are referred to as exemplary materials. These exemplary materials are usually photocopied and shared among colleagues.

Extensive research was conducted during the design and development of CASCADE-SEA. Findings from formative evaluations of prototypes during product development shaped the content, support and user interface of CASCADE-SEA (McKenney & Van den Akker, 2005). This purpose of this article is to describe the summative evaluation of the final version of the CASCADE-SEA software.

THEORETICAL FOUNDATIONS

The CASCADE-SEA program is based on the notions that teacher professional development and curriculum development can occur simultaneously during the process of materials development, and that ICT can offer added value in facilitating that process. Used in a setting where the need for materials is great, this software offers educators the opportunity to learn about curriculum development and reflect on their own ideas about teaching and learning while designing much-needed, good quality teaching materials. Theoretical underpinnings for this perspective are presented below.

Professional Development

Teacher professional development is considered important for a host of reasons (cf. Eraut, 1994), ranging from certification to broadening the teaching repertoire (Hopkins, 1998) to improving pupil achievement (Van Blanken, 1995). And continued professional growth of teachers is widely accepted as an essential ingredient to any educational reform (Black & Atkin, 1996; Fullan, 1991; Loucks-Horsley, Hewson, Love, & Stiles, 1998; Van den Akker, 1996; Yager, 1994). The CASCADE-SEA program was designed specifically for facilitator teachers, often working in Teacher Resource Centers (TRCs), whose inservice agenda includes guiding teams of teachers in the preparation of exemplary lesson materials. This includes materials created to help teachers implement curriculum changes or simply to begin to fill a profound void of teaching resources. CASCADE-SEA was designed to be consistent with professional development experiences that exemplify seven principles identified by Loucks-Horsley et al. (1998), namely, those that:

- are driven by a well-defined image of effective classroom learning and teaching
- provide opportunities for teachers to build their knowledge and skills
- use or model with teachers the strategies they will use with their students
- build a learning community

- support teachers to serve in leadership roles
- provide links to other parts of the educational system, and
- are continuously assessing themselves and making improvements to insure positive effect on teacher effectiveness, student learning, leadership, and the school community.

Putnam and Borko (2000) give attention to the importance of situated learning opportunities in terms of teacher development and curriculum development. They identify a common problem, saying that both novice and experienced teachers often complain that learning experiences outside the classroom are too removed from the day-to-day work of teaching to have a meaningful effect. They identify certain beneficial contexts within which teachers' learning might be meaningfully situated: their own classrooms, group settings where participants' teaching is the focus of discussion, and settings emphasizing teachers' learning of subject matter. Related to each of these contexts, a clear role for curriculum materials (creation) can be identified.

Learning by Design

According to Jonassen and Reeves (1996), "...the people who seem to learn the most from the systematic instructional design of instructional materials are the designers themselves" (p. 695). Other instructional designers (Paquette, Aubin, & Crevier, 1994) emphasize the learning opportunities presented by design activities, as do experts in the area of curriculum change in developing countries (Dove, 1986; Montero-Sieburth, 1992). It therefore comes as no surprise that many inservice educators advocate involvement of teachers in curriculum development as an effective form of professional development (Ball & Cohen, 1996; Ben-Peretz, 1990; De Feiter, Vonk, & Van den Akker, 1995; Dlamini, Putsoa, Campbell & Lubben, 1996). For example, Ben-Peretz (1990) advocates teacher participation in curriculum development because of the opportunities it provides for experiencing decision making with regard to content, instructional strategies, scope, and sequence. McKenney (1995) found that the learning gleaned from creating, as well as using, good quality materials in Namibia can serve to bolster confidence in teaching and, as a result, improve overall classroom performance. Still others have found that products developed by practicing teachers have more credibility to other teachers as being something that is truly usable in the classroom (Doyle & Ponder, 1978; Viggiano & Dixon, 1998). Gray (1998) notes additional benefits of involving teachers in exemplary materials design within the context of secondary level science education in southern Africa. He found that teachers particularly developed:

- critical skills with respect to curriculum development
- writing skills
- greater confidence in subject-matter knowledge
- greater professional confidence and morale-boosting, and
- clarity of their perceptions on teaching and their own classroom practice.

Although learning and reflection are often promulgated by the development of exemplary lesson materials, these processes can also be stimulated by the use of them; this notion is addressed in the following section.

Curriculum Materials in Developing Countries

Lockheed and Levin (1993) found that, in developing countries, teacher guides that are well integrated with the textbook or other instructional materials can have a positive effect on student achievement. Along with calls for local and aid organizations to invest in the development of locally relevant classroom materials (Clegg & Osaki, 1998; Hawes, Coombe, & Lillis, 1986; Lockheed & Levin, 1993; Williams, 1986), international implementation research has explored the role of exemplary materials in supporting curriculum change. Exemplary materials, such as teacher guides, have been found to be especially useful during the initial phases of curriculum implementation. Van den Akker (1998) summarizes three main advantages offered by exemplary materials:

- Clearer understanding of how to translate curriculum ideas into classroom practice
- Concrete foothold for execution of lessons that resemble the original intentions of the designers
- Stimulation of reflection on one's own role with the eventual possibility of adjusting one's own attitude toward the innovation.

To fully realize the potential benefits of exemplary lesson materials, an important question then arises: What kind(s) of materials are most useful?

Characteristics of Materials

Research has shown that teacher support materials including step-by-step guidelines can offer the aforementioned benefits (Brophy & Alleman, 1991; Clegg & Osaki, 1998; De Feiter, Vonk, & Van den Akker, 1995; Ottevanger, 2001; Thijs, 1999; Van den Akker, 1988). Additional supporting arguments for including highly specified procedural guidelines in teacher lesson materials are offered by Hameyer & Loucks-Horsley (1989). They argue that the success of innovative efforts "depends considerably on the quality and demandingness of the materials" (p. 14). Especially when curriculum change is on the agenda, they recommend the following:

Any new product, according to recent research, should be sufficiently flexible for varied use, applicable to different schemes of teaching, its fundamental aims clearly exposed and the conditions under which it works clearly specified. These features do not diminish the necessity of making the indispensable core components explicit, so to speak the heart of the new. Developing exemplary materials is one way to show how the innovation might work. As long as a new idea is explained only in the shape of a general scheme, it remains insufficient for further application. The more complex an innovation is, the more necessary is its specificity in terms of materials or other products so that the users can understand the new. The central point here is the level of specificity. (p. 14)

Although benefits of exemplary materials have been identified by many other researchers (Ball & Cohen, 1996; Roes, 1997; Thijs, 1999; Van den Berg, 1996), most of these experts also agree that offering lesson materials alone yields limited

results. Instead, they recommend a combination of exemplary lesson materials along with additional forms of teacher support, such as inservice education (De Feiter, Vonk & Van den Akker, 1995; Ottevanger & van den Akker, 1998; Van den Akker, 1998). In some cases, materials are introduced to teachers during inservice activities; they may also offer lasting support as follow-up after workshops.

Computer-Supported Curriculum Development

The CASCADE-SEA program was designed to help teachers create good quality materials, possessing the high degree of specificity described in the previous section. At the same time, the program was structured to facilitate the professional development of its users by providing support to better understand and visualize the curriculum development process. This section describes core ideas pertaining to the support offered in CASCADE-SEA.

During the last 15 years, many tools have been developed for the purpose of supporting the complex process of curriculum development (Grabinger, Jonassen, & Wilson, 1992; Gustafson & Reeves, 1990; Nieveen, 1997; Nieveen & Gustafson, 1999; Rosendaal & Schrijvers, 1990; Wilson & Jonassen, 1991; Zhongmin & Merrill, 1991). Both developers of various support systems for curriculum development as well as advocates of the concept of Electronic Performance Support System (EPSS) presume several advantages of providing computer support. First, it is assumed that the use of these systems will lead to an improvement in task performance. According to Gery (1991), people learn to perform their tasks more efficiently with an EPSS than in a traditional training situation. Because an EPSS can provide advice, information, and instruction immediately, or “just in time,” users do not need to remember all issues related to their work, but they can consult the EPSS regarding the issue they want at the time they really need it (Collis, 1994; Nieveen, 1997). This support can thereby reduce the information load during task performance, and perhaps even increase one’s ability to focus on isolated aspects when necessary. An EPSS for curriculum development can encourage a more structured approach and further the internal consistency of design decisions (Gustafson & Reeves, 1990; Nieveen, 1997). Secondly, the use of EPSSs can help promote organizational learning by capturing and sharing knowledge and conventions (Stevens & Stevens, 1995). Finally, the use of a computer support system can help forge a common language among users and, as a result, increase the quality of communication (Flechsig, 1989).

In discussing the potential benefits of exemplary lesson materials, it was previously noted that materials on their own stand to yield far less effect than when embedded in a larger framework such as a teacher inservice program. Similarly, CASCADE-SEA was designed to dovetail with the ongoing activities at TRCs. The support in the program primarily aims to help users improve their task performance—i.e., create better quality materials than they otherwise would. The structure offered within the system also helps facilitate a shared vision of the curriculum development process and a common language with which to discuss it. Additional support aspects are addressed in the program description below.

CASCADE-SEA: AN OVERVIEW

The CASCADE-SEA program aims to support those groups and individuals involved in the process of creating exemplary lesson materials or teacher guides, usually to be shared among colleagues in the same region. The procedural and conceptual model for curriculum development that is supported within this program is presented in Figure 1.

This model may be classified as cyclic (emphasizing an iterative approach) as well as organic (explicitly featuring the core ideas driving the innovation). As this model depicts, four main phases of curriculum development are discerned: rationale, analysis, design, and evaluation. The rationale contains the main aims and ideas behind the yet-to-be-developed curriculum materials, including considerations based on the target setting. Located at the hub of the process, the rationale influences all other phases. The process of defining a rationale is likely to raise additional questions. In many cases, the best way to answer such questions is to conduct a needs and/or context analysis. An elaborated rationale, captured in a “profile,” provides the curriculum developers with guidelines during the design phase and may also serve as criteria against which (formative) evaluation can take place. Due to the detailed nature of the program, (including approximately 250 different activity screens), the following description of the four main components is quite limited. For additional detail, please refer to McKenney (2001) or visit the CASCADE-SEA research Web site at <http://projects.edte.utwente.nl/cascade/seastudy/>.

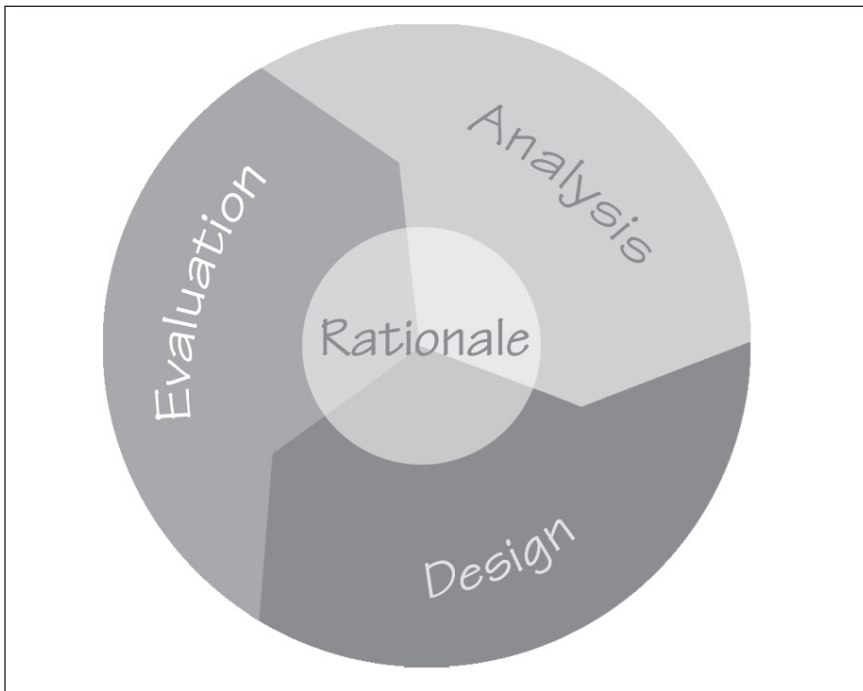


Figure 1. CASCADE-SEA: Procedural and conceptual model.

Rationale

This portion of the program has been designed to assist the users in reflecting on their own ideas by focusing on the questions of who, what, where, when, how, and why as they pertain to the (to be created) exemplary lesson materials. This portion of the program serves two purposes simultaneously. First, it stimulates users to reflect on their own (often not-as-yet articulated) ideas with regard to the creation of good quality lesson materials. As discussed above, such reflection promotes professional development while simultaneously improving the quality of the curriculum being developed. Second, throughout this portion of the program, the computer is gathering information about the users. This information will later be used (in the analysis, design and evaluation components) to provide tailor-made advice, based on the user’s own situation. The four sections of the rationale component are mapped out in Figure 2.

Analysis

This component of the program helps users—usually facilitator teachers, working in small teams making lesson plans for larger groups of teachers within their region—learn more about the needs and the context of the people who will use their lesson materials. It stimulates such consideration to increase the chance that the materials made will actually be beneficial to other teachers. The eight sections of the analysis component are shown in Figure 3 (page 174).

Design

For those users who have an idea of what they would like to create, this component of the system offers support in designing and building paper-based lesson materials. It encourages (but does not require) users to build a lesson series, in the form of a teacher guide. Users are free to choose between more and less structured designing approaches. Figure 4 (page 174) depicts the six sections of the design component.

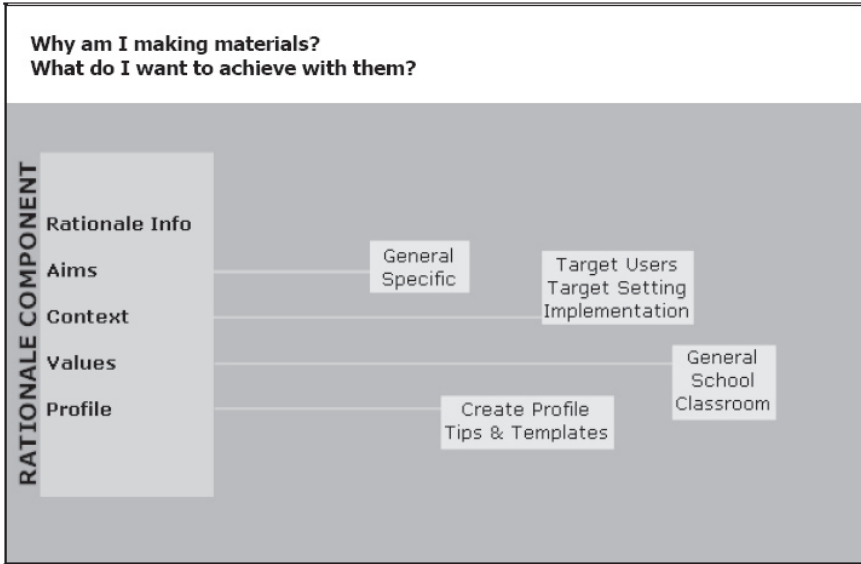


Figure 2. CASCADE-SEA: Rationale component map.

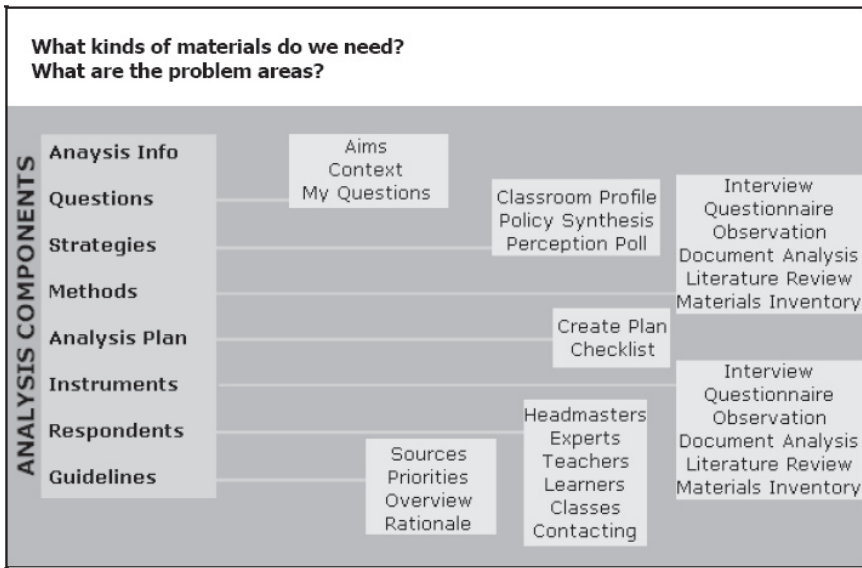


Figure 3. CASCADE-SEA: Analysis component map

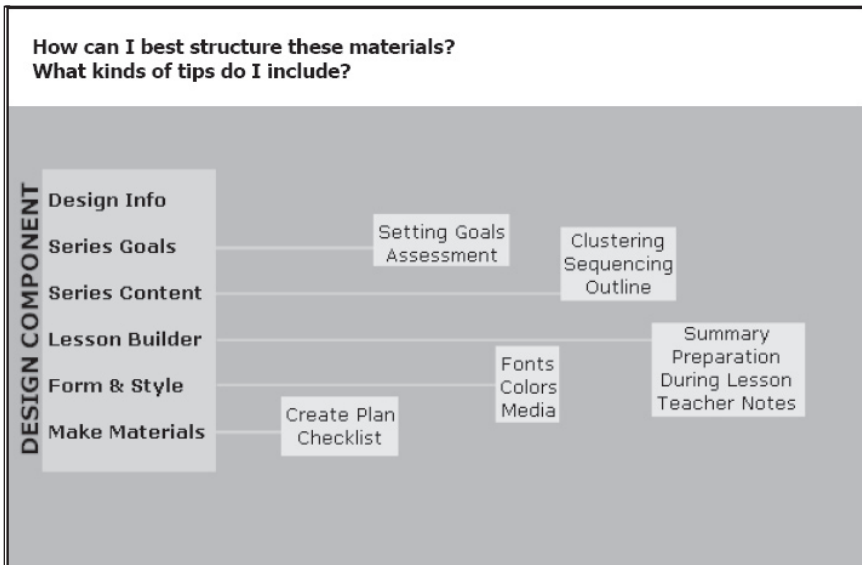


Figure 4. CASCADE-SEA: Design component map.

Evaluation

In this component, information about drafted materials is collected, analyzed, and interpreted in a systematic manner, with the goal of determining how they may be improved. As illustrated in Figure 5, there are eight sections in the evaluation component. It bears a significant resemblance to the structure of the analysis component, due to the fact that both of these phases feature research

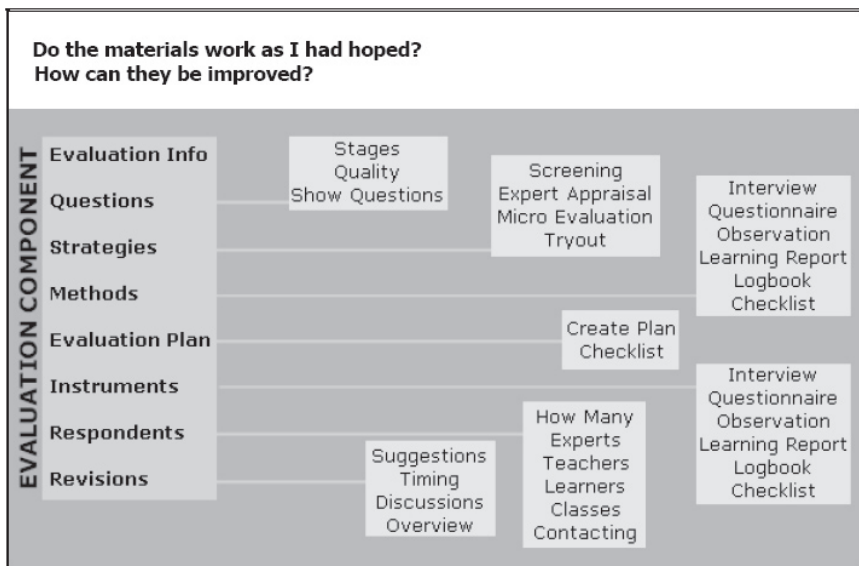


Figure 5. CASCADE-SEA: Evaluation component map.

activities. The main difference between these two components pertains to the questions asked, and the strategies used to answer them.

The program also contains a Windows help package, how-to-use tutorials and an interactive agent offering context-sensitive guidance. Figures 6 and 7 (page 176) help convey the look and feel of the program. Figure 6 shows the database link during the design of a lesson (design component). Figure 7 illustrates how the computer offers support during the instrumentation section of evaluation.

RESEARCH QUESTIONS

To inform future implementation efforts, the primary goal of the final evaluation was to determine if use of the CASCADE-SEA program would actually yield the desired benefits of helping to produce good quality materials while facilitating teacher professional development in the process. Because this study took place during a relatively brief period of six months, genuine long-term effects of use could not be examined. So rather than attempting to collect conclusive evidence of system effectiveness, data were collected to explore the likely value of implementing this system on a full scale. To help understand and interpret those findings, a secondary goal was to assess the validity of the program's substance and its and practicality of use. If a product is known to be invalid or impractical, the chances of it yielding the desired effect can be safely estimated as low. Therefore, validity and practicality are seen as prerequisites for bearing effect potential. The main research question guiding this evaluation was: *What are the validity, practicality, and effect potential of CASCADE-SEA?*

The concepts of validity, practicality, and effect potential were further elaborated. A product is considered *valid* when it contains *state-of-the-art knowledge* that is relevant to the tasks it intends to support, and is offered in an *internally*

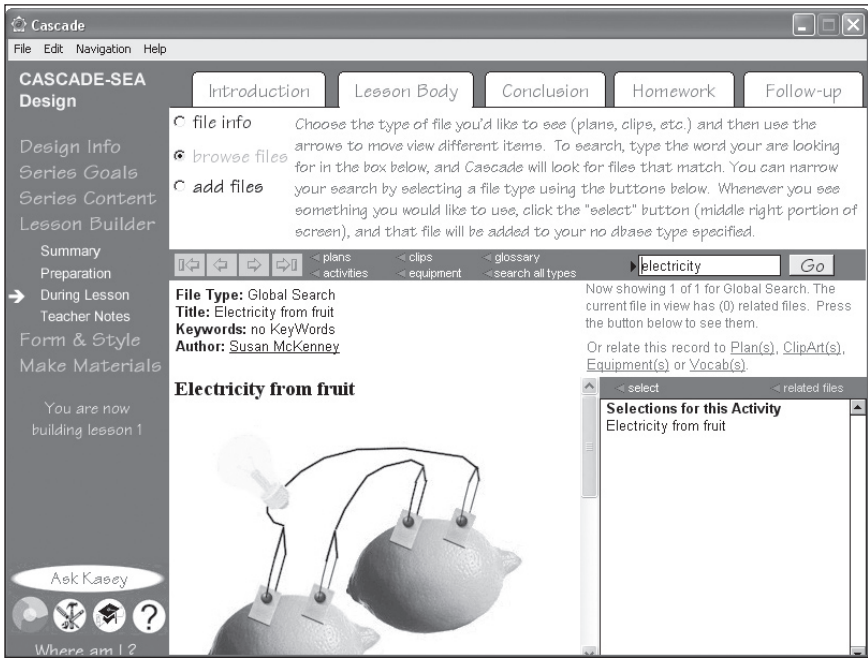


Figure 6. CASCADE-SEA: Design component screen shot.

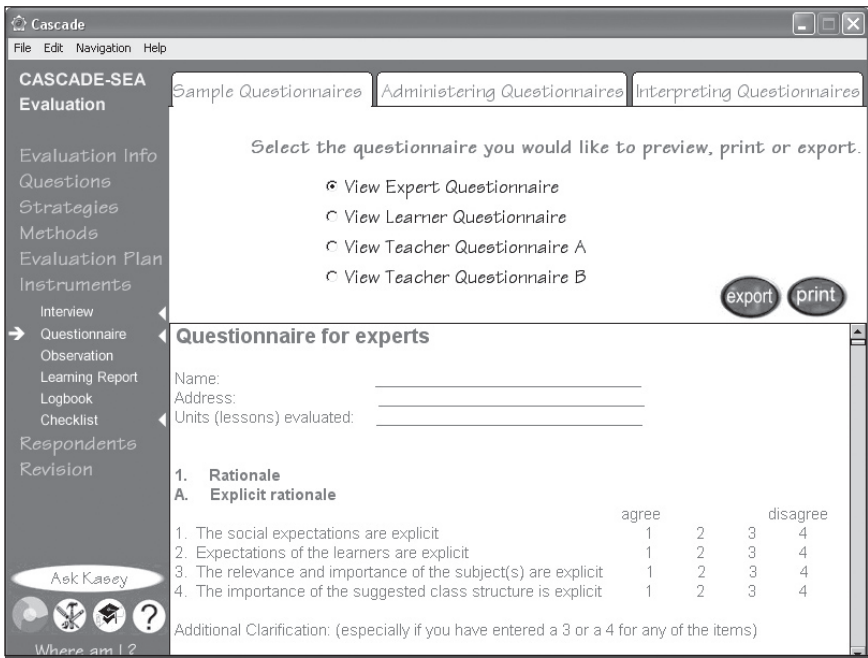


Figure 7. CASCADE-SEA: Evaluation component screen shot.

consistent fashion. *Practicality* relates to the way a tool “fits” with the target setting. Practicality includes the notions of *instrumentality* (usability); *congruence* with user needs, wishes, attitudes, and beliefs; and *cost* effectiveness in terms of investments made in time, effort, satisfaction, and learning. The *effect potential* pertains to the likelihood of CASCADE-SEA to meet its ultimate aims of contributing to the creation of *good quality materials* and helping users learn from the design and development experience (*professional development*). Pertaining to each of these qualities, data were collected on the content, support, and structure of the system or the resulting materials (the latter was the case in assessing the quality of products created with the aid of CASCADE-SEA).

METHODS

Within the six months available for the final evaluation of the CASCADE-SEA program, three cycles of data collection were undertaken to ascertain the validity, practicality, and effect potential of this program: two field tryouts and one expert appraisal. The tryouts took place in collaboration with target users from professional development programs, whereas the expert appraisal involved professionals in the areas of: (science) education in developing countries, (science) teacher professional development, and the use of ICT in education. The descriptions below contain details regarding the approach, participants, and instrumentation for each cycle.

Tryout 1: Tanzanian materials writers

The first tryout in the evaluation of the CASCADE-SEA final product took place in collaboration with a science and mathematics education improvement program, based at the University of Dar es Salaam’s Faculty of Education. In one of their Materials Writing Workshops, where teachers come together for a week during school holidays to create teacher guides, CASCADE-SEA was used. Because limited computers were available and this was the first time that computers would be involved in one of these workshops, it was not feasible for everyone to gain in-depth exposure to the program. Instead, a demonstration of CASCADE-SEA was given to all participants (n=19) and then five materials writers were selected on a volunteer basis to use the system. The small group (n=5) worked with the program for five days, with a few breaks for small and large group discussions, including plenary reporting sessions in which the CASCADE-SEA group related their experiences to the other writers. Data were collected through: (a) recording discussions, (b) observation during the hands-on sessions, (c) analysis of documents produced, (d) a general questionnaire for all teachers with a small section on their impressions about CASCADE-SEA, and (e) a more detailed questionnaire for the CASCADE-SEA user group.

Tryout 2: Namibian facilitator teachers

Facilitator teachers from a Teacher Resource Center (TRC) in rural northern Namibia used CASCADE-SEA during a course on curriculum materials design that was part of a tailor-made training program. The group (n=9) worked with CASCADE-SEA throughout the month-long course, wherein opportunities

were sought to combine research goals with meaningful activities for the participants. Data were collected through: (a) notation of classroom discussions; (b) observation of participants when working hands-on with CASCADE-SEA; (c) participant logbooks which were filled after each of the 10 class meetings; (d) analysis of documents created by participants (analysis and evaluation plans, lesson plans, etc.), in particular the final assignments, which asked for critical reflection on the month's activities; and (e) a questionnaire that was completed at the very end of the course.

Expert Appraisal

The expert appraisal took the form of a one-day workshop. Following a brief introduction, participants (n=17) spent the morning exploring the CASCADE-SEA program in a hands-on session. In the afternoon, experts were asked to reflect on issues relating to the validity, practicality, and effect potential of the CASCADE-SEA program. They wrote their reactions on nine posters. The posters contained leading questions pertaining to the validity, practicality and effect potential of the program's content, support, and structure. Thereafter, three groups were formed: the *content* group contained primarily curriculum development and teacher professional development experts; the *support* group contained experts on education in developing countries, and the *structure* group contained ICT experts. These groups used the comments on the posters (three thematic posters were given to each group) as input for their discussions centered around two main questions:

- Does CASCADE-SEA have the potential to yield a positive effect in terms of curriculum development and/or teacher professional development?
- What recommendations can be made regarding further elaboration and implementation of this system?

They later reported back to the whole group in a plenary session. Data were collected through: (a) observation during the hands-on session and during the small group discussions, (b) analysis of the poster comments, (c) videotaping of the plenary discussion, and (d) a questionnaire administered to all participants at the end of the day.

Data Analysis

Where necessary (e.g. expert appraisal discussion), data were translated before being transcribed and summarized. Data were analyzed deductively and inductively. First, they were coded according to the validity, practicality, and effect potential of the system's content, support, and structure. Thereafter, data were given color codes according to emergent patterns. The questionnaires and observations were used to identify general trends and themes, while the discussions, document analyses and logbooks helped to deepen understanding by examining specific, often more personal insights. Within one overarching framework, variation of sources, participants, and context helped to triangulate (Krathwohl, 1993; Miles & Huberman, 1994) findings on CASCADE-SEA's validity, practicality, and effect potential, as illustrated in Figure 8.

Cycles	Data sources	Validity		Practicality			Impact	
		SAK	INC	INS	CO	COS	BQ	EPD
Tryout 1 Tanzanian materials writers	General questionnaire					•	•	•
	User questionnaire				•			
	Discussion				•	•		•
	Observation			•		•		
	Document analysis						•	
Tryout 2 Namibian facilitator teachers	Questionnaire							•
	Classroom discussions			•	•	•	•	•
	Observation		•	•			•	•
	Logbook	•		•	•	•	•	•
	Document analysis	•		•	•	•	•	•
Expert Appraisal Context, professional development & ICT experts	Questionnaire	•	•	•			•	•
	Plenary discussion	•	•	•	•	•	•	•
	Observations			•			•	•
	Poster comments	•	•	•	•	•	•	•

Figure 8. Data sources in the summative evaluation of CASCADE-SEA. Legend: SAK=State-of-the-Art Knowledge; INC=Internal Consistency; INS=Instrumentality; CO=Congruence; COS=Cost; BQ=Better Quality materials; EPD=Enhances Professional Development.

RESULTS

Validity

State-of-the-Art Knowledge

Participants in the tryouts responded quite favorably to questions pertaining to the state-of-the-art knowledge contained in CASCADE-SEA. In contrast, the experts commented on both the strengths and weaknesses of the program's content. From the expert group, frequently mentioned strengths included the systematic, comprehensive, and wide-ranging avenues (for materials development) the program offers and the level of detail and "enormous amount" of knowledge, information, and tools contained inside the program; the inclusion of information to assist with implementation was also noted as a particular strength. However, aspects listed by some as strengths were noted by others to be weaknesses, for example, "[CASCADE-SEA is] too 'rich' for the target group—cut out some essentialities...Africa is in need of guidelines."

Participants in the second tryout appreciated the advice on materials design, citing the knowledge gained and help offered (e.g. "it made my lesson preparation easy") as the two greatest assets. The expert group also commented on the "good overview of what you have to think of" but recommended that the system should offer more support on (re)design; that is, designing from existing material. Further, this group suggested that much of the support inside CASCADE-SEA is implicit, "... we think that (especially where it is meant to be a learning tool) it [the support] should be made more explicit." Finally, an education in developing countries expert aptly summarized the variety of opinions discussed during the workshop: "The comprehensive generic nature is a strength and a source of weakness. There is a bit of a barrier to opening up a massive program if the task at hand is very specific. One might tend to use the pen and paper or Word, instead."

Both groups also offered feedback with regard to the structure of the program. The user group identified certain screens in the program that could be more technically elegant (and offered specific recommendations for improvement). The expert group offered more general commentary:

- A technically light version is recommended: one that runs quickly and easily (on older computers);
- A Web-based option is recommended;
- Explore improvement of multiple-user database sharing and access; and
- Could the interface be more flexible/adaptable?

Internal Consistency

The bulk of the internal consistency data collected during this cycle came from the expert workshop. In terms of CASCADE-SEA's content, a few experts indicated that they felt consistency inside the product was weak. They felt that the program does not guard against inconsistent answers/responses, and that the differences in the levels addressed are perhaps too broad (saying that goals for a lesson series are abstract, while lesson contents are specific). There were mixed opinions with regard to the relationship between program components. Many experts felt that the link was not present, while others termed it a "loose coupling, sometimes caused by common sense" without a direct (one-to-one) relationship. This group indicated that the interface was consistently designed, but said that more use should be made of the visual support for the design process.

Practicality

Instrumentality

Most participants in all three cycles indicated that they felt CASCADE-SEA guides the user step-by-step in making materials. Participants in the first tryout were able to follow the on-screen instructions, but did not hesitate to ask for clarification when desired. It was often mentioned in the expert appraisal and the second tryout that CASCADE-SEA suggests steps that might not otherwise occur to the user. Most participants found this to be a major strength (saying it "broadens your horizons" in the expert appraisal and "You'll even realize what you haven't think about before," in the second tryout), but a few experts pointed out that this can be distracting. The materials developers in Tanzania worked at their own speed, some dividing up tasks and some staying in teams, throughout the week. Similarly, the facilitator teachers expressed that CASCADE-SEA "... helps guide teachers on what they're supposed to do though it does not prescribe what exactly to do." However, one teacher expressed frustration at "using other ideas, rather than one's own." Expert opinions were similarly varied. Whereas most participants felt that the program does allow users to work at their own pace, mixed feedback was given with regard to personal style. One participant said that the program may, in fact, "block" creative ideas, although another participant pointed out that skipping over (undesired) steps is "very simple" to do.

Self-reporting data indicated that most participants found the program's support to be sufficient, and that they understood the content and procedures in

the program. Observation data showed, however, that the majority of participants in the second tryout requested additional explanation. The expert group commented that some of the texts in the program could be polished, with particular attention to length (some were considered too long) and terminology that some thought to be “too complicated for the target group.” Finally, with regard to the clarity of the structure, it was noted that even those participants with few computer skills were able to learn their way around the program fairly quickly during the first (shorter) tryout. However, observation data emphasized that this program does not speak for itself. Introductory sessions are necessary, especially for new computer users.

Congruence

All three cycles indicated that CASCADE-SEA links well with user contextual realities. In their own ways, each group echoed the sentiment of this participant from the second tryout: “CASCADE-SEA is not a stand-alone solution; it is a support tool that will be used within the existing procedures of developing lesson materials.” Experts generally felt that (with training) the support would be relevant and usable; and 16 out of the 19 participants in the first tryout said that they would be interested in using CASCADE-SEA in future materials writing workshops.

A few participants expressed concern about the lack of computers, but the lack of ICT expertise was mentioned by even more experts and users. Said one user: “Since most schools in our circuit have an acute shortage of materials to support instruction, CASCADE-SEA in my view would be an ideal tool. But... current realities such as teacher computer literacy level, availability of computers and experts to train teachers will have to be addressed. ... Staff development in this circuit would be a crucial condition for successful implementation.” Although this presents an immense challenge, a materials writer in the first tryout had been encouraging. “Look at me,” he said “I knew nothing of the computer before this week, and now I have made materials on it.” Most participants in this circuit did, however, comment that a week was too short. A resource teacher in the second tryout emphasized the importance of the fact that the program has been designed with limited resources in mind, saying that a shared resource such as this one would ideally be “strategically deployed” on the few available computers (at resource centers).

Cost

With all groups, opinions were mixed in terms of the amount of time necessary to use the program: participant assessments ranged from “most efficient” to “time consuming.” The range is likely explained by the program’s flexibility of use, an aspect most participants deemed to be quite satisfactory. This relates to a discussion that emerged during the first tryout on whether the structure in the program was “required” or “suggested.” Participants in the second tryout said that CASCADE-SEA offers a “very flexible way” of working on materials and that the user is “free to make certain adjustments that are more applicable to [one’s] own context or situation.” However, one

participant (second tryout) warned, “CASCADE-SEA may make lazy teachers more lazy as they will think they don’t need to read books for preparation anymore.” Experts suggested that novice users need even more structure and that coaching, in addition to introductory workshops, would be desirable. In contrast, this group also indicated that they found the analysis component to be too detailed. Most participants appreciated the database function and recommended that support could be extended (“[provide even] more good examples”).

Effect Potential

Better Quality Materials

Most participants were satisfied with the structure of the materials produced by CASCADE-SEA. This was evidenced by the fact that participants generally maintained the pre-formatted layout for their materials (although they did add to it) as well as by their comments in this regard, e.g., “they are well formatted but they are flexible to use and [one] can adjust [them] to his or her preference.” When asked to rate the quality of materials they had created with CASCADE-SEA, all of the materials developers in the first tryout indicated either “better than” or “equal to” materials made the usual way. The user group in the second tryout consistently commented that the materials they created with CASCADE-SEA were of high quality. The majority of other participants also implied, but did not always directly so state, that the quality was better than the materials they had made without the computer, e.g., “The lessons are by far more detailed.”

When asked for further specification, three out of the five said that materials created with CASCADE-SEA were: (a) more up-to-date, (b) more practical, and (c) more effective than those made the usual way. Of the other two participants, one consistently said that these factors were dependent on the user (thus, neither better nor worse); the other participant did not answer the question relating to effectiveness, but said that materials made with CASCADE-SEA would be less up-to-date and less practical than those made the usual way. Two teachers felt that the lesson materials created with CASCADE-SEA were more internally consistent than those made the usual way, and one said that the materials were less consistent than those made the usual way. The other two said that there was no difference, because it “Depends how rich the database is” and “because lesson materials are up to date regardless [of whether or not CASCADE-SEA is used].”

All five developers in the first tryout indicated that the materials created with CASCADE-SEA contain clear useful procedural specifications for the teacher. Similarly, one participant in the second tryout wrote, “If care is taken when introducing the CASCADE-SEA program then it will definitely benefit the users and eventually lead to the improvement of teaching, which in turn will lead to the desired educational outcomes of the learners.” The experts felt that CASCADE-SEA might have the potential to contribute to (more) valid, practical and effective materials (e.g., by “[preventing] haphazardness”) but that this depends on two things: how the system is used, and the capabilities of the user.

Enhances Professional Development

Participants in all three cycles concurred that CASCADE-SEA has the potential to contribute to the professional development of its users. Further, they agreed that the program helps users to think about materials development in a (more) systematic and thorough fashion. For example, when participants in the first tryout were asked whether they thought this program could contribute to the professional development of its users, all five (of the intense users) answered yes. In addition, four out of five indicated that CASCADE-SEA has caused them to think in a more systematic way and all five said that it supported them to be more thorough or detailed. Participants in the second tryout were also generally positive in this regard, although one participant did note that “[CASCADE-SEA] makes me reluctant to think.” Finally, the “education in developing countries” expert sub-group suggested that this program has potential as a learning tool for training, for both preservice and inservice education. They also stressed that successful implementation would have to offer sufficient time and opportunity for reflection. The “curriculum development” expert sub-group said, “We don’t think that this program would prevent improvements in the areas of curriculum development and professional development, but as to whether or not it can make a contribution: that depends on how the system is used.”

Five out of five participants in the first tryout indicated that they/their institutions would like to use CASCADE-SEA in the future. Further, all five of these participants indicated that they had learned about creating/adapting materials for their own setting with the aid of this program. All five materials developers in the first tryout said CASCADE-SEA helps (teams of) users to visualize this process of materials development, and one wrote that it “helps to make this work more transparent to us and others.” Further, four out of five found the program easy to follow, and none indicated that the program was (to any extent) complicated, confusing, or frustrating. Participants in the second tryout also stated that they had learned about the process of curriculum development through CASCADE-SEA’s structure. They listed things that they had learned about the process of materials development, such as “...ways I can ... evaluate my materials.” The expert group generally felt that the program’s structure can help to visualize the process of materials development, but that it is difficult to gain an overview of the process as a whole.

DISCUSSION

Revisiting the Findings

The quality aspects of validity, practicality, and effect potential were examined in terms of the program’s content, support, and structure. Compared to the relative consensus on support and structure issues, participant opinions were especially mixed in terms of CASCADE-SEA’s content (it offered too much for some, too little for others). This section discusses possible explanations for such disparate findings.

Beauty, they say, is in the eye of the beholder. One likely reason as to why participant opinions varied so much is because their own needs, wishes, and preferences were also so diverse. For example, the content of the CASCADE-SEA

program was judged by some participants to be (at times too) comprehensive and by others to be deficient. Related to this, such variation in opinions sparked discussions about the merits of two versions of the program, best characterized as: CASCADE-pro (comprehensive) and CASCADE-lite (simple). Generally speaking, it was found that those who argued for a simpler version of the program seemed more interested in curriculum development task support per se than they were in the other aim of the program: fostering the professional development of its users. While some argued that a lite version of the program might be more suitable, others disagreed, echoing the sentiments of Eisner (1994) who said that “curriculum development done by teachers can and often does take form in the creation of materials, but that curriculum development [by teachers] more frequently yields no materials but, rather, plans that might be no more sketchy than notes” (p. 127). This group understood that the tool was not designed for personal lesson planning, and should not try to support that in this context. In contrast, those who saw applications for this tool within professional development programs generally tended to appreciate the various components of the program as offering users room to grow. To this group, fostering insights into curricular processes through the structured analysis and evaluation of existing and nascent syllabi and materials (as advocated by Ben-Peretz, 1990) was a worthy pursuit. However, even some of those who valued the content of the program for its “systematic, rich, clear, thought-provoking” and “logical” nature identified concerns about dampening creativity or even encouraging laziness.

Interestingly, those individuals closely associated with the actual implementation of teacher professional development programs (particularly preservice teacher educators) were less bothered by such concerns and much quicker to articulate their own preferences in terms of how they would use the system. This group seemed to view CASCADE-SEA as a source of “curricular possibilities” and a basis for choice and action, as opposed to a vain attempt to render the development process “teacher proof” (c.f., Ben-Peretz, 1990). Such ideas are closely connected with the basic notions upon which this study was founded. They also say something about the way in which this program should be implemented: namely, the use of CASCADE-SEA must be undertaken by (groups of) individuals who are confident and competent in ensuring that the program be used in such a way as to serve the purposes of their own ongoing endeavors. It has been said of lesson materials that many judgments can and should be made during implementation (c.f., Snyder, Bolin, & Zumwalt, 1992) and that the users of materials are ultimately in control of how they will be implemented in the curriculum, (Ben-Peretz, 1994; Clandinin & Connelly, 1992; Fullan, 2000). Critical selection of useful elements of curriculum materials comes more naturally to those who are more experienced and confident. In terms of making judgments pertaining to the use of CASCADE-SEA software, it would appear that the curricular possibilities are more apparent to those for whom curricular adaptation is regular practice (in this case: teacher educators).

In addition to participant backgrounds and interests, another factor influencing beholder perspectives is their expectations. A surprising number of participants seemed to expect the CASCADE-SEA program to generate automatic,

immediate, and complete results (in the form of materials) for them. At the same time, they anticipated this would happen without expending any effort and without relinquishing any control over the process. Despite the fact that such an attitude contends with some of the basic ideas behind the development of the system, it also evidences a certain degree of naiveté about the potentials of ICT and the processes associated with human-computer interaction.

Another preconceived notion that was frequently encountered contrasts with the aforementioned tendency of certain user groups to consider their own preferences and approaches to using CASCADE-SEA. Specifically, expert participant groups seemed to want to give the computer a greater degree of authority than user participant groups. Although they were clearly more critical of the program (especially concerning the validity of the content), this group showed a predisposition to the assumption that the computer was supposed to offer all the (“right”) answers, as opposed to helping users identify the best solutions for their own situations.

Limitations of the Study

The fact that opinions relating to content were more varied than those on support and interface issues gives one pause to consider what, if anything, is unique about this aspect. Participants’ preconceived notions about curriculum design and development knowledge (as opposed to support or structure knowledge) may have played a role. Because of their professional orientations, participants were probably more adept at critically assessing CASCADE-SEA’s content than the other aspects of the program. Although explicit efforts were made to shape data collection activities in such a way that all participants could provide critical, discriminatory feedback, it is possible that the relative lack of criticism regarding support and interface aspects could stem from comparative inability to do so. This poses a potential threat to the validity of the support and interface data.

The scope and duration of the study also presented limitations. Although the procedures used facilitated deep and rich understanding of participant experiences, those insights are limited to the 45 participants involved. Perhaps more important, they are limited to the three groups of participants and the corresponding three strategies through which data were collected. Further, although the value of increasing the duration of the expert appraisal remains questionable, it seems quite likely that longer tryouts would have been more useful. As with any educational innovation, the lasting effects of short bursts of activity tend to be minimal. Though not feasible within this study, (multiple) year-long tryouts would surely offer better insight into the long-term value of the CASCADE-SEA program.

CONCLUSIONS

Two main conclusions may be drawn about the validity of CASCADE-SEA. First, state-of-the-art knowledge is contained in the program, but choices—particularly regarding the quantity—are questionable. Second, although very few specific inconsistencies in the program were identified, the general consensus

was that internal consistency is present, but weak. In terms of practicality, CASCADE-SEA clearly offers step-by-step guidance to the user, but in the eyes of some participants, perhaps too much. The final evaluation data emphasizes that the program should not be used independently, but rather introduced in a training setting, along with follow-up support. Further, the program would be most practical and effective when used as a shared resource to supplement existing activities in materials development. Data indicate that CASCADE-SEA connects well with the needs, wishes, and context of the target users, particularly in terms of content and support. CASCADE-SEA does possess the potential to have a positive effect on the performance of its users, but this potential is strongly influenced by how the system is implemented and personal characteristics of those using it. CASCADE-SEA can help users to create better quality materials than they would on their own. The program can be a useful learning tool for inservice or preservice education. However, realizing the potential to enhance professional development depends on how the system is used.

How the system is used, in turn, depends on the vision of those deploying it. The program was designed to be used in inservice programs at TRCs—structures that have “become widely accepted across southern Africa as an essential ingredient of a professional support structure for teachers and schools,” (Hoppers, 1998, p. 229). As with any innovation, implementing CASCADE-SEA will likely give rise to unforeseen challenges. But the findings from this study do offer guidelines for implementation that are likely to increase CASCADE-SEA’s contributions to the quality of materials created and the users’ learning experiences:

- The CASCADE-SEA program should be used on a sustained basis within a professional development program.
 - Inservice teachers should be made aware that this is meant for creating exemplary lesson materials, and not designed for personal daily planning.
 - Preservice teachers would benefit from using the program in a course that emphasizes the process of lesson planning.
- CASCADE-SEA should be implemented by facilitators who are already competent and confident about their own skills in the area of curriculum development.
- To help their teachers experience support and not be tempted or threatened to lose their professional autonomy in terms of curricular decision-making, facilitators of implementation should:
 - first formulate their own approach, to safeguard against the naive tendency to overestimate what the computer can and should do; and
 - support users in developing skills of critical selection regarding the curricular opportunities presented in the CASCADE-SEA program.

Anzalone (1991) predicted an increased recognition for the importance of sound instructional design in the creation of curriculum materials in developing countries; he further stated that the development of related capacities would undoubtedly be aided by computers. International literature has called for further exploration into the role of computers toward creating opportunities for teachers to learn through curriculum and instructional design activities (Gra-

binger, Jonassen, & Wilson, 1992; Gustafson & Reeves, 1990; Marx, Blumenfeld, Krajcik, & Soloway, 1998; Nieveen, 1997; Putnam & Borko, 2000). This study speaks to that need by examining CASCADE-SEA's validity, practicality, and effect potential. It has shown that the CASCADE-SEA program does have the potential to offer added value to curriculum and teacher development endeavors in southern Africa. However, the extent to which that potential is realized rests firmly in the hands of those shaping its implementation.

Contributor

Susan McKenney is an assistant professor in the Department of Curriculum (part of the Faculty of Behavioral Sciences) at the University of Twente in the Netherlands. Dr. McKenney's current research and teaching focus on curriculum development, teacher professional development, and, in many cases, the supportive role of computers in those processes. Although much of her work is carried out in collaboration with organizations in developing countries, she is also active in consultancy and research endeavors in the United States and the Netherlands. (Address: Susan McKenney, Department of Curriculum, Faculty of Behavioral Sciences, University of Twente, PO Box 217, 7500 AE Enschede, the Netherlands; susan.mckenney@utwente.nl.)

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