

An editorial on research and development in and with educational technology

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As *ETR&D* embarks on a new year with two new editors (Tristan Johnson and Patricia Young), we thought it would be appropriate to provide our perspectives on research and development in and with educational technology. These remarks are not intended in any way to constrain what should be submitted to or published in *ETR&D*. This is a peer-reviewed journal, and the peer reviewers decide what is worth publishing. Our roles are to (a) recruit and assign qualified reviewers (generally those with five or more years past their terminal degree and who have published in *ETR&D* or a similar quality journal), (b) guide authors in responding to reviewer recommendations, and (c) manage a variety of related issues. However, we thought it might be useful to share a framework and associated perspectives that might prove useful to those planning and conducting research and development efforts. Please take the following remarks as suggestive and far from exhaustive or comprehensive. Please continue to submit high quality manuscripts to *ETR&D* through our online Editorial Manager site located at www.editorialmanager.com/etrd.

Working definitions

For the sake of the framework presented here, we offer these definitions:

- Education is aimed at developing knowledge, skills, and attitudes to enable a person to be an effective problem solver, an independent critical thinker, a lifelong learner, and a responsible member of society; education includes formal education (elementary,

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secondary, and tertiary), informal education (planned, incidental, lifelong learning, etc.), and training (on-the-job, professional development, etc.).

- Technology involves the disciplined application of knowledge to achieve a practical purpose valued by a group or a society; technologies may involve tangible devices as well as the systematic knowledge involved in the creation of a variety of benefits to groups and society.
- Learning involves a stable and persisting change in what a person or a group of people knows and is able to do; the processes that result in learning (e.g., learning activities) can be and often are distinguished from the products of learning (e.g., learning outcomes).
- Instruction is that which is designed to facilitate and support learning; instruction can be direct, as in a lecture or structured presentation, or more indirect, as in guided practice with feedback, inquiry-based methods, and exploratory learning.
- Performance refers to how well a person or a group is able to successfully complete a designated task; performance factors typically include accuracy, speed, consistency, and the ability to transfer knowledge and ability to a more challenging set of tasks.
- Knowledge refers to beliefs that are well grounded in theory, evidence and experience; knowledge involves information that has been validated by others and which is widely accepted as validated and reliable.

These definitions are generally consistent with the elaborated definitions in *Educational Technology: A Definition with Commentary* (Januszewski & Molenda 2007) and the *Encyclopedia of Terminology for Educational Communications and Technology* (Richey 2013); the reader is referred to those volumes which contain more detailed explanations of nuances and issues and along with excellent references.

A framework

The framework for educational technology presented here involves a number of dimensions that can guide educational technology research, including: (a) the processes involved in design, development and deployment, (b) the people involved in various aspects of supporting learning, instruction and performance, (c) the various components involved in a learning environment, (d) the typical constraints encountered in designing, developing, deploying, managing and evaluating learning, instructional and performance environments and systems, and (e) general foundational areas related to educational communications and technology. In each case, a visual representation is offered and accompanied with an elaboration of that representation. Following the framework discussion, each of the *ETR&D* section editors presents a perspective on educational technology research and development pertinent to that section of the journal.

Design, development and deployment processes

The processes involved in the creation of learning environments, instructional systems, and performance technologies vary with the level of focus, the context, the constraints, and the overall approach. A variety of approaches with associated strategies, models, and methods can be found in the *Handbook of Research on Educational Communications and Technologies* (4th ed.; Spector et al. 2013). Over the years, a generic process has evolved called

Table 1 Planning levels and representative concerns

| Levels of planning | Representative concerns |
|----------------------------------|--|
| State/National/ International | Cultural and political climate; national/international goals; funding levels, constraints etc. |
| Institutional | Alignment with mission; operational implications; resources required etc. |
| Program | Evaluation; accreditation; relationship to other programs etc. |
| Curriculum | Professional requirements and standards; prerequisites etc. |
| Course | Requirements; goals; evaluation etc. |
| Module | Coherence; sequencing; context etc. |
| Lesson | Objectives; assessments; context etc. |
| Unit | Content/context/control; relevance etc. |
| Activity | Feedback; meaningfulness; timing etc. |

ADDIE (analysis, design, development, implementation, evaluation) (see Larson and Lockee 2014, for a thoughtful description of ADDIE).

The relevant processes, emphases, and resources required depend in part on the level involved. Table 1 indicates some of the concerns that might be emphasized at various planning levels. This table is only meant to suggest that as the level changes from a learning activity, to a unit of instruction and further up to the course and curriculum and then to institutional and national plans, the processes are likely to change as are the concerns, constraints, resources and challenges that a design/development/deployment team faces. Much of the research conducted to date in the area of educational technology has been at the course level and below, although there are efforts to address the institutional and national levels, which are typically more challenging to address in a research effort. In addition, it is worth noting that the terminology used in the level of planning column may be interpreted differently than intended here. For example, some may regard curriculum planning and program planning to be roughly equivalent, while others may view a curriculum as comprised of the content and activities associated with one or more courses. Such differences are probably best settled by defining one's terms at the beginning of an article.

In addition to different levels influencing the relevant concerns, the overall approach and the values associated with that approach are likely to influence the concerns and, as a consequence the processes involved. These are beyond the scope of this brief editorial but definitely worth consideration when planning and conducting research in the broad domain of educational communications and technology.

Some have criticized the ADDIE model mentioned earlier as implying a linear process. In practice, it is widely documented that instructional designers do not follow a linear process, although the categories mentioned in ADDIE (Larson and Lockee 2014) can be found in many such efforts. In addition, many instructional designers adopt a systems perspective (see Richey et al. 2011). Figure 1 depicts a systems perspective that might be appropriate for the lower half of the levels table above.

Historically, there has been much research in the area of needs assessment and task analysis, although this seems to have fallen out of emphasis in recent years, with more emphasis being placed on the middle two boxes in Fig. 1. Formative evaluation and feedback, especially in the context of scaffolding, is receiving emphasis as well.

A Systems Perspective

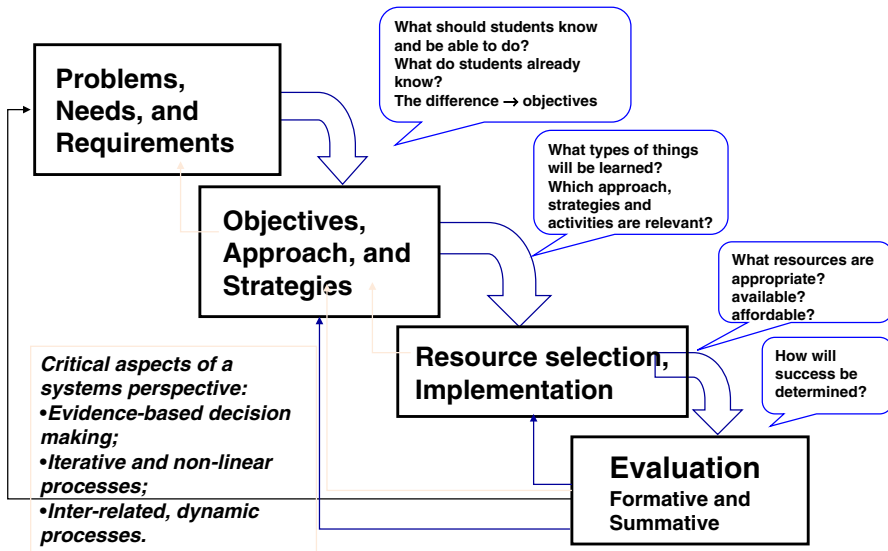


Fig. 1 A systems perspective

People involved with and responsible for educational technologies

There are many different persons involved with the design, development, and deployment of educational technologies at each of the levels indicated previously. The following is a representative list of the relevant actors who have been or might become the focus of research:

- **Learners**—typically, learners have been the focus of much educational technology research and development, which seems entirely appropriate; differences among learners (e.g., prior knowledge, attitudes, interests, age, gender, language ability, etc.) have been studied so as to inform designers, instructors, and the learners themselves; the aim in focusing on learners, of course, is to improve learning, instruction and performance.
- **Instructors**—teachers, tutors, trainers, professors, and so on have also been the focus of research, with particular emphasis being placed on the professional development of teachers and instructors; differences among instructors are likely to result in differences in the way learning is supported and the outcomes achieved.
- **Designers**—professional instructional designers are often used to create large instructional systems and widely used learning environments; the beliefs, values and approaches of designers influence how learning and instruction is developed; the impact of designers' beliefs, values and approaches on learning outcomes is difficult to establish and of current interest to some conducting design-based research (see various chapters in Spector et al. 2013).
- **Development specialists**—this is a heterogeneous group that includes programmers, graphic artists, media specialists and others who turn a design into an actuality; how well a development team performs depends on a number of factors (e.g.,

communication levels, shared understanding, etc.) that affect the cost and effectiveness of an instructional product; cost-effectiveness studies have touched on this group but much more research could be done on design and development teams.

- Funding agencies—those agencies (public and private) funding educational technology research represent a particular group that influences to a large extent the research being conducted at the national and state level; different agencies have different priorities; for example, the National Science Foundation in the USA is generally following *A Roadmap for Education Technology* (Woolf 2010; see an overview at <http://www.cra.org/ccc/files/docs/groe/Roadmap%20for%20Education%20Technology%20-%20Summary%20Brochure.pdf>) in which promising technologies include serious games, data mining, rich interfaces, networking tools, user modeling, mobile tools, and intelligent environments. On the other hand, the US Department of Education's Institutes for Education Sciences emphasizes research on such topics as using technology to improve reading, writing, mathematics, and science skills with emphasis on intelligent tutoring systems and assessment (see http://ies.ed.gov/funding/pdf/2014_84305A.pdf). The European Commission's Seventh Framework has funded a large network of excellence in the area of game-based learning (see <http://www.galanoe.eu/>), but the majority of funding has gone to programs with specific technologies that will improve global economic competitiveness and leadership in specific science, technology, and engineering disciplines (see http://cordis.europa.eu/projects/home_en.html).
- Parents—with educational technology research involving preK-12 students, emphasis is now being placed on parents and parental involvement at home and at school; some of the differences among learners are their home environments, education levels of parents, and parents' involvement with schoolwork and schools.
- Administrators—this group includes head masters, school principals, vice-principals, district superintendents and others who make decisions about curricula, courses, teachers, students, and technologies to be deployed; some research is beginning to be conducted focusing on the impact of this group and learning outcomes.
- School and University Boards—this group determines who will lead schools, districts, colleges and universities, but their impact on education and educational technology has not been explored in great detail, although there is a general belief that a well-functional board with relatively stable administrators contribute to positive learning outcomes.

Other actors can be added to this list, and one might well include schools, faculties, and colleges as relevant actors with something akin to personalities that affect a local educational culture.

Components of learning and instruction

Another lens through which research in the broad area of educational communications and technology can be view involves the various components commonly identified in a learning environment or instructional system (see Fig. 2).

This hierarchy is meant to suggest that research and development could focus on any of the indicated levels, or in how objects at one level are transformed into objects at another level, or on how objects are collected together to comprise an instructional unit or lesson or course or program. One way to think about this objects hierarchy is in association with the lower half of the planning levels in Table 1 and with various design goals. Figure 3 depicts one possible hierarchy of design goals.

A Hierarchy of Components to Support Learning and Instruction

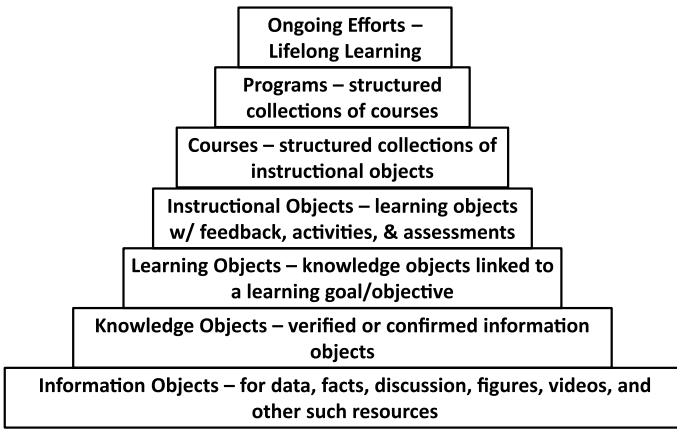


Fig. 2 A components hierarchy

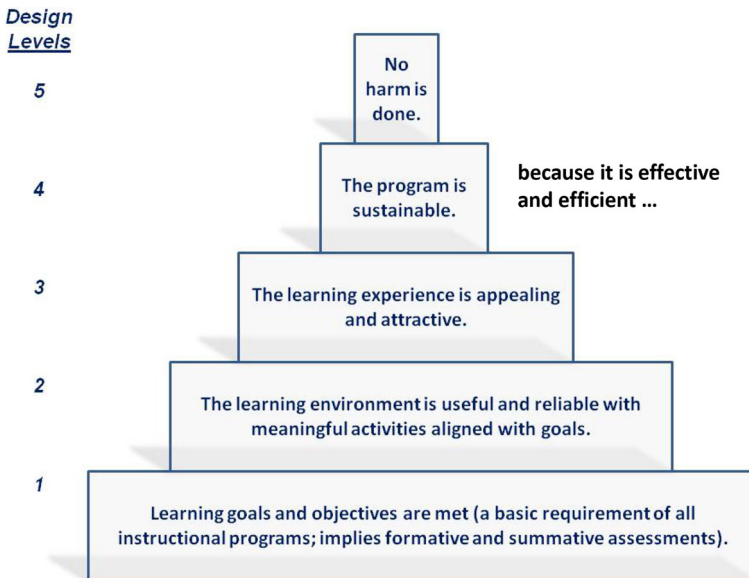


Fig. 3 Design goals

For example, the development and validation of reusable learning objects is often cited as a goal, based on the historical development of learning objects from the object-oriented design movement in computer science. However, to date, there has been only limited success in reusing learning objects from various repositories, although this is likely to improve in the next few years. Designing a program that is easily and cost-effectively sustainable year by year is a concern for those responsible for allocating resources. At the lowest level in Fig. 3, the learning goals and objectives should be met, which requires

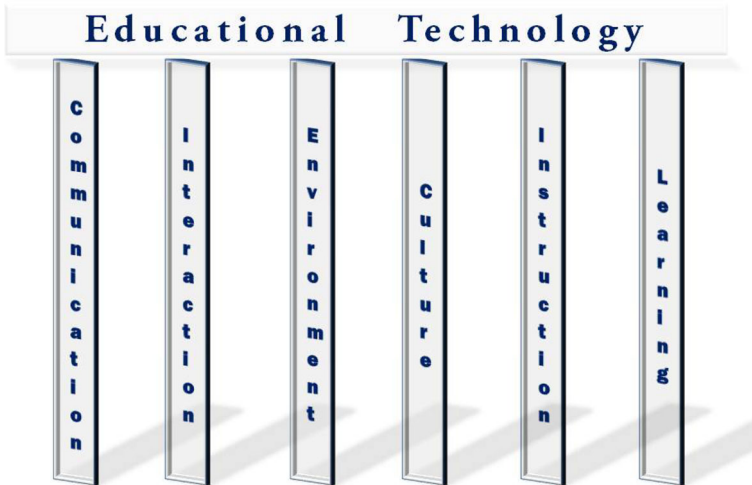


Fig. 4 Educational technology foundation areas

significant emphasis on formative assessment while the instruction is being developed and deployed.

General foundation areas

The general foundation areas pertaining to learning, instruction and performance are very well articulated in several recent publications (Richey et al. 2011; Spector 2012). Figure 4 depicts one representation of relevant foundation areas to consider that might impact one's research focus.

These areas—communication, interaction, environment, culture, instruction, and learning—are areas in which technology might be deployed and which are likely to have an impact on learning outcomes, cost-effectiveness, reusability, applicability, generalizability and other such factors on which research might focus. What is not represented in Fig. 4 are general perspectives, world views and values. The reason for this omission is that perspectives, world views and values cut across these areas and are articulated somewhat differently in each area. Values, as previously suggested, are the bedrock on which education rests, and should be made explicit and taken into account whenever possible.

Research perspectives

As we look at the research focusing on educational technology, there is tremendous value in conducting research using a variety of methods and in variety of foundational areas. For educational technology research to have the impact that is needed to continue to move our field forward, we need to have a greater focus on situating our research in the context of relevant research and theories. By linking our work to that of others, we build on their work and extend ours thereby bringing about a connection of knowledge. These interconnections support meaningful and productive research activities. Part of creating interconnections is to build on the work of others, but we also need to be thoughtful in planning our own

research strategies to make sure that they are tied to theoretical constructs. Appropriate methods are critical for high quality research but we need to situate our work and ask the right questions in order to extend our work and not simply to conduct a study for the purposes of being published.

A clear research focus will support our efforts to conduct research with broader impact. We need to purposefully frame our work, to verify, to challenge, and extend the current state of research. Researchers need to present a strong logic framework that is clearly articulated with the contextual details of their work so as to be useful by other researchers and also by stakeholders. Researchers need to consider the impact of their work not just on learners but also on all educational technology stakeholders including instructors, designers, development specialists, and funding agencies.

As we collectively advance knowledge creation in our field, we need to broaden our methodologies as well as the protocols that we use to report our findings. For example, in looking at probability tests, there is a difference in the phrases ‘statistically significant’ and ‘being important’. While a p value has specific meaning, the level of practical significance may have more meaning for the application of our work into practice. The p value tells us if an effect is genuine, but the effect size tells us how important the effect is. Even in cases where the effect size does not have much meaning within a study, these data could have a lot of value for use in a meta-analysis study.

We need to think beyond our own work. We need to broaden and interconnect our focus (see Table 1) from courses and lessons to curriculum, program, institutional, and national levels. With this approach, we can start to gain a perspective about learning beyond the course level and really looking at learning systems. As we examine a larger perspective, we look less at isolated factors and more at a multidirectional focus considering several foundational areas in the same study. Also we can consider the effects across an array of studies bridging their effects using meta-analysis techniques. We can consider connecting studies across time and systems. As researchers take on more scientific research risk, they can begin to understand the knowledge behind the more difficult and complex problems that we face. They can conduct long-term, large-scale studies delving into the complexities of technology and learning. As a field, we can start to create a research agenda that advances us instead of following the agenda of promotion committees and funding agencies.

All of these interconnections will advance the knowledge creation activities in our field. As we advance our research, we can harness the potential to build synergy by connecting with the work that has already been done but also in connecting across foundational areas, studies, and systems.

Development perspectives

Development is a broad area encompassing all of the processes involved in an ADDIE model, from needs assessment and requirements analysis, through the planning and implementation of solutions, to the evaluation and management of those solutions.

The Development Section publishes research on planning, implementation, evaluation and management of a variety of instructional technologies, learning environments and performance technologies. Empirically-based formative evaluations and theoretically-based instructional design research papers are welcome, as are papers that report outcomes of innovative approaches in applying technology to instructional design, development and evaluation. Papers for the Development Section may involve a variety of research or

analytical methods and should focus on one or more aspect of the instructional development process; when relevant and possible, papers should discuss the implications of instructional design decisions and provide evidence linking outcomes to those decisions.

Those conducting program evaluations where technology plays a key role can consider submitting those program evaluation studies to ETR&D-Development. Such studies can include fidelity of implementation studies as well as impact studies, although the latter might also be submitted to the Research Section (see Spector et al. 2013 for more about program evaluation).

Given the rapid emergence of new technologies, there is a temptation to focus on a very specific technology that may or may not be around in a year or two. What might be taken into account in a Development submission focusing on one specific technology is to include a forward looking conclusion that suggests how that technology might evolve and what additional studies might be conducted taking into account alternative technologies and likely changes.

It is worth noting that ETR&D welcomes studies that report no significant difference when exploring a comparative analysis so long as a compelling story can be told about the lack of significant outcomes. In the case of a program evaluation, the impact study which is likely to be primarily quantitative in nature, might report no significant outcomes, but if there is an accompanying fidelity of implementation study with sufficient qualitative data to explain what happened during implementation and deployment, then important lessons for the future can be reported. In general, ETR&D is interested in the further development of both the scholarly and the practitioner communities.

The Development Editor is beginning his 12th year as an ETR&D editor, and, like the other editors, is elected for a three-year term (consecutive terms are obviously possible) by the Editorial Board and serves at the pleasure of AECT. He has witnessed increased status of the journal (strong impact factor for what is regarded as a niche journal) and significant international expansion (in terms of membership of editorial boards, service as reviewers, and submitting authors).

Cultural and regional perspectives

The Cultural and Regional Perspectives Section, formerly called International Review, welcomes innovative research about how technologies are being used to enhance learning, instruction and performance specific to a culture or region. Educational technology studies, submitted to this section, should be situated in cultural contexts that critically examine issues and ideologies prevalent in the culture or region or by individuals or groups in the culture or region.

Theoretical perspectives can be broadly based and inclusive of research such as critical race theory, cultural-historical activity theory and cultural models. Manuscripts for this section include quantitative, qualitative, mixed-methods and reviews drawing on relevant theories, empirical evidence and critical analyses of the findings, implications and conclusions within a cultural context.

Innovative research refers to an idea that is novel or unique. There has been little research explored in the area, and the manuscript is filling a void in the field of educational technology. The cultural context may be part of this innovation. However, ultimately it is up to the authors to be convincing in their argument of the manuscripts inventiveness.

A cultural context can be achieved through any or all aspects of the manuscript, but it must be a deliberate action inclusive of the anthropological or psychological perspectives

of the culture or nation. Anthropological perspectives might include analyses of an environment, history, language, resources, and the like of an individual, group, culture or society. Psychological perspectives might include analyses of values, beliefs, feelings, or interests of an individual, group, culture or society. The cultural context should situate the research in the specific culture or nation providing an authentic representation.

Authentic representations of cultures and regions are obtained at the human level and critically analyze the cultural and regional issues that enhance, inhibit, and prohibit technological innovation. These representations provide a holistic picture of the study or research, and help those of us who live in other provinces see the world from your point of view.

A high quality of writing is another important requirement for publication. ETR&D's manuscript guidelines should be followed meticulously. A polished paper is more likely to move forward through the editorial process. Authors may need to compare the intended manuscript to those previously published in ETR&D to guide the development of the manuscripts writing style, content, and construction.

When submitting a paper to this section of ETR&D, select the appropriate section editor (Patricia Young), who is honored to serve as the incoming editor of the Cultural and Regional Perspectives section; as with the other editors, she welcomes submissions, feedback and perspectives.

Concluding remarks

We have briefly reviewed a framework for thinking about educational communications and technology and offered perspectives on the kinds of research that might be conducted to contribute to the growth of knowledge and understanding about this challenging and complex area. We hope these ideas prove useful, and we certainly recognize that we have not come close to covering the many areas worthy of exploration and investigation. We encourage submissions that report research and development outcomes in the various areas mentioned here. We especially welcome manuscripts that tell a compelling story about the significance of the research findings, the implications for development and future research, and the insights gained from focusing on particular cultural and regional innovations. Research papers as well as conceptual and analytical papers can be submitted to any of these sections. Should there be uncertainty which section is most appropriate, simply submit to one of the sections as the editors can easily move a submission from one section to another. Again, we invite submissions through our online Editorial Manager system located at www.editorialmanager.com/etrd, and we will continue to do our best to provide feedback to authors within 60 days of submission.

We welcome suggestions for special issues (only one is published each year and alternately managed by the Development or Research Editor); those with the relevant experience who wish to become reviewers (members of the consulting board of editors) are encouraged to contact one of the editors. In closing, we thank our reviewers, our readers, our publisher (Springer), and our sponsor (AECT) for their continuing interest and support. We especially appreciate the excellent work done by our outgoing editors, Michael Hannafin and Abbas Johari; they have both contributed a great deal to the journal and the discipline.

J. Michael Spector, Tristan E. Johnson, & Patricia A. Young ETR&D Editors.

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Patricia A. Young, Ph.D. is an Associate Professor in Literacy Education at the University of Maryland, Baltimore County. Her present research focuses on the Culture Based Model—a framework that supports the development of culture-based information and communication technologies. Dr. Young is involved in mapping the model to a variety of interdisciplinary uses. This research is outlined in her book *Instructional Design Frameworks and Intercultural Models* (2009) published by IGI Global. Dr. Young's research also examines the history of Instructional Design and Technologies made by and for African Americans and Race & Ethnicity in Urban Teacher Education. She has published articles in journals such as: *Artificial Intelligence and Society*; *British Journal of Educational Technology*; *Journal of Educational, Technology & Society*; *Journal of Language, Identity and Education*; and *Race, Ethnicity & Education*.