

Issues for an Early-Stage Research Agenda on TI-Nspire

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TI-Nspire represents not only a new generation of graphing calculator technology, but also an advance in the capabilities of a low-cost personal computing device which is reliable and easy-to-use, and which supports a broad range of instructional models and advanced modes of assessment for teaching math and science. It enters the market at a time when the role and value of graphing calculators in math teaching and assessment has been well demonstrated and is fairly well understood, and the potential of linking calculators in a classroom network is showing considerable promise². There is no need simply to replicate previous research on TI-Nspire. Instead, the goal of early-stage research using TI-Nspire should be to build on our existing understanding of teaching with graphing calculators, by concentrating on capabilities which exploit the advances in the state of the art offered by TI-Nspire. Later stages of research should then add classroom networking to the research agenda, and concentrate on developing additional instructional models.

Of particular research interest are two new capabilities of TI-Nspire: document-based content, and the ability to display multiple representations which are connected and in a single plane. The document-based content system is an organized presentation of multiple screens of mathematics which can be saved, shared, annotated, and revisited. The multiple representation capability dynamically links graphical curves, axes, equations and tables in simultaneous displays, such that a change in one representation is carried through to the others.

At this early stage, the general strategy for research should be first, to develop content models which exploit the advanced capabilities of TI-Nspire in unique and innovative ways. Then, the research should examine the innovations against the criteria of improved achievement and faster mastery, equally for teachers and students. Studies can easily combine these two strategies in an iterative design which emphasizes early learner trials and formative assessment, or they can employ a more linear design to develop, then test new applications. The scope of studies, especially at this early stage, can be fairly small, including perhaps one or two classrooms and a single unit of content spanning a few weeks of classroom time. Or, the studies can be larger and longer, if prior experience justifies the investment of resources. A full range of designs and methodologies should be contemplated for these various study types.

Following are examples of early TI-Nspire issues which may bear examination through research. The list is not meant to be exhaustive, nor does it necessarily imply the funding priorities of TI or other agencies. It is only meant to exemplify a few of the state-of-the-art research issues relevant to our current understanding of TI-Nspire.

1) *Instructional Models*. An instructional model is at its base an instructional strategy for teaching a particular knowledge type, operationalized as one or more activities for teaching/learning and assessment, which are appropriate for a particular context and student type. Unfortunately, there is no commonly-recognized taxonomy of these models³. We are hoping that over time, the models we define will become a common frame of reference for the community of practice surrounding TI-Nspire. By developing a common framework of

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² Research summaries and reviews are available from <http://education.ti.com/educationportal/sites/US/sectionHome/effectivenessoftechnology.html>

³ For a promising basis for this task, see Merrill, M. D. (2006). [First principles of instruction: a synthesis](#). In R. A. Reiser and J. V. Dempsey (Eds.) Trends and Issues in Instructional Design and Technology. Columbus: Ohio, Merrill Prentice Hall. Download from <http://cito.byuh.edu/merrill/text/papers/Reiser%20First%20Principles%20Synthesis%201st%20Revision.pdf>

instructional models, we will better be able to build knowledge cumulatively, and facilitate the dialog among researchers and teachers. Over time, we hope that these models will stimulate the user community and publishers to develop TI-Nspire documents which teach and assess "higher-order" understanding and problem solving in new, more powerful ways than is possible with current platforms.

2) *Content Creation.* A large issue centers on the degree to which teachers and students will be able to use TI-Nspire content creation capabilities to create their own content as part of the teaching/learning process. As we understand the abilities, time and processes here, we are hoping it will be possible to provide support/scaffolding via templated TI-Nspire documents and/or other learning objects

3) *Scaffolding the teacher as well as the student.* We need to understand the degree to which TI Nspire becomes an affordance for scaffolding the math understanding and teaching skills of the teacher. This will allow us to refine the professional development system supporting TI-Navigator in scalable, sustainable ways.

4) *Assessment of problem solving.* TI-Nspire has the ability to capture a progression of documents which represent stages in a student's thinking about a problem-solving task. We need to discover how to exploit this capability for formative and summative assessment, with particular attention to problem solving.

5) *Barriers to CAS.* Effective utilization of CAS is often difficult to achieve. The user interface improvements in TI-Nspire should help. We need to know how it has helped and what issues remain to be addressed by professional development and further development.

Two additional study topics require availability or creation of content at scale, and thus may be possible only in 2008 or later:

6) *Management.* A fully networked TI-Nspire system eventually will include literally thousands of TI-Nspire documents, emanating from students, teachers, and published/downloaded content. Understanding use cases here will help us create a learning object management strategy which is intuitive and easy to use.

6) *Effectiveness studies.* Large-scale effectiveness studies will be feasible when there is enough TI-Nspire content created to allow for semester-long or year-long teaching. If a study of this type is planned, it would be appropriate to consider the usual study design issues of sampling, control, statistical power, measurement, fidelity of implementation, etc.