Institute of Education Sciences
National Center for Education Statistics

NATIONAL INSTITUTE OF STATISTICAL SCIENCES
EXPERT PANEL REPORT

CAPTURING THE CONDITION AND THE IMPACTS OF TECHNOLOGY ON US K–12 EDUCATION

TABLE OF CONTENTS

NATIONAL INSTITUTE OF STATISTICAL SCIENCES

CAPTURING THE CONDITION AND THE IMPACTS OF TECHNOLOGY ON US K-12 EDUCATION

EXECUTIVE SUMMARY

The role of technology in education is expanding and changing. Decisions about the utilization of technology for K-12 learners are made by teachers, schools, and at all levels of governance. Decisions are enabled by funders, by school boards and communities, by parents. At the same time, barriers to successful implementation and utilization of technology for K-12 learning exist and disparities among US learners are great. The starting point for examining equity of opportunity or for evaluating progress or for measuring the impacts of interventions and changes must be the accurate and thorough capturing of the condition and the impact of technology in US K-12 education.

Information on technology in education is variously gathered from National Center for Education Statistics (NCES) surveys and assessments of students, teachers and schools. However, it is not immediately clear how complete a contemporary picture can be drawn from these data. The NCES recognizes the need to give greater focus to technology equity and has established the Ed Tech Equity Initiative. To support this initiative, NISS was commissioned to convene a panel of experts to understand the various needs of different NCES constituencies for information about technology in K-12 education.

The charge to the panel of experts was to think in terms of the information that is needed now and the information that will be needed in five years and in ten years so to design a framework for information that will be robust and valid over time. This framework must encompass the kinds of questions about the dynamic role(s) of technology in education and about the impact of that technology on learning that school officials, education researchers and education policy makers can be expected to ask. The panel unanimously agreed that the first requirement for the Framework is that it should be of continuing merit for the next decade and beyond.

The panel met via teleconference and then on 4-5 April met in person at NCES where NCES staff presentations outlined the work of the NCES Ed Tech Initiative as a basis for the panel's discussions.

Panel's Observations

Observation #1: There is a chain of events from: i) setting a policy to define the purpose and expectations and funding its implementation to ii) providing the hardware, software, internet access, etc. to iii) supporting the teacher to be effective in using the technology to iv) presenting the student with a learning opportunity to v) assessing the student's competency. Breakdown at any point in this chain leaves the end-goal - student learning - in jeopardy.

Observation #2: The purposes for deciding to utilize technology range from augmentation via substitution for teach-led activities to individuation of learning to offering expanded curricula and classroom experiences.

Observation #3: The metric for the value-added by technology ultimately is student outcome.

Observation #4: To be useful as a baseline with subsequent observation over a 10-year horizon, questions must be framed independently of the specific hardware/software/technology.

Observation #5: A national NCES data base must also include sufficiently detailed metadata, i.e., linked demographic and education information, to allow multiple ways of subsetting for data analysis.

Observation #6: Technical information about the inventoried items that needs to be part of the metadata includes: dates of use, respondent or data source, level of decision maker, plus psychometric properties of each item.

Observation #7: There are important comparative examinations to be made about the condition and about the impacts of technology on K-12 learning. Questions of equity or of progress require that the data be unbiased, accurate and sufficiently detailed to define groups precisely and to provide rich enough information for real differences to emerge clearly.

See the report for additional details regarding the panel's observations.

Recommendations in Brief

Technology for K-12 Education is so very broad a field that no one person is a complete technology expert.

Recommendation #1: A roster of experts with varied expertise could provide valuable consultation to NCES on the gathering and reporting of data on technology in/for education. Using a flexible format rather than establishing a conventional advisory body or convening an expert panel, topics or even specific questions could be addressed expeditiously by small groups with the relevant expertise. Flexibility could extend to mode of meeting (in-person, video conference, teleconference) and also duration.

The inventory of items from existing sources and subsequent identification of information gaps requires wide knowledge of both the kinds of questions that will be asked of the data base and the potential responses across the breadth of educational settings.

Recommendation #2: The knowledge bases required to evaluate existing items in NCES data collections or to design new ones are extremely varied across topic. Expertise on both the intended purposes of items and on the details will be needed to undertake the planned review once relevant existing items have been compiled and gaps in each component of the paradigm have been identified.

Recommendation #3: Today K-12 learning takes place in variety of settings. While the traditional public school is the most prevalent of these, resource experts should also include representatives of alternative schooling (e.g., private schools, religious schools, charter schools, schools-within-schools, home schooling).

PREFACE

"As the primary federal source of education statistics, the National Center for Education Statistics (NCES) is charged with informing the condition of education. While there are many factors that contribute to the condition of education, technology is a critical component. . . . Thus, NCES recognizes the need to give greater focus to education equity in the context of technology *or ed tech equity* - equity, as it pertains to an individual's educational experiences and outcomes, evaluated through the lens of technology. To complete this work, NCES established the Ed Tech Equity Initiative, which is led by the Ed Tech Equity Steering Committee.

The goals of the Initiative are as follows:

- To develop a conceptual framework—one that captures the necessary components to inform ed tech equity.
- To use this framework to analyze and enhance existing 6NCES ed tech equity efforts related to data collection, analysis, reporting, and dissemination.
- To develop and operationalize a strategic plan to further advance the Initiative."

- from the *NCES ED TECH INITIATIVE Fact Sheet*

To support this Initiative, NISS was commissioned to convene a panel of experts with a diversity of backgrounds and positions in order to understand the various needs of different NCES constituencies for information about technology in K-12 education.

Thus the assembled panel included panelists outside the public education sector as well as panelists central to the public education sector - one at a policy/high-level administrative position and the other charged with implementation in the classroom. In addition the panel membership included researchers whose studies rely on NCES data and panelists acquainted with the implications and use of technology data for a federal data base. Brief biographies appear in the Appendix to this report.

The panel met via teleconference and then on 4-5 April met in person at NCES where NCES staff presentations outlined the work of the NCES Ed Tech Initiative as a basis for the panel's discussions.

National Institute of Statistical Sciences
Technical Expert Panel Report

CAPTURING THE CONDITION AND THE IMPACTS OF TECHNOLOGY ON US K-12 EDUCATION

I. INTRODUCTION

Premise

Technology is changing our way of life. In consequence, the role of technology in education is expanding and changing. Technology is changing *what* K-12 students learn, it is changing *how* they learn, *where* they learn. Technology is changing *how* teachers teach; it is changing *what* teachers need to know; it is changing the resource pool of teaching materials and opportunities. Technology is changing *how* performance is defined and *how* and *when* it is assessed and by *whom*.

Decisions about utilization of technology for K-12 learners are made variously by teachers, schools, and all levels of governance. Decisions are enabled by funders, by school boards and communities, by parents. At the same time, barriers to successful implementation and utilization of technology for K-12 learning can be geographic, financial, philosophical, attitudinal, related to insufficient training or to lack of acquaintance with the range of opportunities.

While the world is now technology-rich and increasingly technology-dependent, affecting *all* K-12 learners, disparities among these US learners are great in regard to the roles and expectations for technology in K-12 education. The starting point for examining equity of opportunity or for evaluating progress or for measuring the impacts of interventions and changes must be the accurate and thorough capturing of the condition and the impact of technology in US K-12 education.

Role for the Panel

To this end, Acting NCES Commissioner Peggy Carr commissioned NISS (National Institute of Statistical Sciences) to assemble a panel of technical experts with the breadth and depth of technical expertise and experience to adequately address the multiple aspects on this topic. The goal for the NCES Initiative and the topic for this panel is to define a framework for assembling data that will be sufficient to give a clear picture of technology in education and the impact on educational progress today and five years from now or even a decade into the future.

With advancing technology and the ubiquity of electronic devices, technology contributes to both process and content in learning and probably to cognitive processes as well. Thus, assessment of the roles and impact of technology must be multi-faceted. At the same time encompassing the variety of situations in which K-12 students learn is critical to an accurate picture of education and learning.

Therefore, the panel was constituted to assemble a wide range of expertise with focus ranging from visions of technology for the classroom over the next decade to research knowledge of factors including technology that affect a student's success, to practical knowledge of the workings of education policy, to understanding of the realities of implementation in a functioning educational system (students, teachers, facilities, administration), to familiarity with education outside the traditional public school and to a broad view of influences on learning beyond the formal education setting.

At present information on technology in education is variously gathered from National Center for Education Statistics (NCES) surveys and assessments of students, teachers and schools. Since information has never been fully assembled across surveys and organized, it is not immediately clear how complete a contemporary picture can be drawn from these data. At the same time, the challenge is even greater with the increasingly technological world and the rapidity of change in technology to conceive a framework that will be as relevant in five years or a decade from now.

The overall strategy for this initiative is for NCES staff to develop the background for development and an initial conceptualization of a framework for a panel of experts to take as a starting point. The charge to the panel will be to think in terms of the information that is needed now and the information that will be needed in five years and in ten years so that the design of a framework for information that will be robust and valid over time for answering the kinds of questions about the dynamic role(s) of technology in education and about the impact of that technology on learning that school officials, education researchers and education policy makers can be expected to ask.

Once the framework is created, NCES will undertake an inventory of existing data. At present information on technology in education is variously gathered from National Center for Education Statistics (NCES) surveys and assessments of students, teachers and schools. Since information has never been fully assembled across surveys and organized, it is not immediately clear how complete a contemporary picture can be drawn from these data. At the conclusion of this task, the inventory will be reviewed by a similarly broad panel of technical experts who will be charged with evaluation of the completeness of these existing data with particular consideration of their relevance over the next decade.

CONTEXT

Through the lens of technology use, US K-12 education runs the entire gamut. There are schools that no longer purchase hardcopy texts; there are homeschooled students whose "school" has the face of a computer; there are classrooms where students are proceeding at individual, varied instructional paces to optimize their engagement and to maximize their learning; there are students working remotely on team projects with no two students co-located; there are school districts where every student has a school-supplied computer. At the other end of the spectrum, there are schools with computer access limited to scheduled time in a computer room; there are teachers who are uncomfortable with technology and who, given the choice, avoid or minimize its incorporation into the curriculum or into lesson plans; there are students preparing for graduation without the "basic skills" to manage a simple spreadsheet. For K-12 students these disparities are great and their consequences post-high school are both profound and long-lasting.

The variation on the instructional side in determining and implementing technology utilization is also wide. Technology may be a strategic tool for managing budget or for raising graduation rates by replacing a teacher's time with online/remote coursework or assessment. Technology may expand offerings a small school or district or non-traditional setting could not otherwise provide in terms of staff or collaboration or external resources. Technology may individualize education to speed progress or to adapt to a student's learning style and/or needs or to transfer more responsibility for monitoring progress to the student. In short, technology can be used with positive or negative result to transform the traditional teacher-classroom-student paradigm.

II. STRUCTURING THE FRAMEWORK

A NOTE ON EQUITY AND TECHNOLOGY

While "equity" as defined by UNESCO, for example, is an issue of prime importance, the word is used in different contexts without a consistent and precise meaning. Whichever official definition or colloquial usage of "equity" or "equity of opportunity" is applied, the term applies to a comparison either among groups or between a defined group and a norm. Therefore, any framework from which "equity" is to be judged must be a complete context for making comparisons whether these comparisons are between subgroups or across time, across geography, or according to other distinctions. From this full rendering of the context, systematic differences – inequities – can be objectively discerned and analyzed.

Hence, the charge to the panel is both larger and more restricted than "equity" as it might be construed; so, an alternative title was proposed without the word "equity." The issue for the panel is rephrased as: *Capturing the Condition and the Impacts of Technology on US K-12 Education*. This title also reflects the urgent national need for information on technology utilization and the changes in education that technology has brought and will continue to bring to US K-12 education with increasing rapidity.

STARTING POINT AND REQUIREMENT

Unanimously the panel agreed that the first requirement for the Framework is that it should be of continuing merit for the next decade and beyond. That is, the Framework itself should not be tied to contemporary questions or internet capabilities/impediments or to current technologies including hardware, software, electronics, online services or to specific available educational materials, resources and opportunities.

NCES staff presented a preliminary draft of elements for a Framework (diagram is included in the Appendix to this report). This diagram is valuable in capturing a number of specific aspects of technology as symptoms or putative sources of differences in opportunity that have been widely reported as consistently related to economic, geographic and demographic attributes of the school districts or of the student populations. Other diagram elements include the decision makers and resource providers: school, parents, community, government.

PANEL'S OBSERVATIONS

It is the learners who are at the center of any depiction of the condition of education and at the center of any discussion of education progress or of education disparities. Technology relates to them directly in two ways: 1) as a set of skills needed after grade 12 for the technology-rich workplace or academic setting and 2) as a learning tool. Technology relates to them - once removed - through teachers, teaching materials and interactive experiences and through assessment both self-assessment and formal testing.

Twice removed are the decision makers and funders who set expectations and standards for teachers and for students and who determine what resources will be made available.

> *Observation #1*: There is a chain of events from: i) setting a policy to define the purpose and expectations and funding its implementation to ii) providing the hardware, software, internet access, etc. to iii) supporting the teacher to be effective in using the technology to iv) presenting the student with a learning opportunity to v) assessing the student's competency. Breakdown at any point in this chain leaves the end-goal - student learning - in jeopardy.

Judging the success of an implementation of technology depends upon a clear understanding of the goals; and these are varied. The mere introduction of technology is not *a fortiori* positive and may not always be directed primarily at enhancing learning. For example, if the intent is replacement of a teacher's role or of a classroom activity with multiple goals such as a team project then what is lost needs to be identified as a cost.

> *Observation #2*: The purpose for deciding to utilize technology may range from: i) replacing a teacher-led remediation with simple completion of self-administered software (to raise graduation rates) to ii) augmenting school offerings with online courses (e.g., AP courses not in the regular curriculum offerings) to iii) expanding classroom experiences beyond what would otherwise be possible to iv) enabling adaptive, interactive learning for students to progress and to receive help according to their personal trajectory to v) offering training in use of technology that will be expected either in post-secondary education or in the workplace.

> *Observation #3*: The metric for the value-added by technology is student outcome (either achievement or, perhaps preferably, evidence-based). Decisions affect aggregates of students; and these can be evaluated based on student data, properly subsetted.

The origin for this NCES Initiative was the investigation of "equity of opportunity" for K-12 learners with regard to technology. Since the needed data base to address this question must encompass the whole context of K-12 education, the value of these data is greatly increased.

> *Observation #4:* Questions about technology in US K-12 education, and the data to provide the answers, will be useful as baseline and subsequent observation over a 10-year horizon if these are framed independently of the specific hardware/software/technology.

> *Observation #5:* To be useful, a national NCES data base must also include sufficiently detailed *metadata*, *i.e.*, linked demographic and education information, to allow multiple ways of subsetting in order to answer questions from policy to implementation, from decision-making to more basic research and to answer questions pertinent to education settings that include but go beyond traditional public school systems.

> *Observation #6:* In addition, the technical information about the inventoried items needs to be made part of the metadata, to include the obvious information of dates used, respondent (teacher/student/administrative record/etc.), level of decision maker (teacher/school/local school board/superintendent/state department of education/federal government), whether item was tested (compliant with OMB requirement), psychometric properties.

There are two requirements beyond impartial data collection and unprejudicial items. These are that the data include sufficiently refined information about the kinds of groups or attributes to be explored or compared and that the primary information from the data gathering be sufficiently detailed and penetrating to assure that differences will be revealed.

> *Observation #7:* There are important comparative examinations to be made about the condition and about the impacts of technology on K-12 learning. Whether these are questions of equity (evaluation of group-to-group disparities) or of progress (comparative study over time), these can be answered credibly if the data are unbiased, accurate and sufficiently detailed to define groups precisely and to provide rich enough information for real differences to emerge clearly.

III. DEFINING A FRAMEWORK

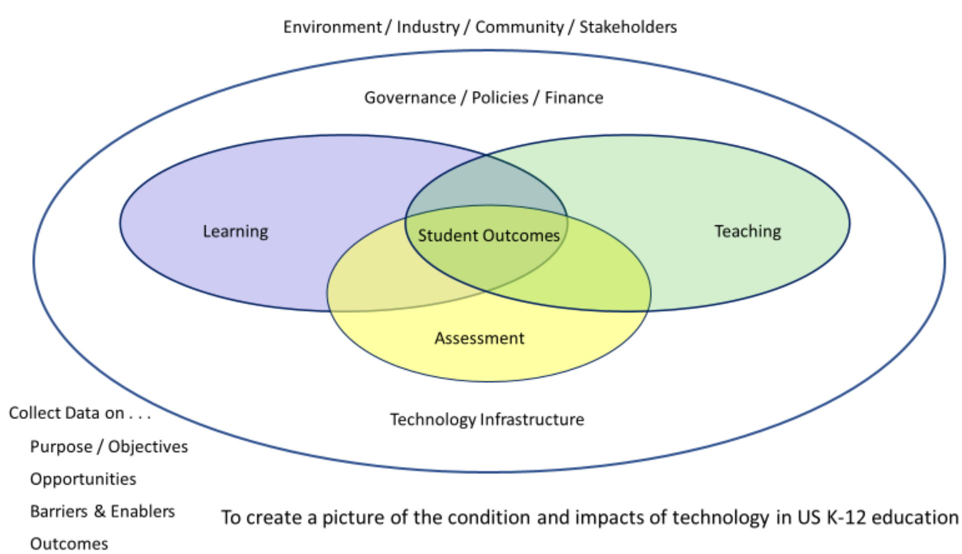
Based on all the considerations outlined above and also taking into account the diversity of settings for K-12 education today, the panel developed a paradigm that places student outcomes at the center. The role of technology in learning, in teaching, in assessment and the extent to which these are transformative all have their impact through the student outcomes.

Policy, governance and finance set the stage for both goals and limitations on the objectives. The technology infrastructure both enables and sets constraints on what can be put into place. Outside all of these are the environment, industry and its response and supply of technological materiel, the community and the stakeholders.

Technology itself is not at the center - technology is continually morphing and expanding. The student is at the center and student outcomes are the basis for measuring the impact of technology.

Within each of the three areas that directly affect students there are objectives, opportunities, barriers and enablers for the purposes set through policy and governance. Data can be gathered for all of these in the three areas, learning, teaching, assessment. Questions about purpose or motivation and expectation and about technology infrastructure are of immediate and crucial interest as well.

The diagram below shows the integration of these parts of the context.



An outline form of this Framework for inventorying items to address each part of the diagram is presented below. As a very preliminary feasibility test, the panel created a short series of possible item topics or questions that would belong to a review of the condition of technology in K-12 education and then organized these under the outline headings (see Appendix).

FRAMEWORK OUTLINE

LEARNING

Examples of ATTRIBUTES/FEATURES to consider:

- Students' age, ethnicity, gender, SES, English language proficiency, and disability status.
- Students' preferred learning styles, e.g., visual, aural, verbal, logical, social, solitary.
- Students' prior technology experience, access/ownership.

A. Goals/Objectives

i. Specific skills

ii. Traditional knowledge

iii. Innovative assistive learning

iv. Cognitive development

B. Barriers/Enablers

i. Technology access in and out-of-school

ii. Impact on collaborative learning opportunities

iii. Policies on Bring Your Own Device

C. Opportunities

i. New communication/social media

ii. Extend learning opportunities

iii. New technology opportunities: gamification/virtual reality

iv. Authentic learning

v. Personalized learning

D. Engagement

i. Availability

ii. Utilization

iii. Completion

iv. Perception/Understanding of technology

TEACHING

Examples of ATTRIBUTES/FEATURES to consider:

- Teachers' ethnicity, gender, and years of teaching
- Teachers' preferred teaching pedagogies including 1) general methods such as teacher centered methods, learner-centered methods, content-focused methods, and interactive methods and 2) subject-specific methods such as task-based methods for language teaching

I. TEACHERS’ TEACHING AND USE OF TECHNOLOGY

A. Goals/Objectives

i. Curriculum/Classes

ii. Self-paced learning

iii. Assistive learning

iv. Curriculum innovation

B. Barriers/Enablers

i. Implementation

ii. Time/freedom to individualize

C. Opportunities

i. Transfer to student pace progression

ii. New technologies

iii. Adaptive/Assistive technologies

D. Engagement

i. Availability

ii. Access/Utilization

II. TEACHERS’ LEARNING, KNOWLEDGE AND SKILLS

A. Goals

B: Teachers’ Knowledge

C. Resources

D. Teachers’ Learning

E. Teachers’ Engagement

ASSESSMENT

Examples of ATTRIBUTES/FEATURES to consider:

- Types of assessment such as diagnostic assessment, formative assessment, summative Assessment
- Level of assessment such as local assessment, large-scale assessment;
- Assessment with difference references such as norm-referenced assessment, criterion-referenced assessment

A. Goals/Objectives

i. Measurement of students’ knowledge and skills

ii. Comparative effectiveness

iii. Diagnostic/learning tools

iv. Achievement results—district, state, & nation

v. Cognitive & non-cognitive skills

B. Barriers/Enablers

i. Time/Instruments

ii. Self-assessment tools

iii. Feedback loop

C. Opportunities

i. Frequency

ii. Individualization

iii. Flexibility

iv. Diagnostics

v. (Cognitive) technology effective - traditional skills vs. new capabilities

D. Engagement

i. Utilization/Satisfaction

ii. Participation

iii. Measurement change → impact on learning & teaching

POLICIES/FUNDING/GOVERNANCE

Examples of ATTRIBUTES/FEATURES to consider:

- Levels of governance/funding: local, state, federal

A. Funding Source and Support (Type: Mandatory, Optional, and Voluntary)

B. Goal Setting and Decision Making

i. Goal setting

ii. Decision makers

iii. Bases for decision making

C. Outcome Evaluation and Dissemination

i. Outcome evaluation

ii. Dissemination

TECHNOLOGY INFRASTRUCTURE

Examples of ATTRIBUTES/FEATURES to consider:

Components of technology infrastructure such as hardware, software, network resources and service required for the technology maintenance

A. Tech Availability and Access

i. Availability

ii. Access

B. Tech Utilization and Security

i. Tech utilization

ii. Security

ENVIRONMENT/COMMUNITY/INDUSTRY/STAKEHOLDERS

Examples of ATTRIBUTES/FEATURES to consider:

- Stakeholders such as parents, community
- Source of support such as state, local
- Type of support such as law, policy, resources

A. Communication with and Support from Stakeholders

i. Communication with stakeholders

ii. Support from stakeholders

B. Goals, Decision Making and Outcomes

i. Goals

ii. Decision making

iii. Outcome measures

IV. ADDITIONAL FINDINGS AND RECOMMENDATIONS

Technology for K-12 Education is so very broad a field that no one is a complete technology expert. Hardware's constraints and capabilities - at the system level for the school or school district, at the individual level for the student and/or the teacher - software's technical requirements and adaptability, conventional as well as novel content in standard or innovative presentation, interactive materials, and potentials for real-time online learning or teaming/collaborations, administrative data tools, communication tools for teachers and students, . . . the list of knowledge and expertise relevant to the tasks that face NCES goes on.

Recommendation #1: A roster of experts with varied expertise could provide valuable consultation to NCES on the gathering and reporting of data on technology in/for education. Using a flexible format rather than establishing a conventional advisory body or convening an expert panel, topics or even specific questions could be addressed expeditiously by small groups with the relevant expertise. Flexibility could extend to mode of meeting (in-person, video conference, teleconference) and also duration.

For the next task at hand, the inventory of items from existing sources and then identification of information gaps, practicality demands wide knowledge of both the kinds of questions that will be asked of the data base and equally wide knowledge of potential responses across the breadth of educational settings.

Recommendation #2: The knowledge bases required to evaluate existing items in NCES data collections or to design new ones are extremely varied across topic. Both experts on the intended purpose of items and experts on the details will need to be assembled for each component of the paradigm to undertake the review planned of the compilation of existing items and the identification of gaps in each component of the paradigm.

Recommendation #3: Today K-12 learning takes place in variety of settings. While the traditional public school is the most prevalent of these, private schools, religious schools, charter and other alternative schools, schools-within-schools, and home schooling educate growing numbers of K-12 learners. It is desirable to include knowledgeable representatives of the non-traditional schools among the resource experts, for example to take part in the next task of considering the current inventory of data item.

APPENDICES

Appendix A: Meeting Agenda for 4-5 April 2017

Appendix B: NCES Preliminary Framework Diagram

Appendix C: Panel Framework with Examples

Appendix D: NCES Questions with Brief Responses

Appendix E: Expert Panel Members' Biosketches

Appendix A: Agenda

AGENDA

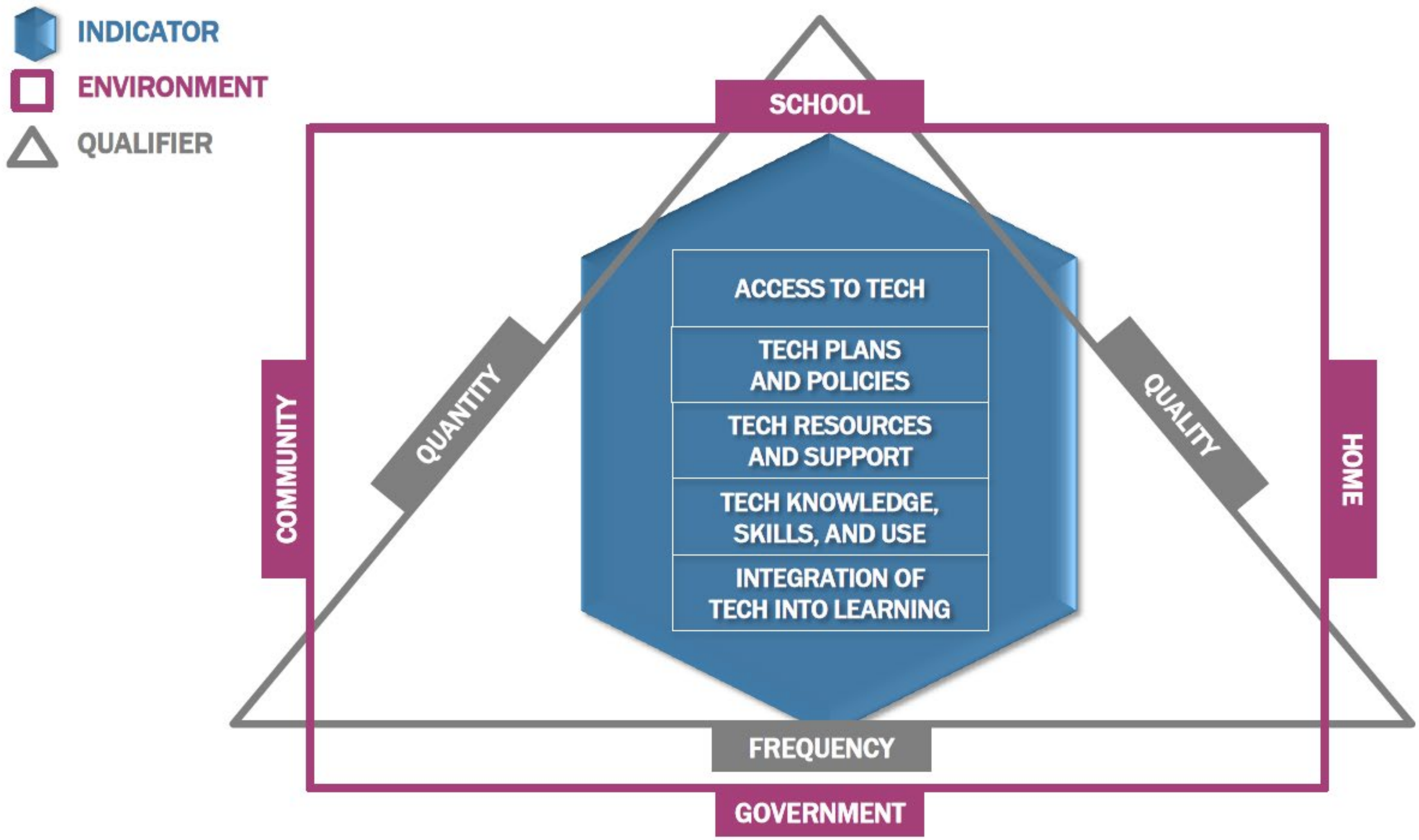
NCES Expert Panel
Capturing the Condition and the Impacts of Technology on US K-12 Education

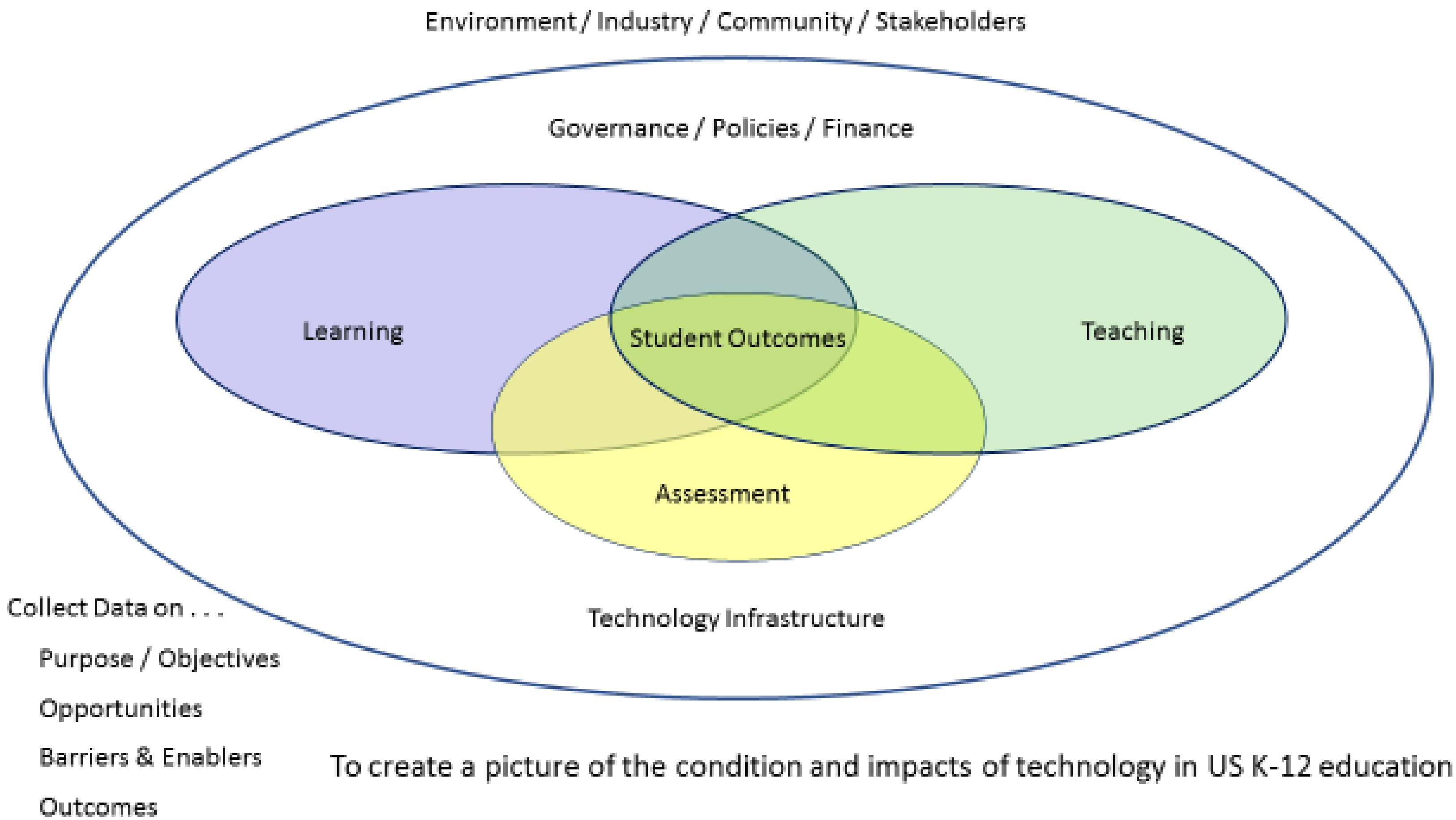
April 4-5, 2017
PCP Building, Room 7105

Tuesday, April 4, 2017	
9:00 a.m. – 9:30 a.m.	Arrival Through Security
9:30 a.m. – 10:15 a.m.	Background and NCES viewpoint presented by NCES staff
10:15 a.m. – 11:00 a.m.	Discussion with NCES
11:00 a.m. – 12:00 p.m.	(Closed) Panel discussion
12:00 p.m. – 1:00 p.m.	LUNCH
1:00 p.m. – 3:30 p.m.	(Closed) Panel discussion
3:30 p.m. – 4:15 p.m.	(Closed) Summarization of Findings; Formulations of New Questions
4:15 p.m. – 5:00 p.m.	Debriefing from Panel with NCES
	Adjournment

Wednesday, April 5, 2017	
9:30 a.m. – 10:00 a.m.	(Closed) Panel discussion
10:00 a.m. – 11:00 a.m.	Discussion with Dr. Peggy Carr and NCES staff of New Questions
11:00 a.m. – 12:00 p.m.	(Closed) Panel discussion
12:00 p.m. – 1:00 p.m.	LUNCH
1:00 p.m. – 3:30 p.m.	(Closed) Panel discussion
3:30 p.m. – 4:30 p.m.	Summarization of Findings with NCES
	Adjournment

Appendix B: Framework Diagrams




Environment / Industry / Community / Stakeholders
Governance / Policies / Finance
Learning
Student Outcomes
Teaching
Assessment
Technology Infrastructure
Collect Data on . . .
Purpose / Objectives
Opportunities
Barriers & Enablers
Outcomes
To create a picture of the condition and impacts of technology in US K-12 education

Appendix C: Expanded Framework with Examples

A primary goal of this panel is to provide a logical approach and a framework for gathering information on the use of technology in K-12 education that is already being collected as part of NCES assessments and surveys. To test the feasibility of compiling an inventory of existing items, the panel considered the elements of the framework and for each identified a short series of possible items and/or questions that would be relevant to a review of the condition of technology in K-12 education. This expanded framework is intended to be illustrative and perhaps a starting point but is in no way considered comprehensive.

LEARNING

Examples of ATTRIBUTES/FEATURES to consider:

- Students' age, ethnicity, gen der, SES, English language proficiency, and disability status
- Students' preferred learning styles, e.g., visual, aural, verbal, logical, social, solitary

A. Goals/Objectives

i. Specific skills
ii. Traditional knowledge
iii. Innovative assistive learning
iv. Cognitive development

Examples:

- Using tech for multiple modes of representation, expression, and engagement (UDL)
- Alignment of out-of-school learning experiences with formal learning goals
- Usefulness to achievement measures
- Develop critical thinking who curate, collaborate, create, and communicate
- Technology use for high-order thinking

B. Barriers/Enablers

i. Technology access in and out-of-school
ii. Impact on collaborative learning opportunities
iii. Policies on Bring Your Own Device

Examples:

- Access/to courses learning Example: What are K-12 enrollments in online courses (course taking) & successful completion?
- Access/learning: What is prevalence (enrollment across US districts) of students' enrollment in online credit recovery?
- Three software programs with most district licenses
  - Excluding: Headquarter productivity (MS office), SIS/Messaging, Networking/(Gmail, Exchange), Directory
- Tech influence on collaborative learning
- Prevalence of device use in classroom, at home (by type)
  - Policy for Bring Your Own Device → policy area

C. Opportunities

i. New communication/social media
ii. Extend learning opportunities
iii. New technology opportunities: gamification/virtual reality
iv. Authentic learning
v. Personalized learning

Examples:

- Communication through social media tools
- Learning opportunities beyond the classroom (museums, libraries, other out-of-school settings)
- Student enrollment in online classes and how enrollment is facilitated (e.g., in computer lab with a facilitator, at home, etc.)
- Explore the integration of gamification, virtual & augmented reality
- Organizing learning around real-world (authentic) challenges; project-based learning
- Personalizing learning experience to align with needs of student (personalized learning, adaptive technologies)

D. Engagement

i. Availability
ii. Utilization
iii. Completion
iv. Perception/Understanding of Technology

Examples:

- Can school monitor/track more than 1 year of academic growth? (progress)
- Student survey: How they use tech at school
- Student use of tech to complete work
- Student outcomes
- Student understanding of tech-readiness
- Technology skills and comfort/familiarity

TEACHING

Examples of ATTRIBUTES/FEATURES to consider:

- Teachers' ethnicity, gender, and years of teaching
- Teachers' preferred teaching pedagogies including
  - general methods such as teacher centered methods, learner-centered methods, content-focused methods, and interactive methods and
  - subject-specific methods such as task-based methods for language teaching

I. TEACHERS' TEACHING AND USE OF TECHNOLOGY

A. Goals/Objectives

i. Curriculum/Classes
ii. Self-paced learning
iii. Assistive learning
iv. Curriculum innovation

Examples:

- Promote the use of student portfolios to demonstrate student progression
- Student-centered: cultivate an environment that supports student ownership
- Technology products enable more customized instruction for each student? Give choice in resources for goals
- Access to mentors/tutors outside school day via tech

B. Barriers/Enablers

i. Implementation
ii. Time/freedom to individualize

Examples:

- Implementation
- Factors influencing the teacher's decisions about technology

C. Opportunities

i. Transfer to student pace progression
ii. New technologies
iii. Adaptive/Assistive technologies

Examples:

- Teachers assigning different tech to different students (differentiating across technologies as well as within)
- Change in teaching methods based on tech—indiv, team
- Extension of classroom to world via tech content
- Organization of physical space around digital tool use (whole-class, small group, index learning, collaborative)
- Is technology used to review data on:
    - Non-academic skills (social skills, habits and work)
    - SEL
    - Student interests/passion

D. Engagement

i. Availability
ii. Access/Utilization

Examples:

- Technology to support modern learning
    - Student record/learner profile
    - E-portfolio
    - LMS/SMS with performance levels and progress
    - Adaptive technology for
        - Literacy leveling
        - Entry benchmark assessment
- Do you have
    - Digital content repository?
    - OER?
    - Playlist?
- Support learning: Do you use the following (actual enrollments)
    - Online academic tutoring
    - Online academic counseling
- How regularly are teachers implementing personalized learning using technology in classes (just beginning / ongoing) (frequency? every day / . . . /occasional)
- Do Teachers use/have access to virtual learning networks?

II. TEACHERS' LEARNING, KNOWLEDGE OR SKILLS OF TECHNOLOGY

A. Goals

B: Teachers' Knowledge

Examples:

- Teacher understanding of technology.
- Extent tech training as part of regular professional development (PD).

C. Resources

Examples:

- Teacher access to current info on research-supported practices and best uses of emerging technologies.
- Teacher support (both funding and time) for accessing tech and learning how to use it effectively.
- Do Teachers have access to PLCs (professional learning community.
- Teacher access to professional PD at each level of understanding of technology.

D. Teachers' Learning

Examples:

- Empowering educators through personalized learning opportunities.
- Teachers as co-learners with students.
- Formal PD but also professional learning communities with mentoring on integrating tech into education.

E. Teachers' Engagement

Examples:

- Do Teachers use PLCs (professional learning communities)?
- Extent of teacher adoption of tech.
- Teacher confidence in using technology for learning? For assessing? For data-driven instruction?

ASSESSMENT

Examples of ATTRIBUTES/FEATURES to consider:

- Types of assessment such as diagnostic assessment, formative assessment, summative Assessment
- Level of assessment such as local assessment, large-scale assessment;
- Assessment with difference references such as norm-referenced assessment, criterion-referenced assessment

A. Goals/Objectives

i. Measurement of students' knowledge and skills
ii. Comparative effectiveness
iii. Diagnostic/learning tools
iv. Achievement results - district, state, & nation
v. Cognitive & non-cognitive skills

Examples:

- Assessment as diagnostics for students or teachers
- Assessing non-cognitive as well as cognitive skills

B. Barriers/Enablers

i. Time/Instruments
ii. Self-assessment tools
iii. Feedback loop

C. Opportunities

i. Frequency
ii. Individualization
iii. Flexibility
iv. Diagnostics
v. (Cognitive) technology effective - traditional skills vs. new capabilities

Examples:

- Process indicators - underlying
- Real-time data
- Embedded assessments - Adaptive assessments
- Assessment accessibility (UDL)
- Online test prep

- Adaptive Formative/diagnostic assessment (outside of grade level) to meet kids where they are
  - Variation of types digital assessment used:
    - Straight
    - Adaptive
    - Virtual reality
    - Virtual laboratory
    - ETC.

D. Engagement

i. Utilization/Satisfaction
ii. Participation
iii. Measurement change → impact on learning & teaching

Examples:

- Teacher survey: Do teachers mainly analyze info on student performance from:
  - Own tracking
  - School/District Dashboard
  - Don't analyze data
- Extent of digital assessments in regular classes
- Viewing and using data from learning technologies
- Is technology used to assess prior knowledge before beginning a course of study?
  - Participation in digital assessment nationally (NAEP, PARCC, SBSC)
  - Variation of results by tech type
  - Impact on data
  - School based equipment
  - NAEP model
  - Bring Your Own Device
- How often is technology supporting assessment:
  - Student work
  - Common assessments
  - Summative (NWEA, PARCC, NAEP) (daily, weekly, once a month, etc.)

POLICIES/FUNDING/GOVERNANCE

Examples of ATTRIBUTES/FEATURES to consider:

- Levels of governance/funding: local, state, federal

A. Funding Source and Support (Type: Mandatory, Optional, and Voluntary)

Examples:

- Funding constraints State/Fed/Local
- Technology investments/costs and funding sources - how getting funded, who, and how much?
- What are sources for technology? Fed, State, local, tax levy, foundation
- Support from parents & communities - variation

B. Goal Setting and Decision Making

i. Goal setting
ii. Decision makers
iii. Bases for decision making

Examples:

- Ed learners goals for how and why school/district/state wants to transform learning and how technology accomplishes
- Who is driving decisions on technology?
  - District vs local superintendent
  - Curriculum & Instruction
  - Teachers
- Support from parents & communities—variation
- Parent involvement in school tech decisions
- Making decisions on ed tech based on rigorous evidence

C. Outcome Evaluation and Dissemination

i. Outcome evaluation
ii. Dissemination

Examples:

- Rapid cycle evaluations of ed tech/use models
- Accountability policies
- Do stakeholders use NCES tech data
- How is tech used to disseminate info to stakeholders?

TECHNOLOGY INFRASTRUCTURE

Examples of ATTRIBUTES/FEATURES to consider:

- Components of technology infrastructure such as hardware, software, network resources and service required for the technology maintenance

A. Tech Availability and Access

i. Availability
ii. Access

Examples:

- Annual district software license spend (turn into $$ per student)
- Features of technology (e.g., modes of input/output)
- School adoption of tech: hardware, software, $
- Industry sales of ed tech → industry dependency: hardware, software, $
- Data dashboards
- Fitness for purposes

- Ensure that student have access to reliable devices/internet during instructional & non-instructional hours
- Does every student have access to device in school & at home?

B. Tech Utilization and Security

i. Tech utilization
ii. Security

Examples:

- Annual district bandwidth use (GB) (national heat map)
- Growing use of open education resources (OER)
- Bandwidth consumption
- Bandwidth, network design, (public, cloud, hybrid, private), connectivity to web (direct, shared)
- Other issues: What other data is e-rate collecting? OCR
- Responsible use policies (privacy & security)
- Security

ENVIRONMENT/COMMUNITY/INDUSTY/STAKEHOLDERS

Examples of ATTRIBUTES/FEATURES to consider:

- Stakeholders such as parents, community
- Source of support such as state, local
- Type of support such as law, policy, resources

A. Communication with and Support from Stakeholders

i. Communication with stakeholders
ii. Support from stakeholders

Examples:

- Connecting to parents using tech: Do you have parent communication tools?
- Connecting with experts in the field (e.g., students working with scientists)
- Using tech to communicate with parents about students' learning needs?
- How is NCES tech data released to other school/district/student info? Valid and reliable?
- Access community
- Supports from state, local, and outside sources
  Law, policy, resources
- Supports in community

B. Goals, Decision Making and Outcomes

i. Goals

ii. Decision making

iii. Outcome measures

Examples:

- Environment for everyone to thrive
- Access to the same quality of opportunities, funding, resources, talent for all
- Decision sources:
  - is a tech leader involved?
  - does school/district have CIO? Full or part time?
- Spending relative to budgets

Appendix D: NCES Questions with Brief Responses

THE NCES ED TECH EQUITY INITIATIVE: SPECIFIC QUESTIONS POSED BY NCES FOR THE PANEL'S CONSIDERATION

Each of these topics is discussed in the body of the report, so brief summary responses are collected here.

1. *Does the phrase Education Equity in the Context of Technology properly describe the scope of this initiative?*

   "Capturing the Condition and Impact of Technology in US K-12 Education" more properly describes the scope of the Initiative.

2. *Is Ed Tech Equity the proper way to paraphrase the title of the initiative?*

   Equity is an overused and loaded term. It is about access, barrier, opportunity, and performance. As "equity" has no consistent precise definition, it is not a good way to title or paraphrase the title of this Initiative.

3. *Does the framework contain the necessary components to collect data that truly reflect education equity in the context of technology?*

   The Framework proposed by the panel focuses on how education is altering as technology in many forms takes an increasing role. Thus, the Framework does not limit focus to the specific contemporary challenges or current opportunities and implementations.

4. *Is the interaction of an indicator in the context of a particular environment and measured by a given qualifier, the proper way to analyze education equity in the context of technology?*

   Quantity, quality and frequency do not apply well as utilization of technology is not readily counted. Extent, intensity and depth make sense – but are not easily graded across the wide range of implementations and opportunities for technology in K-12 education. It is more important to determine the intended goals and purpose, to identify the barriers and the enablers, to consider the range of opportunities (options taken and options passed up), to evaluate the depth of integration into the teaching and learning and to evaluate success. New surveys should ascertain the usefulness of the technology and gather information on its scope, depth, and intensity.

5. *How should the initiative account for rapid technological change and innovation related to education? Are the framework's components broad enough to remain the same and any technological changes will be reflected in NCES survey items?*

   The Framework is centered on the learning, teaching, and assessment instead of on the technology. Teaching, learning, and assessment are the core; information on decisions and decision-makers' goals set the standards and the constraints for what can be achieved.

6. *Should the indicators be prioritized in a particular way – should greater focus be given to certain indicators?*

   The original indicators don't have a role in the Framework developed by the panel.

7. *Should the environment be viewed as an active or passive component of the framework – does the environment facilitate the educational experience or is it the setting in which the educational experience takes place? Does this distinction matter?*

   Not applicable to the Framework developed by the panel.

8. *How significant is the community environment?*

   With metadata including descriptors of the community, results can be reported for smaller demographic units. For example, local estimates for individual "small rural school districts in the upper Midwest" may not be possible due to privacy concerns; but the aggregate may be large enough to report. NCES would do a valuable service by expanding their reporting to include reports for smaller districts (aggregated) or other demographically defined groups, just as it has done for urban districts.

9. *How significant is cost as a qualifier: Can we continue to collect this data at the macro level, or does this data need to be collected at the micro level in order to truly inform education equity in the context of technology?*

   Cost is important to educators (whether state, school or home) because choices are inevitably trade-offs. That is why the intent of decision-makers is important to the picture of K-12 education. Successful student outcomes depend on the intersection of implementation and cost. Good programs with poor implementation are not successful. External funding may come in with strings attached, or there may be uneven allocation that is ineffective. Cost is only one part of achieving a goal for successful implementation of technology.

   Data collection is a cost consideration for NCES. Designing surveys is always a matter of considering the multiple possible sources of information, the level of detail that cost (and time and permissions to access schools or data bases) can support.

Appendix E: Expert Panel Members' Biosketches

Brenda Cassellius, *PhD*

Commissioner of Education, Minnesota Department of Education

Since her appointment as Commissioner of Education in 2010, Dr. Brenda Cassellius has endeavored to enact comprehensive education reform that will benefit every child throughout Minnesota. Under her leadership, the Minnesota Department of Education implemented a better, fairer, more accurate and supportive accountability system for schools. A respected educator throughout her profession and across partisan lines, Commissioner Cassellius was critical in passing new alternative licensure, principal and teacher evaluation laws, as well as increased funding for pre-K through grade 12 education, legislation ensuring a sharp, statewide focus on every child reading well by 3rd grade, and expanded access to quality early childhood education. She is a tireless advocate for equity in education, driven by a personal conviction that every single child throughout Minnesota has the opportunity to succeed.

Daniel Chenok, *MPP*

Executive Director, IBM Center for the Business of Government

Dan Chenok is Executive Director of the IBM Center for the Business of Government. He oversees all of the Center's activities in connecting research to practice to benefit government, and has a special focus on technology, cybersecurity, regulation, budget, and acquisition issues, and on Presidential transitions. Mr. Chenok previously led consulting services for Public Sector Technology Strategy, working with IBM government, healthcare, and education clients. In addition, he is a CIO SAGE with the Partnership for Public Service, Fellow of the National Academy of Public Administration, Chair of the Cybersecurity Subcommittee of the DHS Data Privacy and Integrity Advisory Committee, and Member of the Cyber Policy Task Force with the Center for Strategic and International Studies; previously, he served as Chair of the Industry Advisory Council (IAC) for the government-led American Council for Technology (ACT) and Chair of the Federal Information Security and Privacy Advisory Board. Mr. Chenok also generally advises public sector leaders on a wide range of management issues. Before joining IBM, Mr. Chenok was a Senior Vice President for Civilian Operations with Pragmatics, and prior to that was a Vice President for Business Solutions and Offerings with SRA International. As a career Government executive, Mr. Chenok served as the Branch Chief for Information Policy and Technology with the Office of Management and Budget, where he led a staff with oversight of federal information and IT policy, including electronic government, computer security, privacy and IT budgeting. Prior to that, he served as Assistant Branch Chief and Desk Officer for Education, Labor, HHS, and related agencies in OMB's Office of Information and Regulatory Affairs. Mr. Chenok began his government service as an analyst with the Congressional Office of Technology Assessment, and left government service at the end of 2003. In 2008, Mr. Chenok served on President Barack Obama's transition team as the Government lead for the Technology, Innovation, and Government Reform group, and as a member of the OMB Agency Review Team. Mr. Chenok has won numerous honors and awards, including a 2010 Federal 100 winner for his work on the presidential transition, and the 2016 Eagle Award for Industry Executive of the Year. Mr. Chenok earned a BA from Columbia University and a Master of Public Policy degree from Harvard's Kennedy School of Government.

Alex Hernandez, *MA/MBA*

Partner, Charter School Growth Fund

Alex Hernandez is a Partner at the Charter School Growth Fund (CSGF), a nonprofit that supports the growth of the nation's best public charter schools. He leads CSGF's Impact Team which helps charter networks develop new innovations, build capacity, and share best practices. Alex also built and led CSGF's Next-Generation Schools practice to help charter school networks launch new models. Alex is a former Area Superintendent at

Aspire Public Schools where he managed schools in the California Central Valley region. He taught high school math in South Los Angeles and later served as a Broad Fellow at Portland Public Schools. Before that, Alex worked for several years with JP Morgan and Disney's venture capital arm, Steamboat Ventures. He is a graduate of Claremont McKenna College, has an MBA and Masters of Education from Stanford University, and is a Pahara-Aspen fellow for leaders dedicated to transforming public education. He is a board member of DSST Public Schools, Ednovate, Rocketship Education and 4pt0 Schools. Alex lives near Boulder, Colorado with his wife Michelle and twin sons.

Dewayne McClary, *MS*

Director, D.C. Public Schools, Elementary Education Technology Program

As a proud native of Kingstree, South Carolina, Dewayne J. McClary educational foundation began in the Williamsburg County School District. In 2002, Dewayne graduated with honors from Kingstree Sr. High School. He went on to further his education at Francis Marion University and received a Bachelor of Science degree in Political Science in 2006. He continued his studies at George Washington University, to complete his Masters of Science in Educational Administration. In 2007, Dewayne began pursuing his passion in the education profession when he joined the Williamsburg County School District at Kingstree Jr. High School. Teaching 8th grade Social Studies to all boys, Dewayne was able to touch and change the lives of many young men. He began blossoming in his role, which led to him serving in various roles such as the Single-Gender Liaison, Athletic Director, and Administrative Assistant. Dewayne's knowledge and talents would eventually take him beyond his roots in South Carolina. In August 2011, Dewayne accepted a position with Arlington Public Schools in Arlington, Virginia. He began his tenure with Arlington Public Schools as an Instructional Technology Coordinator, but he also served as Interim Assistant Principal and Lead Senior Instructional Technology Coordinator. In October 2014, Dewayne was appointed as the Manager of Technology Integration Strategies & Technology Instructional Coaches for the District of Columbia Public Schools. Currently, he serves as the Director of Educational Technology, where he manages large-scaled educational technology projects, including development, implementation, and evaluation for 117 schools in Washington, DC.

Jessica Mislevy, *PhD*

Senior Researcher, Center for Technology in Learning, SRI International

Jessica Mislevy, Ph.D., is a senior researcher with SRI Education's Center for Technology in Learning, where she studies highly innovative teaching and learning approaches that use advanced technology in STEM. With a background in quantitative methods, evaluation design, and survey methodology, she specializes in mixed-methods research and evaluation. Mislevy's projects often have an educational technology focus. She served as co-principal investigator on a project aimed to identify generalizable design and implementation features associated with quality online learning in Algebra I, funded by the Bill & Melinda Gates Foundation. Mislevy also supported two separate projects funded by the Michael & Susan Dell Foundation and Bill & Melinda Gates Foundation that sought to understand the ways schools and teachers are blending online instruction with more traditional practices to support teaching and learning. Currently, she provides technical assistance to grantees developing a new generation of personalized digital courseware for high-enrollment undergraduate courses as a part of SRI's evaluation work for the Bill & Melinda Gates Foundation's Next Generation Courseware Challenge. Much of Mislevy's work also centers around STEM education. She serves as the task manager for an NSF-funded project laying the groundwork for a national K-12 STEM education indicator system proposed by the National Research Council in Monitoring Progress Toward Successful STEM Education:

A Nation Advancing? She also serves as Task Lead on a U.S. Department of Education initiative to build capacity in the STEM teacher leadership community by spurring research action around common challenges and promising practices for programs designed to develop and support teacher leaders. Additionally, Mislevy supports a randomized control trial with the University of Washington and George Washington University to study the implementation and impact of the College Board's new inquiry-based AP science curriculum funded by the National Science Foundation. Mislevy earned her Ph.D. in measurement, statistics, and evaluation from the University of Maryland and a Graduate Certificate in Intermediate Survey Methodology. Prior to joining SRI, Mislevy conducted higher education research in institutional research, planning, and assessment at the University.

Susan Patrick, *MA*

President & CEO, International Association for K12 Online Learning (iNACOL)

Susan Patrick is the President and Chief Executive Officer of the International Association for K-12 Online Learning (iNACOL). iNACOL is a nonprofit providing policy advocacy, publishing research, developing quality standards, and driving the transformation to personalized, competency-based, blended and online learning forward. She is the former Director of the Office of Educational Technology at the U.S. Department of Education and wrote the National Educational Technology Plan in 2005 for Congress. She served as legislative liaison for Governor Hull in Arizona, ran a distance learning campus as a Site Director for Old Dominion University's TELETECHNET program, and served as legislative staff on Capitol Hill. Patrick was awarded an Eisenhower Fellowship in 2016. In 2014, she was named a Pahara-Aspen Education Fellow. In 2011, she was named to the International Advisory Board for the European Union program for lifelong learning. Patrick holds a master's degree from the University of Southern California and a bachelor's degree from the Colorado College.

Panel convened by National Institute of Statistical Sciences

Nell Sedransk, *PhD*

Director, National Institute of Statistical Sciences; Statistics Professor, North Carolina State University

Dr. Nell Sedransk is the Director of the National Institute of Statistical Sciences and Professor of Statistics at North Carolina State University. She is an Elected Member of the International Statistical Institute, also Elected Fellow of the American Statistical Association. She is coauthor of three technical books; and her research in both statistical theory and application appears in more than 60 scientific papers in refereed journals. The areas of her technical expertise include: design of complex experiments, Bayesian inference, spatial statistics and topological foundations for statistical theory. She has applied her expertise in statistical design and analysis of complex experiments and observational studies to a wide range of applications from physiology and medicine to engineering and sensors to social science applications in multi-observer scoring to ethical designs for clinical trials.