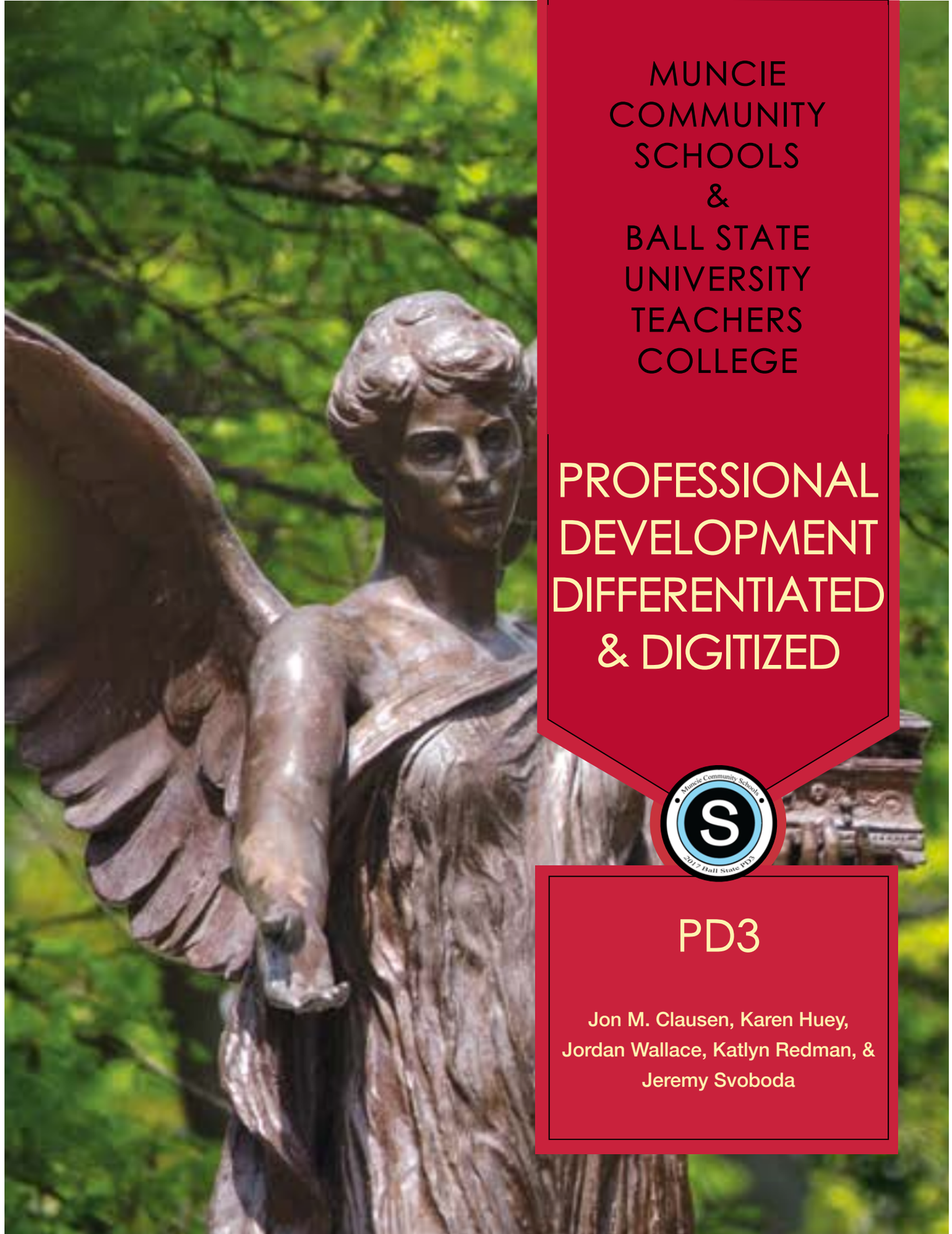

MUNCIE
COMMUNITY
SCHOOLS
&
BALL STATE
UNIVERSITY
TEACHERS
COLLEGE

PROFESSIONAL DEVELOPMENT DIFFERENTIATED & DIGITIZED

PD3

Jon M. Clausen, Karen Huey,
Jordan Wallace, Katlyn Redman, &
Jeremy Svoboda

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The author would like to thank the Ball State University students who participated in this immersive learning experience. None of the projects success would have been possible without their willingness to step out of their comfort zones, be actively engaged with the our community partners, and to take leadership roles within their own learning. Their learning, development, and professionalism highlights the best of our Ball State students and teacher education candidates.

*He would also like to acknowledge the vital role of our community partner. Muncie Community Schools administration graciously provided project students and faculty with access to the schools, teachers, and district PD opportunities. This access allowed BSU students to learn **with** teachers as they worked to adopt the new learning management system. BSU Students gained valuable knowledge about the complexities of technology adoption and integration, as well as issues facing public education at the local, state, and national levels. BSU students also learned the power of communication, collaboration, and shared decision-making as part of their professional learning & development. This community and university partnership highlights successful collaboration in meeting a community defined need.*

Finally, I would like to acknowledge Ball State University, the Provost Immersive Learning Grant Initiative, and Teachers College Dean John Jacobson. Grant funding supported student activities throughout the semester. Dean Jacobson encourages faculty to pursue their passions while engaging students and the community. Without this support, we would not have been as successful.

PREFACE

Program Overview

Professional Development, Differentiated and Digitized (PD3): Muncie Community Schools Learning Management System Adoption and Implementation

The PD3 project is a 9 credit hour experience with the goal of assisting Muncie Community Schools' (MCS) adoption and implementation of a new Learning Management System (LMS). K12 teacher education candidates engaged MCS personnel in order to successfully implement the LMS. Candidates created professional develop opportunities, helped teachers create digital curriculum and assessments, and promoted use of the LMS.

PD3 Students also developed a Science, Technology, Engineering, Mathematics (S.T.E.M) instructional unit for the Muncie P3 After school program. The unit focused on electricity and circuits. The four week unit was taught three separate times for first, second, and third graders. Candidates modeled student-centered and constructivist pedagogies for teachers, and differentiated the lessons to accommodate the different student ages and contexts where the unit was taught.

University courses within the project were multidisciplinary and drew from a wide variety of colleges and program areas.

Project Description

The PD3 project offers an opportunity for BSU Teacher Education Candidates and Muncie teachers to engage in efforts to implement a new Learning Management System (LMS) for Muncie Community Schools (MCS). This 9 credit hour experience primarily focused on the successful implementation of a new LMS within the school system. This was done through the planning, development, and implementation of a professional development program and materials. The program included both face-to-face workshops and individualized technology

mentoring/coaching, and created digital materials that school personnel can access at any time. It also provided candidates opportunities to develop their personal philosophy of education, learn about and develop a variety of assessment materials, develop a digital curriculum, and develop professional relationships with educators.

Digital technologies have become a ubiquitous aspect within our society. Within education, a substantial investment has been made across the educational landscape to create a context in which digital technologies are available and used for assessment, accreditation, and instruction. Recent examples include increased investments in mobile and interactive technologies (ie 1:1 computer/iPad initiatives). Even though the amount of technology available in schools and society today has increased, there remains an ongoing challenge for teachers to utilize these technologies in a meaningful way with their students and within their instructional practice (Hall, 2010, Strudler, 2010). The Professional Development, Differentiated and Digitized project addressed this challenge by developing teacher education candidates who were able to apply knowledge within context, and create professional development opportunities that build the capacity of our community partner and existing teachers to utilize technology effectively.

This project builds off of the technology mentoring project that has been part of Educational Technology 355: Learning and Teaching with Emerging Technologies for the past five years. The PD3 project expands the technology mentoring partnerships developed between BSU students and area teachers, and becomes a more holistic teacher education experience for undergraduate preservice teachers.

This is done in a number of ways. First, the project was located at Central High School of the Muncie Community School district. This provided candidates with direct access to the instructional context where teachers work, and where the LMS will be implemented. Second, the project was a 9 credit hour experience. These credits were a combination of courses focusing on educational technology and assessment, and bundled into a 4 hour block of time three times a week. Longer blocks of time within the school context provided faculty and candidates with opportunities to apply the various course content within context, and break down the traditional silos candidates build between courses when offered on campus. Blocked time also allowed for candidates to engage in metacognitive processing of the concepts and ideas being covered, the challenges they experienced, and the solutions they created.

This immersive learning project also offered an opportunity for the BSU Teachers College to bridge the gaps between the University and local school communities, therefore bridging the gaps between theory and practice. As part of the professional development school network, Muncie Community Schools is a vital partner in Teachers College preparation of professional educators. This project helps to develop the capacity of the context where Teachers College sends its candidates, therefore providing those candidates with quality experiences in their preparation. It is the intent of the project director that this project will continue beyond the spring 2017 semester and become a national model for teacher preparation that not only develops high quality teacher education candidates, but also develops existing teachers and their instructional contexts to effectively adopt, integrate, and embed technology that supports learning and teaching.

The reciprocal nature of this project is that both the BSU students and the Muncie teachers will gain knowledge and expertise throughout the process. For example, BSU students learned about the LMS and other technologies, but also gained knowledge of how these technologies may be integrated within instruction to support teaching and learning, they also learned about the existing instructional contexts where teachers work, curriculum planning, content knowledge, and assessment. Candidates had the opportunity to develop a professional learning network with the teachers and other students in the program. Teachers and other personnel within the school and district received both general and individualized support as the district implemented the new LMS. Candidates identifed teachers needs, and worked to make the implementation a success. Candidates also worked with our community partner to develop a professional learning community that supported the adoption of the LMS and other technologies, developed a digital curriculum where they created lessons and/or projects for student learners, and fostered a collaborative environment where administration, teachers, students, and community members could learn from one another.

Traditional forms of professional development for technology integration tend to be in the form of after school workshops. Frequently these workshops do not connect directly with a teachers content or grade level, are not well attended, and there is little follow up afterward, leaving those who attended on their own as they decide whether or not to use what was presented. In contrast, providing ongoing support for learning new technologies is needed in order for those technologies to be adopted by teachers.

Ongoing support can be provided in a number of ways. Two of the most effective are the creation of Professional Learning Communities (PLC's), and development of Technology Mentoring Programs. PLC's provide teachers with opportunities to share success stories, resources, and ideas for implementation. These learning communities also foster collaboration and cross curriculum application of new technologies. PLC's will be used in a reciprocal manner where both teacher education candidates and our community partners learn from each other within this project. Successful teacher mentoring and technology coaching programs, provide shared visions and goal setting, individualized technology support, a break down in the hierarchal structure, establishment of an open dialogue and collaborative relationships, and provides mutual benefits for mentors and mentees (Chaung and Schmidt, 2007; ISTE, 2011). The mentoring element of this project focused on teachers developing their technology knowledge and providing the essential ongoing individualized support teachers need in order to adopt new technologies successfully. It also provided candidates with opportunities to work closely with teachers in the field.

This project is based on several principles advocated by Ball State University and Teachers College. Ball State University's emphasis on student-centered entrepreneurial learning and community engagement provides a wonderful opportunity to develop projects and experiences that move students from experience to information, information to knowledge, and knowledge to judgment. The conceptual framework for Ball State University's Teacher Education program states that, "candidates are engaged educational experts who are sensitive and

responsive to the contextual bases of teaching, learning, and development."

In this project, candidates had experiences that provided them with new information about technology adoption. They then used that knowledge to make decisions and develop professional learning materials for the district. In order to do this, candidates needed to be engaged and able to demonstrate their expertise within the context of a professional learning community.

Student Driven Nature of the Project

This project is student driven in many ways. After initial training about the LMS and devices the school had adopted, candidates were in charge of planning, developing, and creating all of the professional development materials, and programs. Because candidates also worked individually with teachers, they and their learning partners determined what was to be learned, how they would apply that knowledge to the development of digital curriculum materials for students.

Candidates also developed, planned, and implemented the S.T.E.M unit for the Muncie P3 after school program. They used a variety of resources, identified needed materials, and planned each lesson. They also collaborated with each other to teach the lessons and activities with first, second, and third graders.

Faculty roles within this context provided resources and content to help guide candidates in their work.

How our community partner contributed to our student learning outcomes

Muncie Community Schools provided a real-world context for teacher education candidates to learn about technology adoption and integration. MCS provided the physical space for students and faculty involved in the project, they also provided candidates with access to faculty who we worked with. MCS also contributed access to the LMS, various additional resources, and personnel as candidates created a variety of professional development materials. MCS and the Muncie P3 after school program also provided access to the local elementary school and students in the after school program.

Addressing our community partners identified need

The project fulfilled MCS's identified need to successfully implement and adopt a new learning management system. Candidates in the PD3 project worked primarily with teachers who were part of the Schoology pilot program for the district. A challenge MCS faces is the cost of ongoing professional development. Under Superintendent Baule's leadership, the district has begun to address a number of financial challenges. At the same time, the district is placing a priority on improving the technology infrastructure and challenging teachers to effectively integrate technology within their teaching and learning contexts. In order for this effort to be successful MCS needed to provide teachers with resources and support. Implementation of the PD3 project fulfills that need by providing ongoing general and individualized support for technology adoption and integration. Products produced by candidates are accessible by teachers and school personnel during and after the project has ended.

Project Outcomes:

STUDENT (CANDIDATE) LEARNING OUTCOMES INCLUDE:

1) understanding the complex interplay of factors that influence a teacher's decision to adopt or not adopt technology.

2) appreciate how a teachers' content, pedagogical, and technological knowledge (TPACK) impacts transformational instructional practices with technology.

3) experience the importance of relationships – with peers, teachers, faculty, administration, students, and community members in creating learning communities.

4) discover the needs of teachers through interaction with members of the school community.

5) translate an understanding of these needs into creative measures through which to address identified needs, and find solutions.

6) implement concrete strategies and learning opportunities, in cooperation with community partners, to meet identified need.

These outcomes directly address Ball State University's emphasis on experiences that move students from experience to information, information to knowledge, and knowledge to judgment.

Dissemination of Project Outcomes

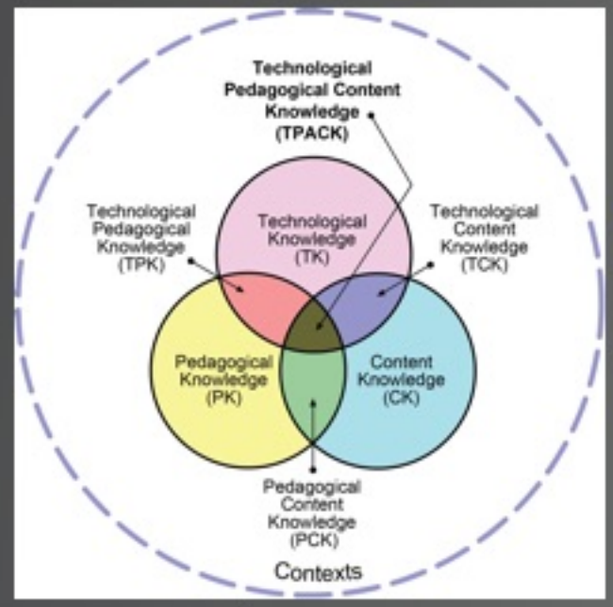
All professional development materials developed by candidates will be made available to MCS for future use. These products will be disseminated through the district web resources, and directly to teachers within the district. A compilation of BSU candidate work will be made available via this digital text, and a shared Google Drive folder made accessible to MSC district leadership.

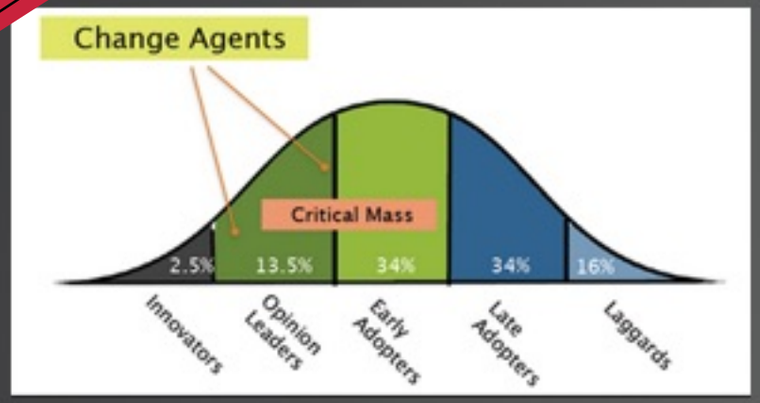
Further dissemination of this work will be through faculty research and presentations to various academic outlets. This will be done through proposals submitted to conferences, articles submitted to peer reviewed publications, and continued work both locally and nationally to improve teacher learning, development, and technology adoption.

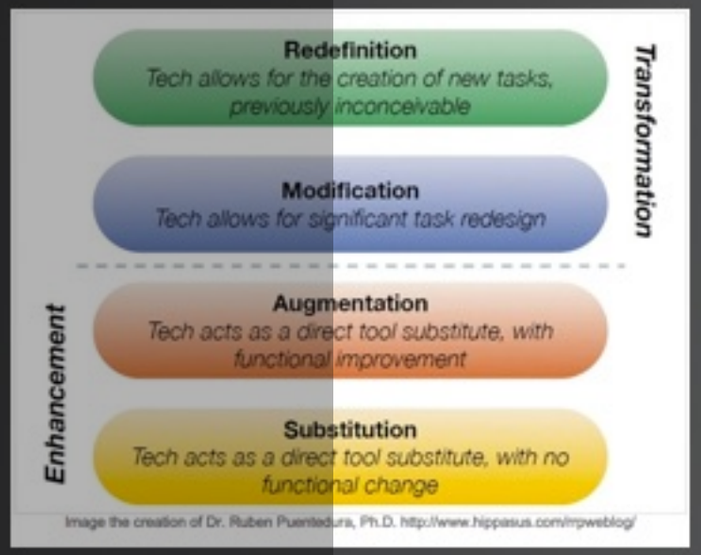
Chapter 1

FOUNDATION

Several theoretical frameworks and standards guided our inquiry and work throughout the semester.







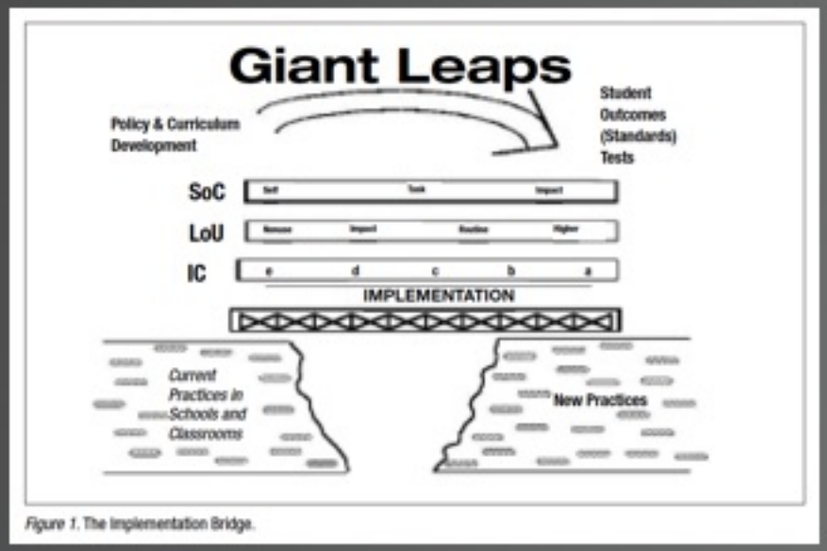


Figure 1. The Implementation Bridge.

Theoretical Frameworks & Models for Technology Adoption

FRAMEWORKS & MODELS

- **Ecological Systems Theory**
- **Implementation Bridge**
- **Diffusion of Innovations Theory**
- **TPACK**
- **ACOT**
- **SAMR**

Section 1

PD3 students began the semester examining technology adoption and integration models. These models provided several lenses to help understand what students observed and experienced as they worked with our community partner.

The first section of chapter one provides a basic overview of the different theories, and models introduced to students as a means to provide them with a theoretical foundation for their work during the semester. The theories and models, and the concepts within each of them, were continually brought back throughout the semester as students worked with teachers and tried to make sense of different challenges that arose.

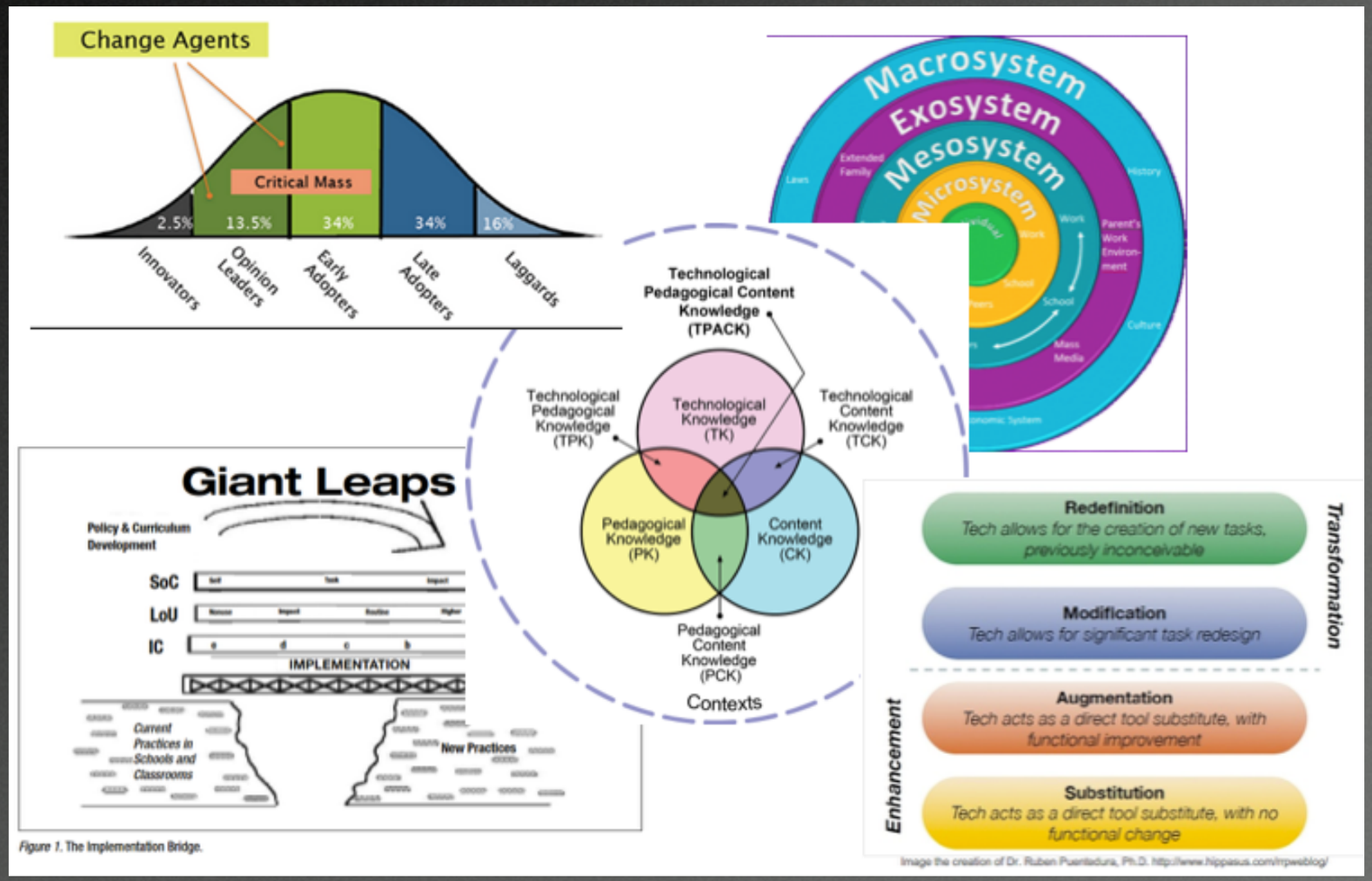


Figure 1. The Implementation Bridge.

Image the creation of Dr. Ruben Puentedura, Ph.D. http://www.hippasus.com/rrpweblog/

Ecological Systems Theory for Student Learning

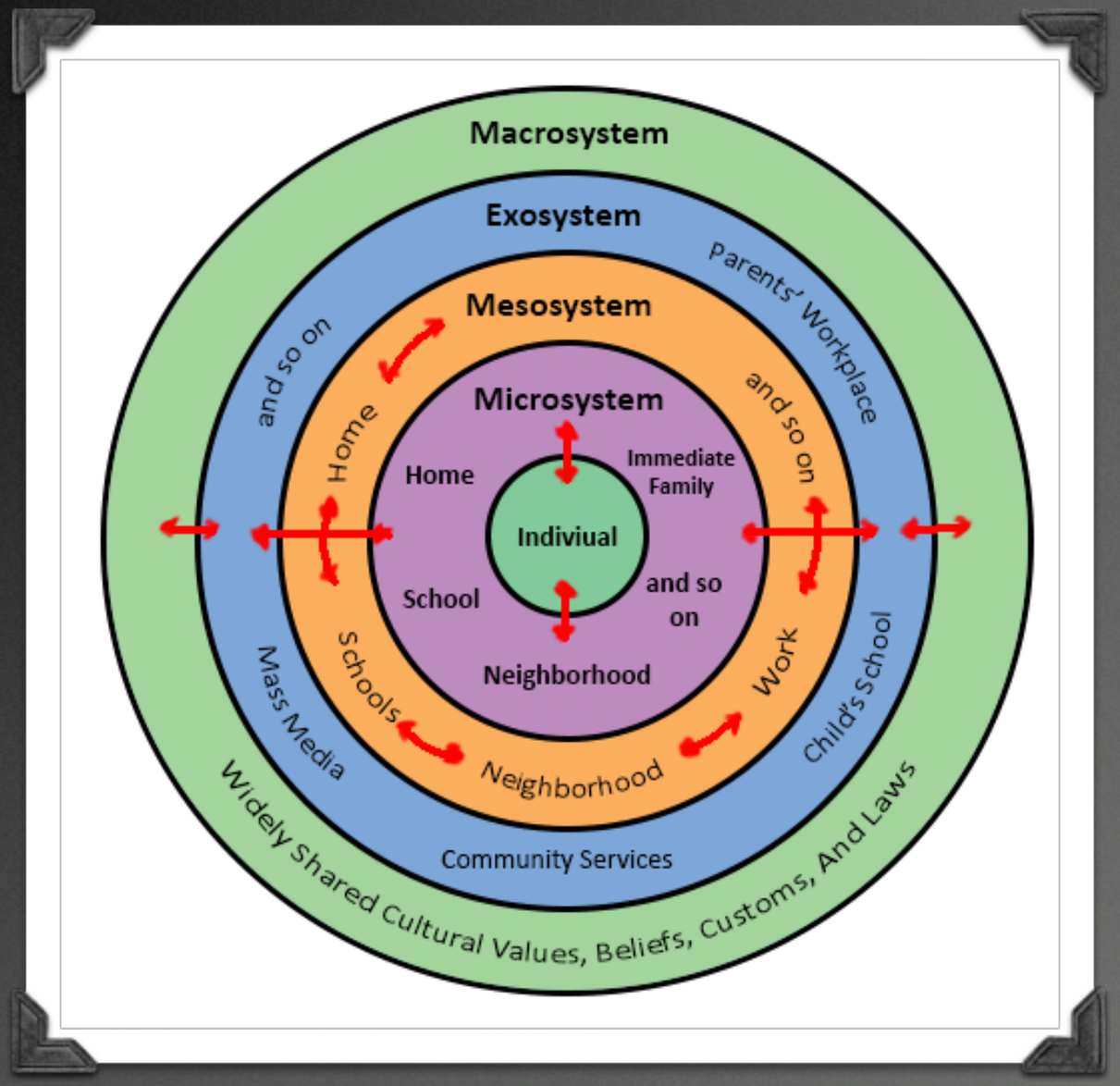
The ecological systems theory, developed by Urie Bronfenbrenner, is most frequently used to describe the various systems that impact a child's development. This provides a powerful explanation of all the different factors that can influence student learning.

When examining technology adoption in schools and by teachers, the ecological systems theory is also useful in helping to understand the influences that impact the rationale for implementing technology adoption initiatives. Understanding not only the teachers level of technology knowledge, but the larger contexts that may be influencing teachers', school, or district decisions about technology adoption is vital in a successful adoption process.

The following videos provide additional information on this theory.

The following link can provide you additional information about Urie Bronfenbrenner and the ecological systems theory.

https://www.psychologynoteshq.com/bronfenbrenner-ecological-theory/



Implementation Bridge

Another model to consider for district leaders, technology directors and coaches is the Concerns Based Adoption Model (C-BAM) developed by Hall & Hord (2012). The model is very detailed and emphasizes that any meaningful change requires a developmental process that takes time.

Leaders should consider a variety of factors that can aid or hinder the change process. A useful tool within the change process is the Implementation Bridge. The Bridge articulates existing practices and the implementation process needed in order for new practices to take hold.

For more information follow the links below.

A really good video on C-BAM: https://youtu.be/4JovqU3SD7o

Lecture from Dr. Hall on the change process: https://vimeo.com/13838354

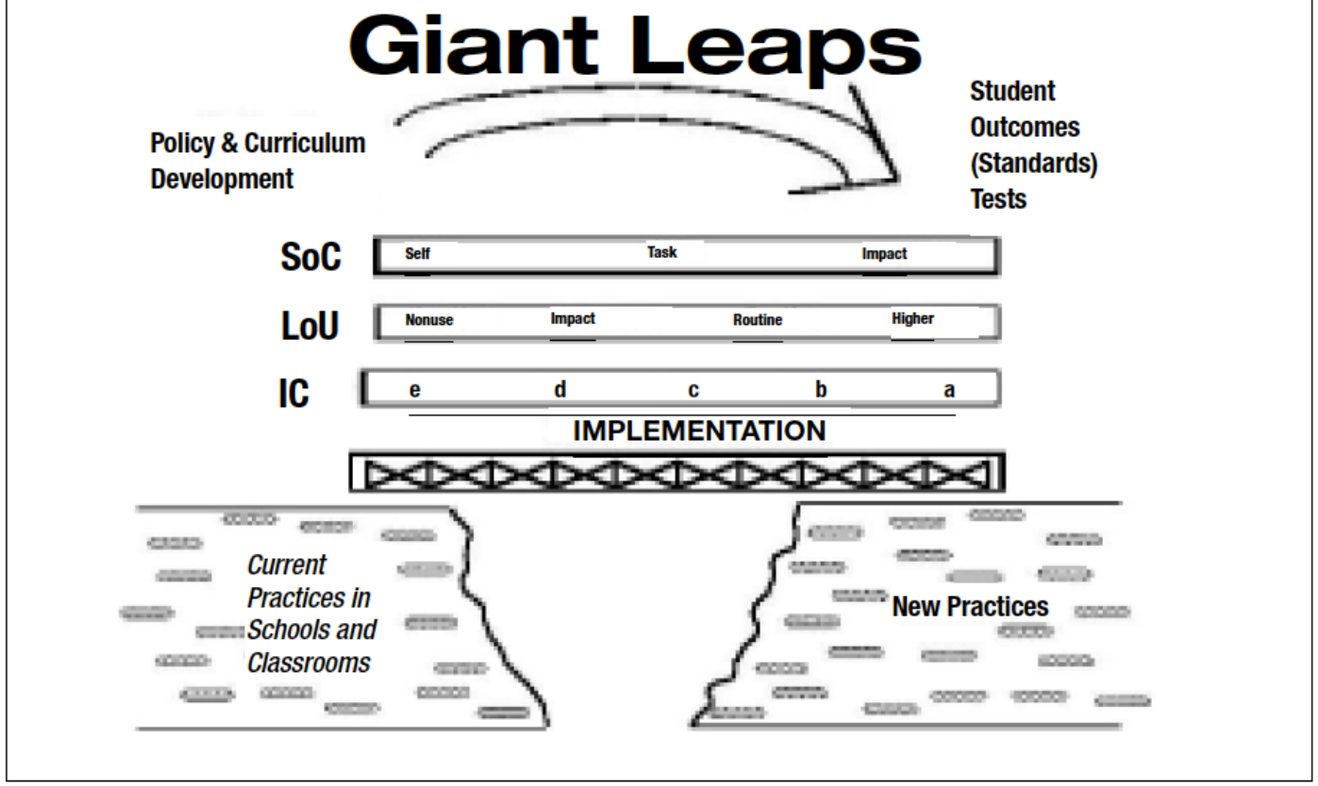


Figure 1. The Implementation Bridge.

Diffusion of Innovations Theory

Diffusion of Innovations Theory, developed by Dr. Everett Rogers, can help district leaders and teachers understand the process by which innovations are adopted.

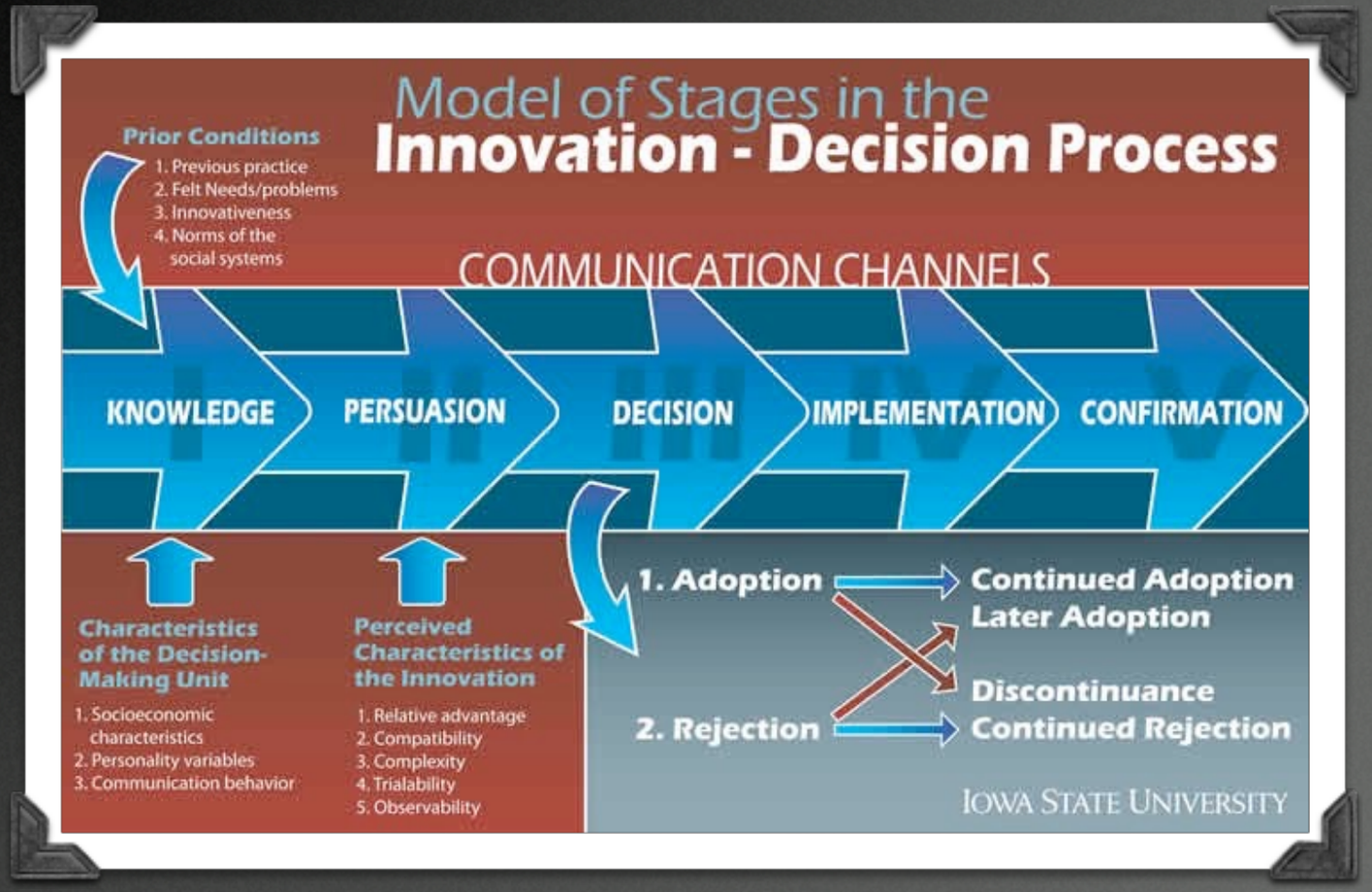
The theory helps explain how, why, and at what rate a new innovation (ideas or technology) might spread through cultures.

Key elements to the theory are the innovations, the adopters, communication channels, time, and the social system that my influence the potential adopter.

To find out more about Diffusion of Innovation Theory check out the resources below.

Dr. Rogers discussing the theory: https://youtu.be/j1uc7yZH6eU

YouTube video on the theory: https://youtu.be/OU_B-tfK0DU



TPACK

The Technological, Pedagogical, and Content Knowledge (TPACK) model (Mishra & Koehler, 2006) represents the intersections of various knowledge domains teachers use as they consider technology integration within their instructional practices.

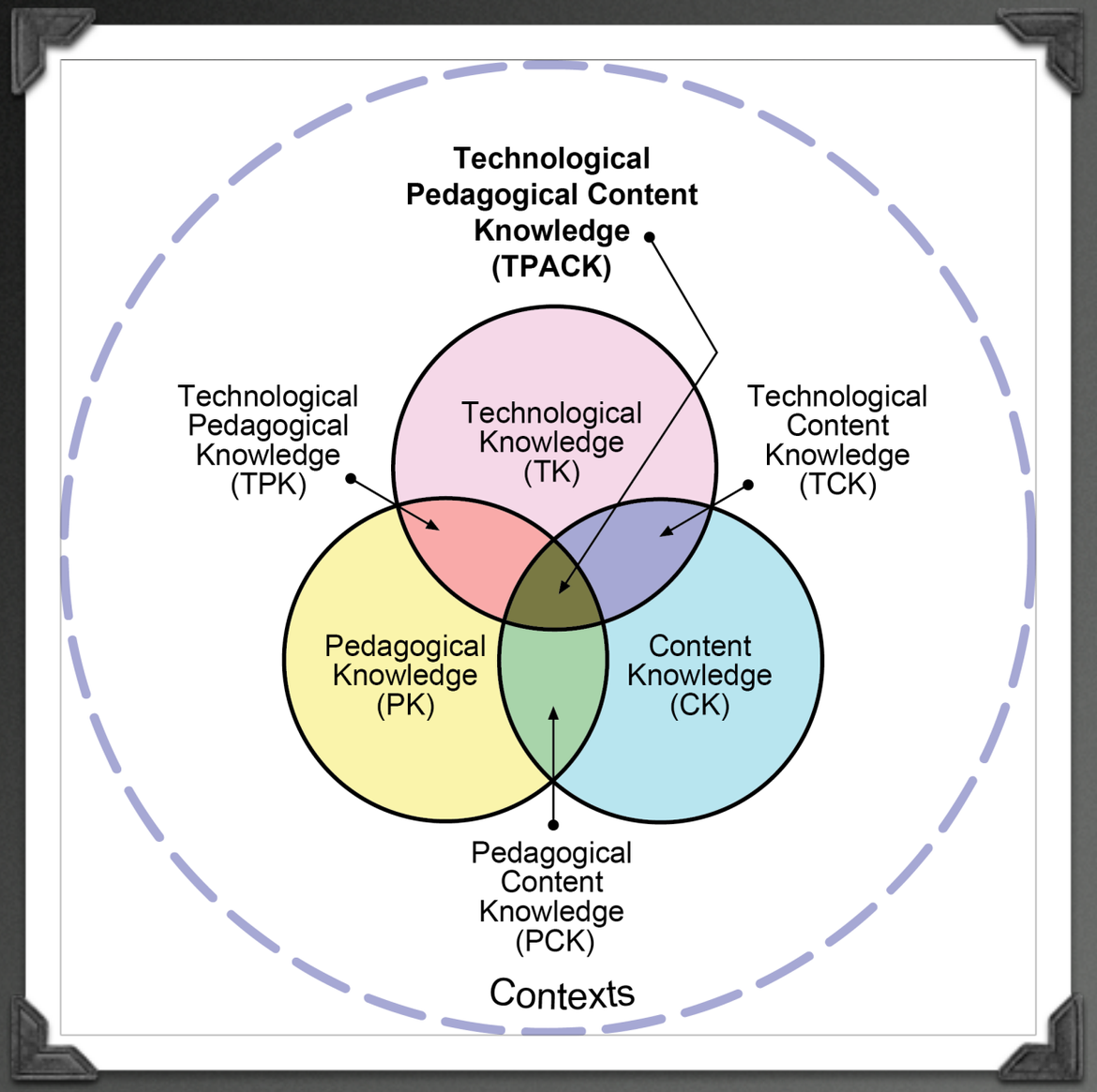
This model is very useful in helping teachers consider their instructional contexts, and how they may utilize available technologies that align with their pedagogical practices and aid in meeting their instructional objectives.

District leaders and Technology Coaches will find this model useful in professional development sessions and planning sessions.

Follow the links below to find out more information about TPACK.

SITE Conference Keynote Address: https://youtu.be/1iCPLTz7Z-Q

TPACK Homepage: http://www.tpack.org



Apple Classrooms of Tomorrow

The Apple Classrooms of Tomorrow was some of the first research to be done examining teachers technology use with students. Researchers identified that the changes in pedagogical practices changed as more technology was adopted into the instruction practices of teachers. Teachers' instructional practices shifted from teacher transmission of information and became more student centered. Technology use involved greater student agency in decision making and student inquiry in the learning process.

Researchers identifies five stages of teacher technology use (Entry, Adoption, Adaptation, Appropriation, Invention). These stages, used in conjunction with other models and frameworks for technology adoption & integration, are helpful for teachers, administrators, and instructional coaches in identifying where an individual might be in regards to their technology knowledge and can assist teacher and school leaders to develop meaningful professional development opportunities.

Sandholtz, J.H., Ringstaff, C., Dwyer, D.C. (1997). Teaching with Technology: Creating Student-Centered Classrooms. New York: Teachers College Press.

1. Entry
Educators struggle to learn the basics of using technology;

2. Adoption
Educators move from the initial struggles to successful use of technology on a basic level

3. Adaptation
Educators move from basic use of technology to discovery of its potential for increased productivity

4. Appropriation
Having achieved mastery over the technology, educators use it "effortlessly" as a tool to accomplish a variety of instructional and management goals; and

5. Invention
Educators are prepared to develop entirely new learning environments that utilize technology as a flexible teaching and learning tool. They begin to "think with technology," designing new ways to solve learning problems that their students may have faced in the past.

SAMR

The SAMR model (Puentedura, 2006) can help teachers, technology coaches, and school leaders identify how they may be using technology within their teaching and learning contexts, and how current use may be transformed as teachers move up the SAMR ladder.

Districts have used SAMR, as well as the Apple Classrooms of Tomorrow (ACOT) stages of technology adoption, to assist teachers in considering where they are in the technology adoption process and to help teachers redefine their instructional practices as technology is used to create more constructivist and student centered learning environments.

Follow the links below to find out more about the SAMR model.

Dr. Puentedura's Weblog: http://www.hippasus.com/rrpweblog

Kathy Schrock's Guide to Everything: http://www.schrockguide.net/samr.html

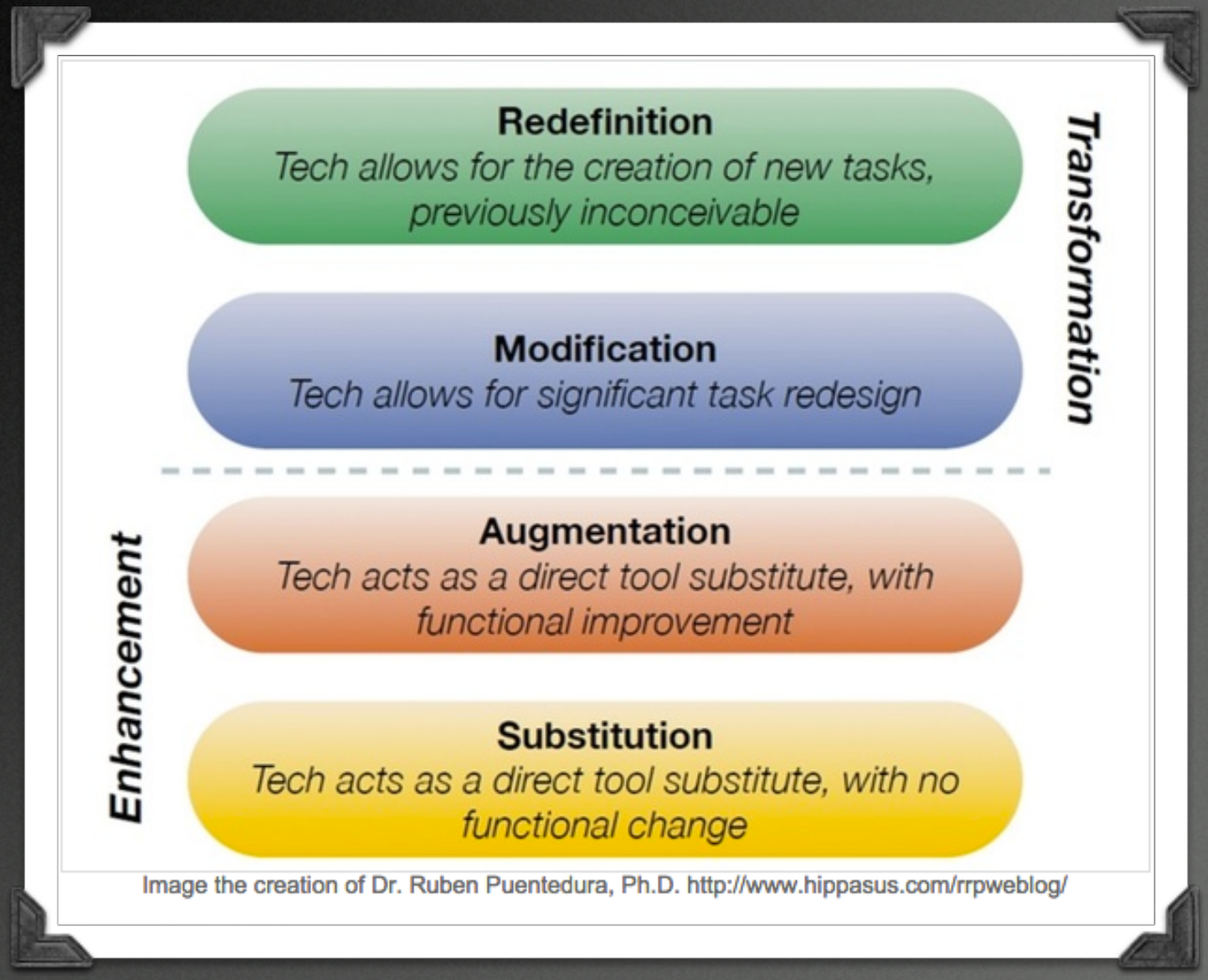


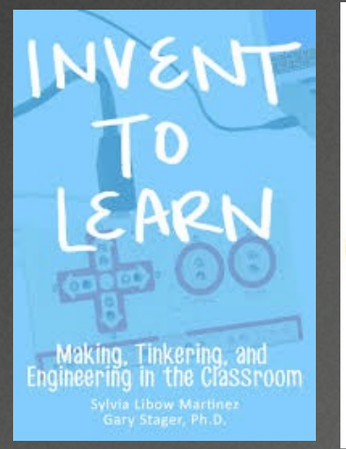
Image the creation of Dr. Ruben Puentedura, Ph.D. http://www.hippasus.com/rrpweblog/

Text & Standards

- **U.S. Department of Education: Educator Preparation Challenge**
- **Invent to Learn**
- **National Educational Technology Standards for Teachers**
- **National Educational Technology Standards for Coaches**
- **INTASC Standards**

Section 2

This section of chapter one focuses on the significant readings from the semester and the various standards PD3 students addressed through their work in the project. Beginning with the challenge by the U.S. Department of Education's office of Educational Technology to teacher preparation programs, PD3 students then read "Invent to Learn". This text provided students with a solid foundation in learning theory and challenged them to demonstrate how they might construct representations of their learning and the learning of their own students. From there, PD3 students reviewed the International Society for Technology in Education (ISTE) standards for teachers and coaches to help them understand what they should know and be able to do, but to also provide a frame for their work in the school and with students. Finally, the students examined the Interstate Teacher Assessment Support Consortium (InTASC) standards which articulate core teaching practices and behaviors that support K12 student learning in todays world.



Educational Technology in Teacher Education Challenge

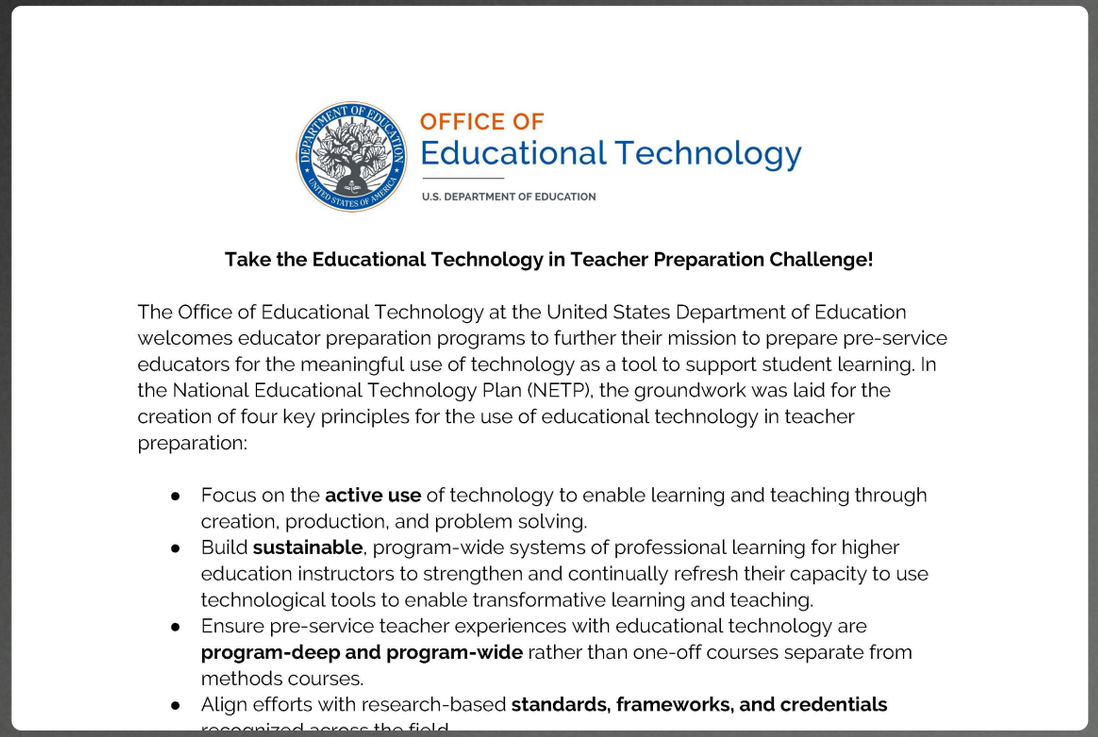
In 2016 the U.S Department of Education's Office of Educational Technology issued the Educational Technology in Teacher Preparation Challenge and encouraged teacher preparation programs to develop educators who can meaningfully use technology to support student learning. In conjunction with the 2016 release of the National Educational Plan, they identified four key principles for technology use within teacher preparation.

- Focus on the active use of technology to enable learning and teaching through creation, production, and problem solving.
- Build sustainable , program-wide systems of professional learning for higher education instructors to strengthen and continually refresh their capacity to use technological tools to enable transformative learning and teaching.
- Ensure pre-service teacher experiences with educational technology are program-deep and program-wide rather than one-off courses separate from methods courses.
- Align efforts with research-based standards, frameworks, and credentials recognized across the field.

Over seventy Teacher Preparation programs, including Ball State University, have signed onto the challenge.

The BSU Educational Technology program within BSU's Teachers College and the PD3 project works to meet this challenge. PD3 students modeled active technology use, aided in the development of a sustainable system-wide program for professional learning, and aligned their work with research-based standards and frameworks.

Gallery 1.1 EdTec in Teacher Education Challenge



OFFICE OF
Educational Technology
U.S. DEPARTMENT OF EDUCATION

Take the Educational Technology in Teacher Preparation Challenge!

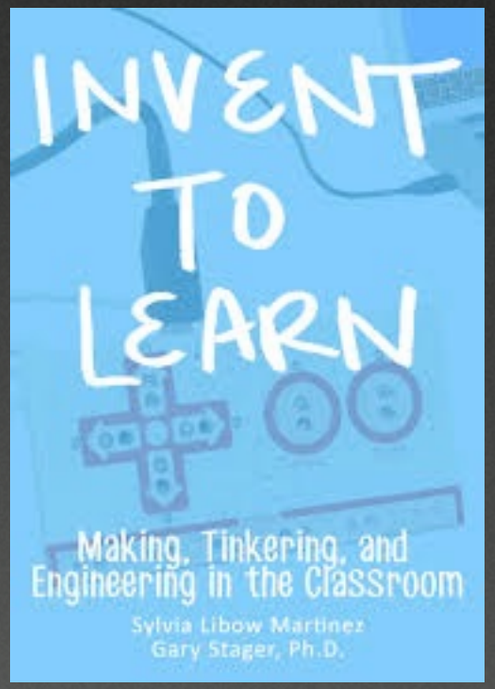
The Office of Educational Technology at the United States Department of Education welcomes educator preparation programs to further their mission to prepare pre-service educators for the meaningful use of technology as a tool to support student learning. In the National Educational Technology Plan (NETP), the groundwork was laid for the creation of four key principles for the use of educational technology in teacher preparation:

- Focus on the **active use** of technology to enable learning and teaching through creation, production, and problem solving.
- Build **sustainable**, program-wide systems of professional learning for higher education instructors to strengthen and continually refresh their capacity to use technological tools to enable transformative learning and teaching.
- Ensure pre-service teacher experiences with educational technology are **program-deep and program-wide** rather than one-off courses separate from methods courses.
- Align efforts with research-based **standards, frameworks, and credentials** recognized across the field.

Invent to Learn

Invent to Learn was the text PD3 students read this semester. The book by Sylvia Libow Martinez and Gary Stager, Ph.D. does a wonderful job of helping readers understand the connections between theory and practice, and provided candidates with a valuable lens through which they could conceptualize their work throughout the semester.

The text assisted PD3 students in thinking about the kinds of work they would be doing with MCS teachers and with children in the after school program. The specific chapters and sections of the text on learning, thinking, making projects, and teaching all helped the PD3 students consider not only their own experiences in both formal and informal instructional contexts, but how they might be able to construct learning opportunities for our community partners in ways that engaged the learners, allowed them to have agency in the learning process, and how they might construct representations of that learning throughout the process.

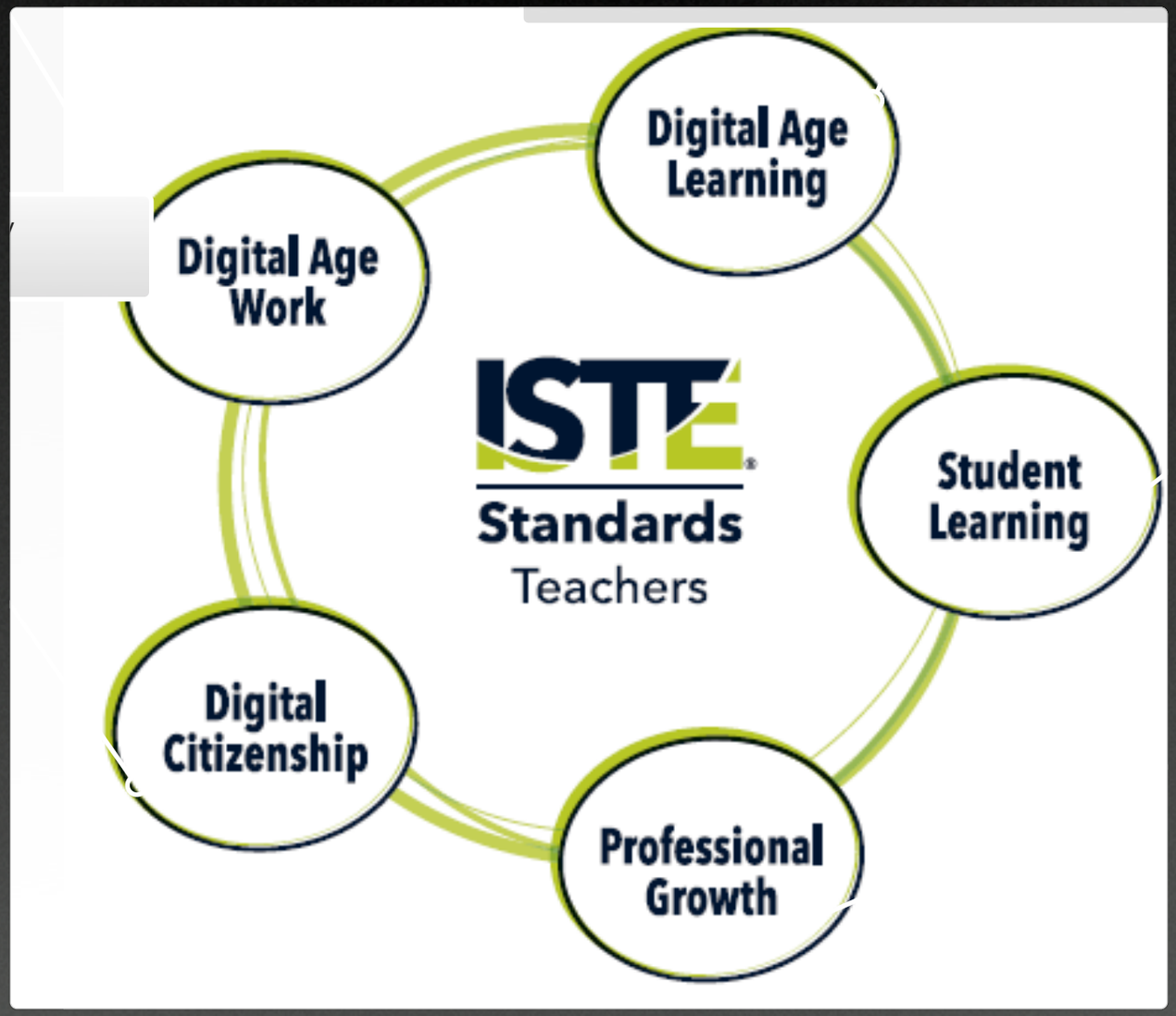


PD3 students were familiar with the learning theory constructivism from educational psychology and other education courses, but they were unfamiliar with the theory of constructionism. While constructivism describes the cognitive processing individuals do when they connect prior knowledge to new knowledge, constructionism goes a step further toward action. This movement from internal cognitive processing to active construction makes “learning real and sharable” (p. 31) and can be manifested in a variety of creative ways. Constructionist learning theory was first described by Seymour Papert.

Design models for learning was another area of the text that resonated with the PD3 students. The authors describe how design is an iterative process and how important it is for learners to understand this process. The PD3 students reflected on this within their own learning and work in designing learning opportunities for our partners. They recognized that they too were going through this process as they learned about Schoology and differentiated S.T.E.M. lessons for the elementary kids in the after school program.

NETS - Teachers

Interactive 1.1 ISTE NETS - Teachers



The National Educational Technology Standards for Teachers (NET-S) identify what teacher should know and be able to do in order to teach, learning, and work in a digital age. The standards stress the technological and pedagogical knowledge teachers need in order to make the most of the technologies they have available, how technological innovations can be used for continued teacher learning, and how they can model legal and ethical behaviors with technology in their professional practices.

PD3 students demonstrated these standards in a variety of ways throughout the semester. In their specific coursework they demonstrated ethical and legal uses of technology and sought a variety of external resources to engage content beyond the provided materials. They developed digital age learning opportunities that inspired creativity and for both MSC teachers, but also children in the Muncie P3 after school program.

NETS - Coaching

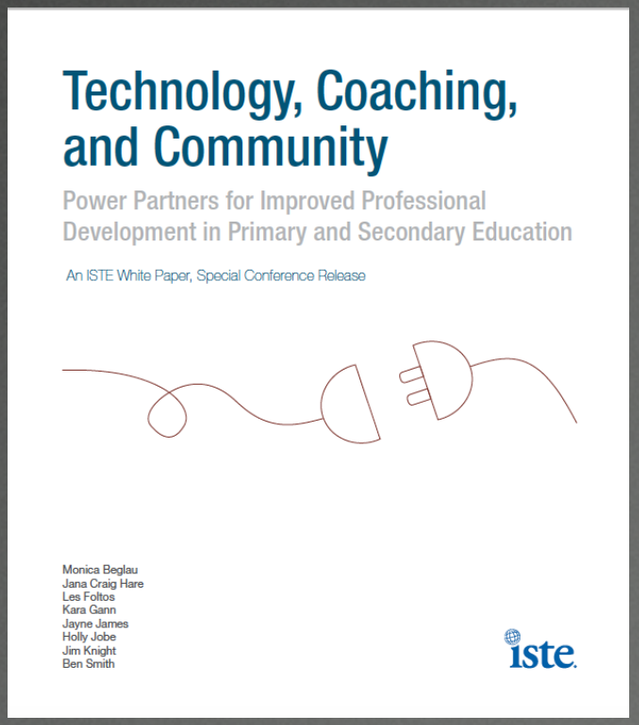
Interactive 1.2 National Education Technology Standards for Coaches

Digital Citizenship

Professional Development & Program Evaluation

The National Educational Technology Standards for Coaches (NETS-C) help to bridge the gaps between where teachers are regarding their technology use to support learning and teaching, and where they need to be. The NETS-C not only assists coaches in how they can aid teachers in designing, but also articulates the different ways they can assist in meeting district goals for technology adoption and integration within instructional contexts.

Along with studying the NETS-C, PD3 student read the ISTE White paper titled, “Technology, coaching, and community: Power partners for improving professional development in primary and secondary education”. This white paper emphasizes the importance of developing relationships. The paper also provides several suggestions and models to assist school systems develop high quality professional development opportunities for teachers.



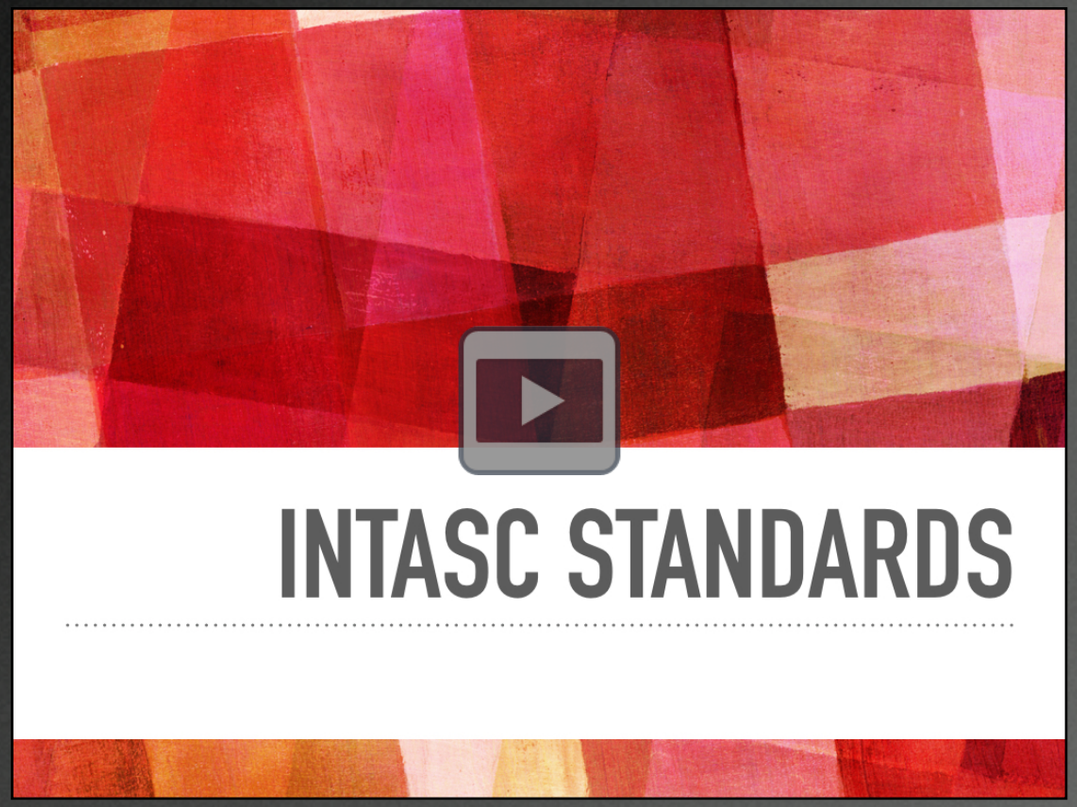
The Muncie Community School district identified that they needed assistance in preparing teachers to use the learning management system the district had purchased. MCS charged the PD3 students to develop professional develop materials and opportunities for teachers in the pilot program. The information from both the white paper and NETS-C provided new ways for the students to think about technology adoption and professional development. These materials also helped students in developing their activities and in their work with teachers throughout the semester.

INTASC Standards

The Council of Chief State School Officers (CCSSO), through its Interstate Teacher Assessment and Support Consortium (InTASC), offers a set of Model Core Teaching Standards that outline what teachers should know and be able to do to ensure every PK-12 student reaches the goal of being ready to enter college or the workforce in today's world.

This "common core" outlines the principles and foundations of teaching practice that cut across all subject areas and grade levels and that all teachers share. More importantly, these Model Core Teaching Standards articulate what effective teaching and learning looks like in a transformed public education system – one that empowers every learner to take ownership of their learning, that emphasizes the learning of content and application of knowledge and skill to real world problems, that values the differences each learner brings to the learning experience, and that leverages rapidly changing learning environments by recognizing the possibilities they bring to maximize learning and engage learners. A transformed public education system requires a new vision of teaching.

Interactive 1.3 INTASC Standards



Council of Chief State School Officers. (2013, April). Interstate Teacher Assessment and Support Consortium InTASC Model Core Teaching Standards and Learning Progressions for Teachers 1.0: A Resource for Ongoing Teacher Development. Washington, DC: Author.

Chapter 2

SCHOOLOGY

The main work by BSU students throughout the semester focused on assisting the Muncie Community School district in the adoption of Schoology, a learning management system (LMS).

This chapter describes the different activities by BSU students to understand the context where the LMS was being introduced, and how they addressed the various needs of the teachers involved in the Schoology pilot.

Preparation

- **School Visit to Avon Public Schools**
- **District Survey**
- **Pilot Teacher Survey**
- **How Initial Experiences and Survey Results Informed Actions**

Avon High School Visit

PD3 students were invited to accompany Muncie Community Schools administrators early in the semester to learn how teachers at Avon were using Schoology as an embedded part of instructional activities with students.

The trip provided BSU students with opportunities to engage with Avon teachers & administrators as well as MCS administrators who would be involved with Schoology adoption within the district. The BSU students observed several teachers using Schoology with their students.

During the classroom observations, Avon teachers had students respond to a discussion prompt within Schoology and then used the responses to discuss the topic in more depth. Another teacher had students working in “virtual stations”. Instead of student groups moving around the room in a traditional manner, students stayed with their partners, but utilized Schoology to navigate to different group activities the teacher had set up within the LMS. This allowed for a more efficient use of class time for student learning. Students in this class also were accessing Schoology on a number of different devices. Some used a school laptop, but several used their own device such as an iPad, cell phone, or personal laptop computer. In another classroom, the teacher had set up a quiz that students took at home. The teacher then used student responses to review concepts that the students missed. BSU students also engaged the high school students and asked them about their Schoology use. The high school students liked how all of their information was in

one location, and that they could access to assignments and courses from any device.

Avon teachers described the values of a shared vision and planning when it came to Schoology adoption in a conference session with visitors. They told visitors how Schoology allowed each of them to share resources in a centralized location, and that any of the teachers could access the resources. This feature allowed them to tailor their individual instruction, but also allowed them to have consistent curriculum across the various sections of the same course. In the final meeting of the day, the districts' instructional coach spoke with the visitors and shared how her role helped teachers who may not have as much technical knowledge, become comfortable using the LMS. She stressed that engaging teachers about their content was the key in helping with the Schoology adoption.

PD3 students reflected on the observations and discussions. The students highlighted the conversations with teachers and how their shared planning, resources, and communication helped make use of Schoology meaningful for students . They also expressed how important the role of administration was in creating a shared vision toward Schoology adoption. This shared vision set expectations for adoption throughout the district. District leadership also developed support mechanisms to aid teachers in the adoption process. This was highlighted by the development of the instructional coach position. PD3 students took special notice of this role in aiding in the adoption process by meeting teachers wherever they are in their knowledge of using an LMS, and then moving forward from there.

As BSU students continued to reflect on the visit, it became clear to them the value of finding out more about Munice schools, the teachers levels of technology knowledge, and the teachers knowledge and experience using a learning management system.

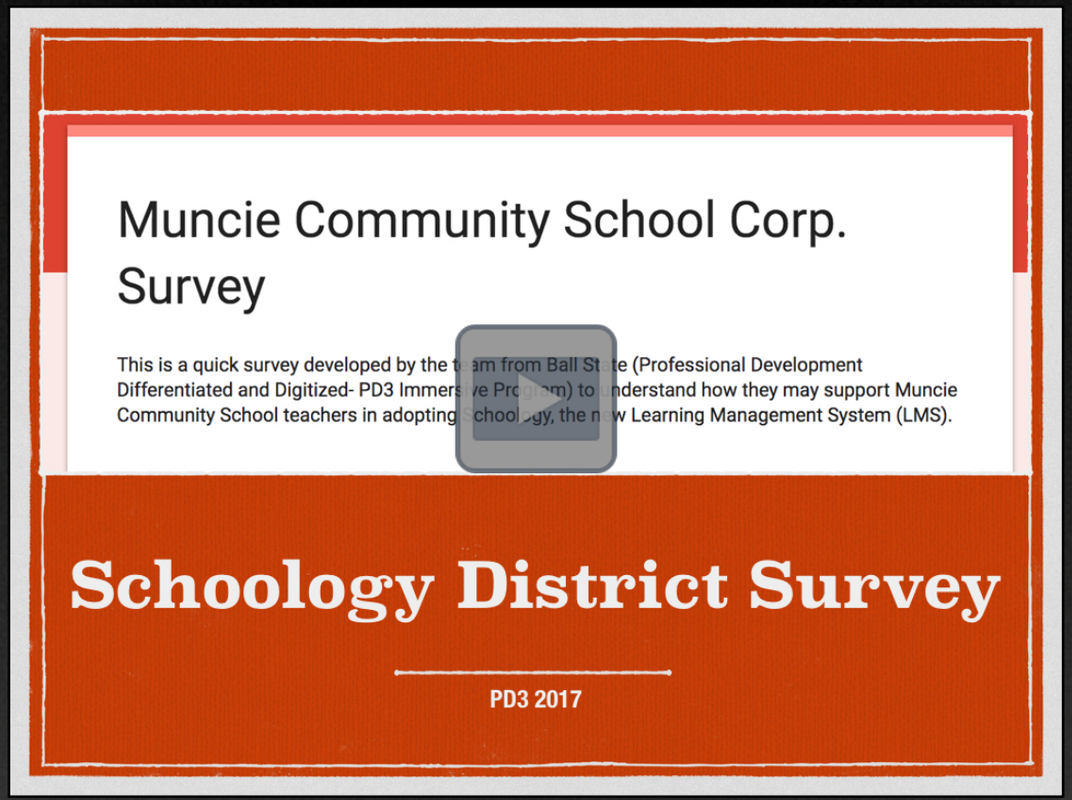
District Schoology Teacher Survey

Following the visit to the Avon high school PD3 students undertook the task of finding out more about Muncie Community School teachers, ways they currently use technology, and their level of knowledge about the new LMS. We had 66 teachers respond to the district wide Schoology teacher survey.

Results indicated that teacher felt comfortable using technology generally and several of them utilize Google Docs and YouTube videos within their classrooms. The majority of respondents had not starting using Schoology at all, but those who had were uploading content, creating content, or doing general exploration within the LMS. Teachers expressed concern about migrating to the Schoology LMS. The largest concern (62.3%) was the capacity of the existing district technology infrastructure to handle use of the LMS. The second and third largest concerns (both 34.4%) of those who completed the survey indicated that learning the LMS would be time consuming and other undefined concerns about migrating to Schoology.

A clear majority of respondents (84.6%) indicated that they would be, or might be, interesting in attending an information session on Schoology. When asked which times worked best for these information sessions, respondents indicated directly after school (61.1%), during their Professional Learning Community (PLC) time

Interactive 2.1 District Schoology Teacher Survey



once a week (53.7%), and during their planning/preparation time (20.4%) as the three best times to learn more about the LMS. In response to the question asking how teachers would prefer to learn how to use Schoology the majority (53.3%) preferred a combination of approaches. Choices included formal instruction (8.3%), a partner from the MP3 team (20%), and working independently (15%).

Short answer responses about professional goals teachers would like to accomplish with the new LMS ranged from basic knowledge and information about Schoology, to ways for teachers to work more efficiently, and ways to improve student responsibility and use of digital devices provided by the district.

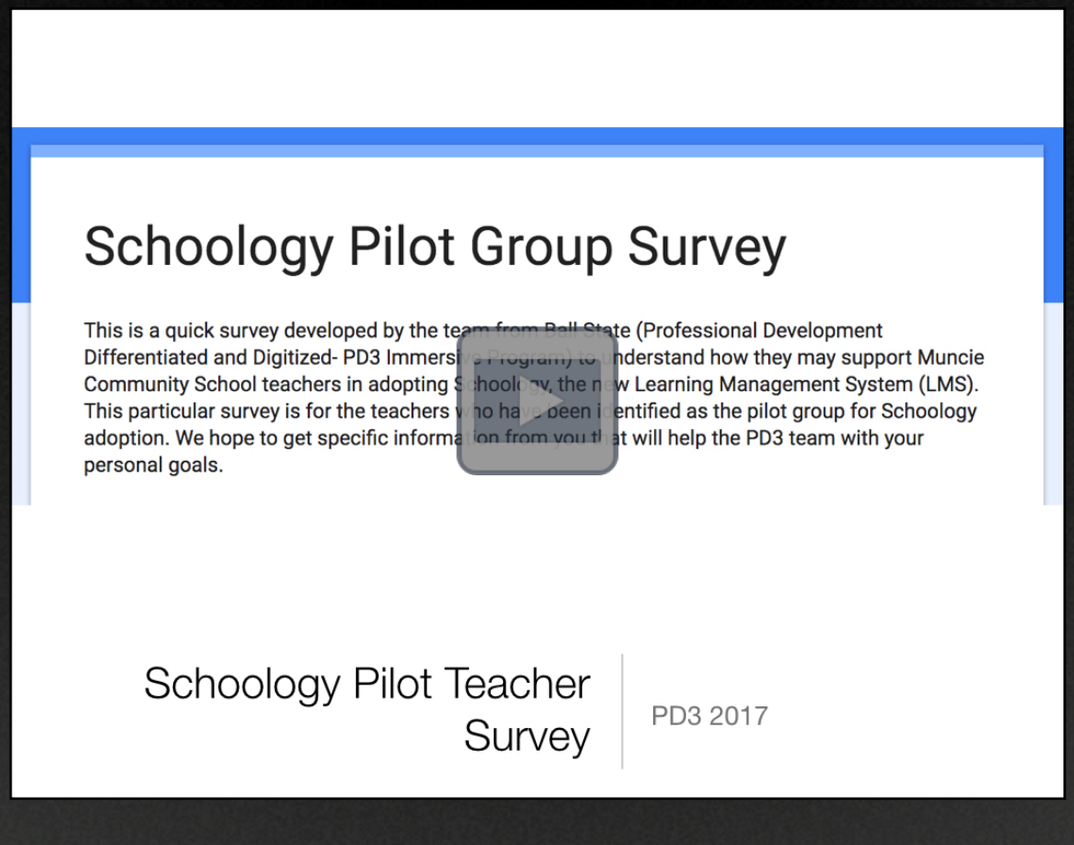
Schoology Pilot Teacher Survey

PD3 students decided to follow up the district wide survey with one more focused on the teachers who were part of the Schoology pilot teachers for Muncie schools. After reflecting on the initial survey sent to teachers throughout the MCS district, students decided to refocus several of the questions in an attempt to understand the different ways teachers were already using technology and how they were asking students to use technology to demonstrate their knowledge.

The Schoology pilot teacher survey was sent to 25 teachers who were identified by MCS administration as being part of the Schoology pilot program. Eleven teachers responded to the survey.

The first four survey questions attempted to find out more about how teacher in the pilot group used technology within their professional practice. The first question asked teachers to respond to how often they used technology in their own professional practices (ie. creating lesson plans, locating resources, developing instructional aids, etc...). On a five point likert scale ranging from one being “not at all”, to five being “daily”, eight respondents (72.7%) identified they used technology for their professional practices daily. The second question asked how often teachers used technology for their professional development (ie. webinars, professional learning communities, national organizations, workshops, etc...). on a five point likert scale ranging from one being “not at all” to five being “it’s my preferred choice”, the majority of responses 6 (54.5%), identified three on the scale, with four other participants (36.4%) identifying two as their choice. The third question asked to what extent do students use technology in classrooms to demonstrate their knowledge of content.

Interactive 2.2 Schoology Pilot Teacher Survey



Again, a five point likert scale was used with the range of one being "access materials and resources you prepare and identify" to five being "student creates or develops their own products". The range of responses were 1 (9.1%) for 1 , 2 (18.2%) for 2 , 6 (54.5%) for 3, 2 (18.2%) for 4, and 0 for 5. In the fourth question teachers were asked to identify specific technologies and whether teachers had used them in their classrooms. Similar to the district wide survey, teachers in the pilot survey used YouTube (100%) and Google Docs (81.8%) most frequently. Pilot teachers also had begun using Schoology (54.5%) and had developed their own web sites (45.5%) for their courses.

81.8% of the teachers in the pilot survey had already begun digitizing their instructional materials and 72.7% of them had already started using Schoology in some way. When asked which features within Schoology they had experimented with, 8 (100%) of the teachers had started to add materials to the LMS. 7 (87.5%) had added integrated third party resources like Google Docs, YouTube, Khan Academy etc.... 6 (75%) had communicated with other teachers and/or students through the LMS. 5 (62.5%) had created a quiz or test within the Schoology interface.

When asked about which Schoology features teachers in the pilot group were interested in mastering, teachers identified things like conducting and grading quizzes/test through Schoology, integrating Google Drive, and creating content within the LMS. Teachers in the pilot group indicated that the best ways for them to learn about Schoology were "formal instruction" (0%), "I can learn on my own, just give me a few days to tinker with it" (3=27.3%), "Individual partner with a member of the PD3 team" (3=27.3%), "A little bit of both. Give me tasks to accomplish. but I don't think I need that much instruction" (4=36.4%), and "Give me a safe place to tinker with support if I have questions" (6=54.5%). Similar to the district wide survey, teachers in the pilot survey also indicated that the best times to conduct professional development sessions would be after school (7=70%), during Professional Learning Community time once a week (7=70%), and during their preparation and/or planning period (4=40%).

The short answer question in the pilot survey asked teachers what they would like to accomplish with the new LMS and the PD3 team from Ball State. Responses to this question also emphasized using the

LMS for assessments, but the responses also highlighted challenges related to the technology infrastructure of the district. this included comments related to the reliability of the wireless network and students not having digital devices to access the new LMS.

Research on Muncie Community Schools

Another outcome from this initial work by candidates was an understanding that they did not know very much about the Muncie community school district, what had been the district's past attempts at technology adoption, and what factors may be playing a role in the success or failure of those attempts. While candidates were gathering data from the surveys, they also began to investigate recent developments within the school district. This investigation lead to several newspaper articles describing school closings, reductions in enrollments, teacher contract negotiations, and financial challenges for the district. Awareness of these issues guided the candidates in how they wanted to approach the professional development of teachers within the district. The issues continued to play a role in their work with teachers throughout the semester.

How Initial Experiences, Survey Data, and Research Informed Actions

The trip to Avon high school and the various data from the two surveys guided PD3 students next steps in working with Muncie teachers in their adoption of Schoology. PD3 candidates focused on the concept of being Schoology coaches and developing a learning context for teachers that was nonthreatening, and where teachers felt welcome to ask questions while being supported in the adoption of this new learning management system.

PD3 candidates focused on a "ground up" approach intended to engage teachers in ways that supported their existing instructional practices, but one that would also challenge teachers to stretch themselves to do more within the LMS. The next section will describe the work of students and how they assisted teachers in the Schoology pilot program.

Schoology PD Implementation

- **Schoology PD Course Development**
- **Schoology PD Work Room**
- **Mentoring / Coaching Activities**
- **District Schoology PD Session**

This section describes the different activities and projects PD3 students undertook in their efforts to assist Muncie Community School teachers who were part of the Schoology pilot program. PD3 student work moved rapidly following their trip to Avon High School. They began meeting at Muncie Central High School. They were given a tour of the high school and access to a workroom where they could meet with teachers, hold class sessions, and plan their work with teachers. Once PD3 students were given access to the MCS Schoology system, they began to explore the LMS and brainstorm how they might begin their work with Muncie teachers. Students were encouraged by the levels of collaboration of teachers and the different ways they observed the teachers and their students using the LMS for instructional activities at Avon high school. They hoped to develop a similar learning environment for teachers in the Muncie Schoology pilot program.

Schoology Professional Development Course Development

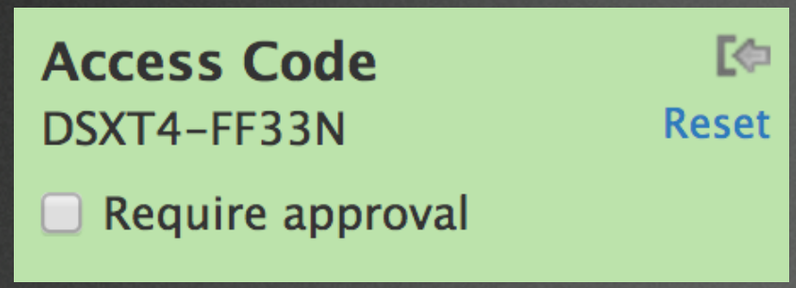
PD3 students were eager to learn more about the Schoology LMS following their visit to Avon High School. Students searched through existing resources from Schoology, as well as YouTube, and other Internet resources to learn about the system. After exploring available resources, PD3 students began brainstorming the various ways they might engage MCS teachers to begin interacting with the Schoology interface and developing instructional materials they could use with students. PD3 students decided to develop their own course within Schoology.

The students began planning the professional development course within the Schoology LMS interface. The course would be entirely focused on professional development, and be organized in a way that allowed teachers to investigate the course based on their interests and needs. The course's organization centered on topics teachers would need to develop their own courses within Schoology. PD3 students identified "Profile", "Home", "Courses", "Groups", and "Resources" as the five primary headings to organize their resources. These headings corresponded with the four main menus in the Schoology interface with "Profile" added as a starting place for teachers who may be using Schoology for the first time. PD3 students created sub-categories with additional resources, video clips, and

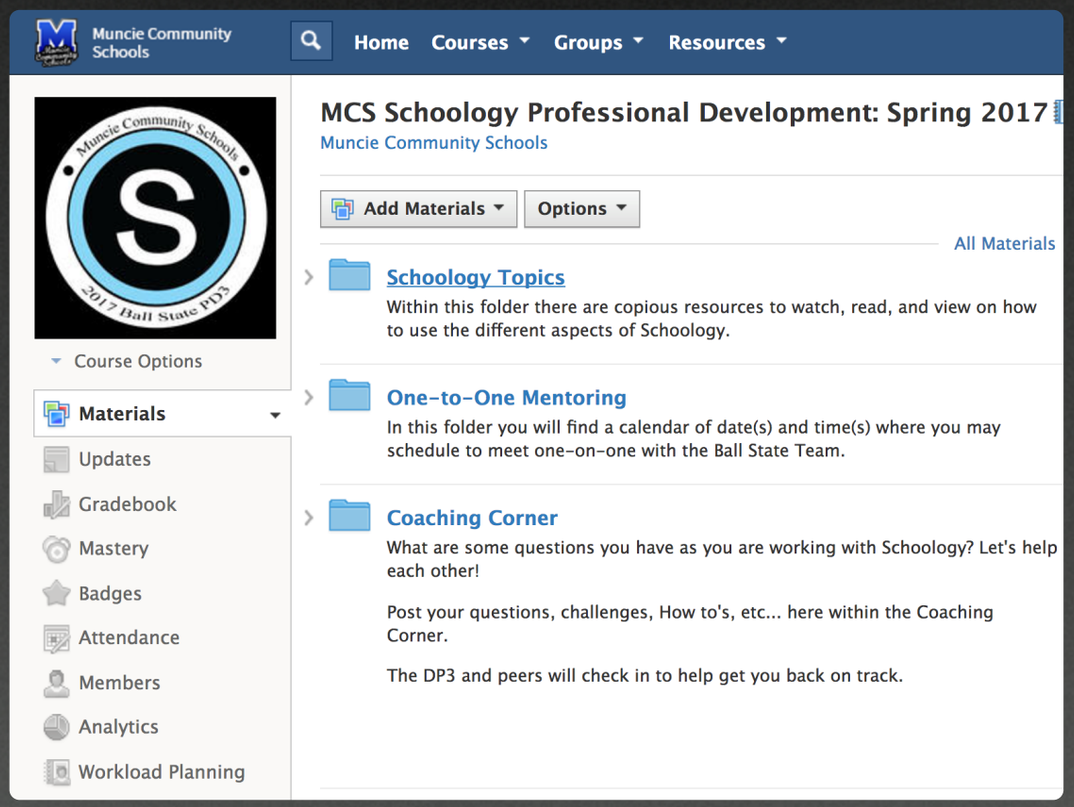
written documentation within each topic area,. This way teachers could easily look for and locate information they might need. Once the basic organizational structure of the course was determined, PD3 students set out to create their own video screencasts that would introduce various sections of the course and to catalog additional resources focused on different topics.

Work on the MCS Schoology Professional Development Course continued throughout the semester. As PD3 students discovered new resources, such as Open Educational Resources (OER), or had questions as they worked with pilot teachers, they collaborated with each other and problem-solved the issues and then added their new discoveries to the PD course.

PD3 students shared the course with pilot teachers and MCS administration once most of the materials were prepared. An access code to the course provided pilot teachers access to the PD course. This code was emailed to all the teachers in the pilot program and to MCS administration. It was also shared individually with teachers as students met with them in their personal coaching sessions. Eventually the access code was shared with other teachers in the district who participated in a district-wide professional development session.



Gallery 2.1 Schoology PD Course Development



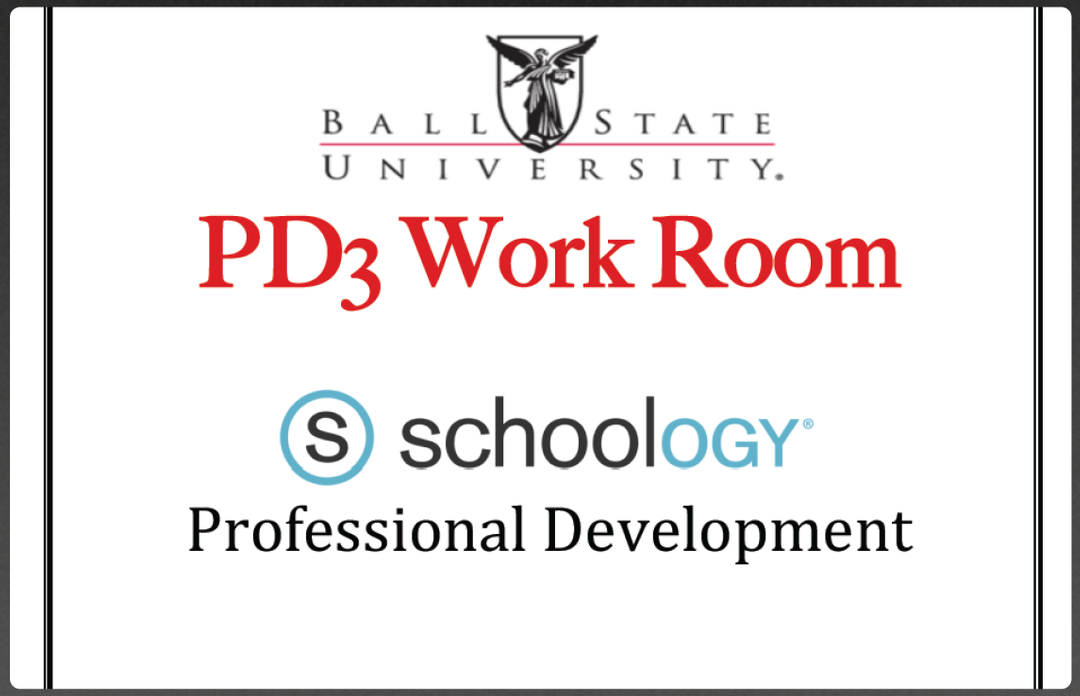
Schoology PD Work Room

While PD3 students worked on the Schoology professional development course, they also wanted to address feedback they received from teachers on two Schoology surveys that were sent earlier in the semester. Responses from teachers indicated that they felt comfortable with technology, but wanted time and a space to work with Schoology. They also indicated that the preferred types of support were ones where support was available in case teachers had difficulties or just needed a little help to get themselves started. They were not in favor of traditional forms of PD that tended to show details

of a technology, but left out connections to teachers content or grade level. Taking this information into account, PD3 students designed the PD3 Schoology workroom space that was welcoming and inviting to teachers. Students printed posters of some of the different frameworks they had read about along with other posters intended to assist teacher think about the different ways k12 students might use technology to demonstrate their knowledge and understanding of content.

Students organized a PD3 workroom open house and invited teachers to attend once the room was set up the. The goals of the open house were to introduce Schoology pilot teachers to the PD3 students, to register the teachers into the MCS Schoology professional develop course, to engage teachers in some initial discussions about what they would like accomplish with Schoology, and to exchange contact information so that the PD3 students could then follow up with regular meetings with the teachers.

Gallery 2.2 PD3 Workroom, Open House, & Communication



Mentoring / Coaching Activities

PD3 students divided up teachers within the pilot program in order to establish personal meeting times after the Schoology work room open house. A personal email was then sent to each teacher from the student who selected to teacher they were to work with. PD3 students also followed up the emails with attempts to see the teachers in their classrooms during planning periods or after school. Once student made initial contact with the the teachers, they were suppose to set up regular meeting times with the teachers so that they could establish learning goals and a timeline to accomplish those goals.

These meetings were focused on helping teachers identify specific features of Schoology they would like to learn and to engage teachers in a dialogue about technology use within their instructional practices. Teachers within the pilot program had a varying degrees of technology knowledge and specific knowledge of Schoology. The individual coaching sessions were intended to meet the teachers where they were and to not force teachers into something they were not ready to do. This incremental approach allowed teachers to develop their knowledge and skills as they identifies their own needs. It allowed PD3 student coaches to learn more about content and the challenges of technology adoption within complex school contexts.

Some examples of the range of activities and how teachers progressed through out the semester include teachers or building administrators who were accessing Schoology for the first time, developing their profiles, and learning about several of the basic features. For example, one assistant principal did not have the opportunity to work with Schoology prior to our project. Once he got access to the system, he wanted to learn more about establishing groups. This feature could be a useful way to improve communication for clubs, sports teams, and other student groups within the school.

Some teachers had several of the Schoology basics already mastered, but were looking for ways to use the LMS for instructional activities. They wanted to use the LMS to engage students immediately at the beginning of class for “Bell Ringer” activities so that students would focus on content topics and be ready for continued instruction. Other teachers were involved with digitizing existing materials and identifying a variety of web resources that could be saved within the Schoology system.

More advanced teachers looked for assistance in finding specific solutions for their content areas. PD3 students helped these teachers by researching specific Schoology apps that could serve as “add-ons” to the existing Schoology interface or link to external web resources. For example, Schoology has the capability to connect to a teachers existing Google Drive. This way a teacher would not have to duplicate existing materials, but simply share them with the School interface. The teacher can control what folders and files students see within the Teachers’ Drive.

PD3 students spent the reminder of the semester working with individual teachers. By the end of the semester a few teachers wanted to try activities with their classrooms. PD3 students worked with the teachers to develop activities, but device availability and scheduling issues prevented the activities from taking place before the end of the spring 2017 semester.

District Schoology PD Session

Muncie Community Schools Curriculum Director Cassandra Shipp invited PD3 students to collaborate with MCS teachers from the Schoology pilot program to plan, develop, and conduct a professional development session for teachers around the district on Schoology toward the end of the semester. The PD session would be a basic introduction to several of the features within Schoology and would be intended for teachers who had heard about the districts adoption of the learning management system, but had not had an opportunity to explore the interface. PD3 students and teachers had about one week to plan for the session.

Teachers from the pilot program, PD3 students, and faculty met during one of the programs regularly scheduled meeting times after school at Central high school to plan for the PD session. Two of the teachers, Jenn Jensen and Drew Shermeta had previously conducted a PD session on Schoology at a district-wide PD day in January. The third teacher was a middle school science teacher and was the primary Schoology user in his building.

After some discussion about the time and place of the PD session, the group brainstormed ideas for PD session. The teachers shared their

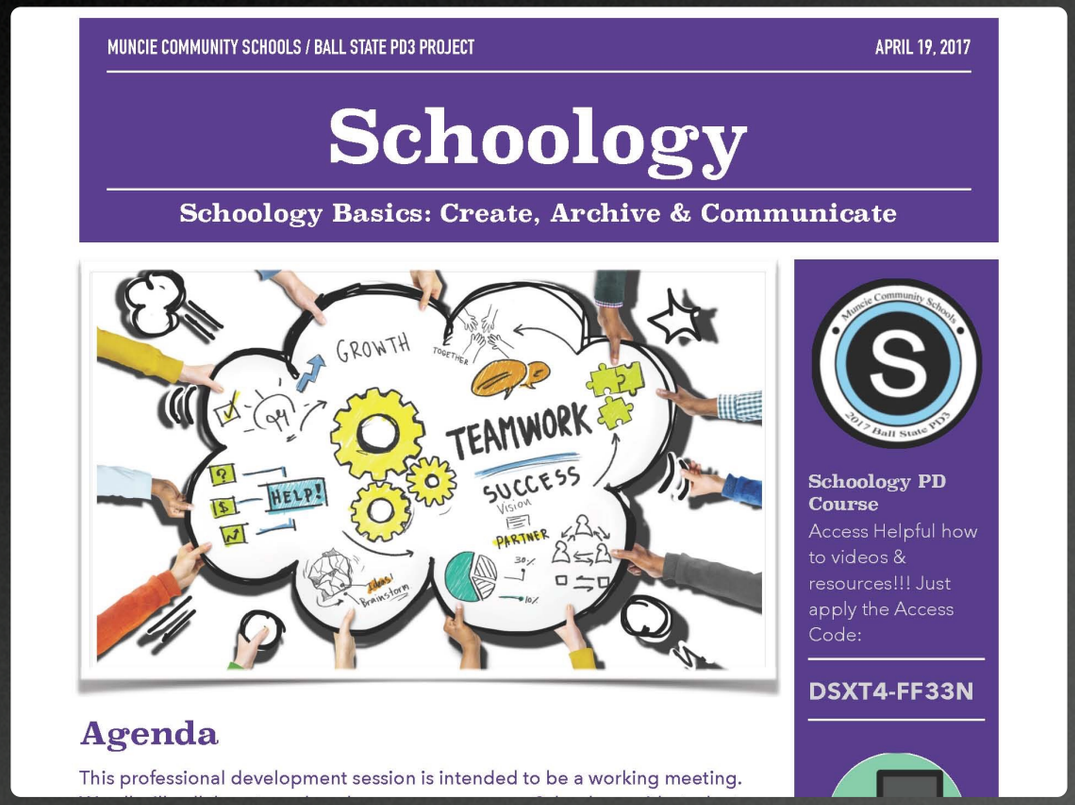
prior experience and materials from past sessions. These included a "how to" guide and an "A to Z" list of activities teachers and students could do with Schoology. During the discussions about the organization and pedagogy of the session itself, all agreed that the session should not be a traditional PD session where presenter stand in front of the room and show attendees features of a technology while they sit passively and unengaged. Instead, the group decided to create a session that engaged attendees in meaningful activities directly connected to their own classrooms, content, and students. This workshop approach was intended to be a working session for teachers that would produce a tangible outcome by the end of the session.

Once the organizers had a list and emails of those who would attend, they sent the attendees a welcome email with session fliers, access codes to two different Schoology courses, and a list of materials teachers would use during the session. The planned organization of the session would utilize PD3 students in describing the MCS Schoology Professional Develop course within Schoology and have them facilitate individual discussions with teachers, troubleshoot problems teachers may encounter with Schoology, and to work along side teachers as they began developing materials within the Schoology interface.

On the day of the workshop, session leaders arrived early to prepare the room and make sure there were additional devices available for all attendees. The session itself had a blend of demonstration and work time for teachers. Pilot teachers shared their prior uses of Schoology within their own instructional contexts. From there, PD3 students shared some basic information about the PD course they had developed within Schoology and how teachers in MCS could access the course. Two separate breakout sessions allowed attendees to work along side PD3 students, pilot teachers, and faculty to troubleshoot, problem-solve, and consider ideas for Schoology use by teachers.

Initial feedback at the end of the session indicated that teachers in attendance believed the workshop was effective and provided them with ideas and support for using Schoology in the future. Organizers of the workshop were encouraged to conduct a follow up session at district PD during the summer.

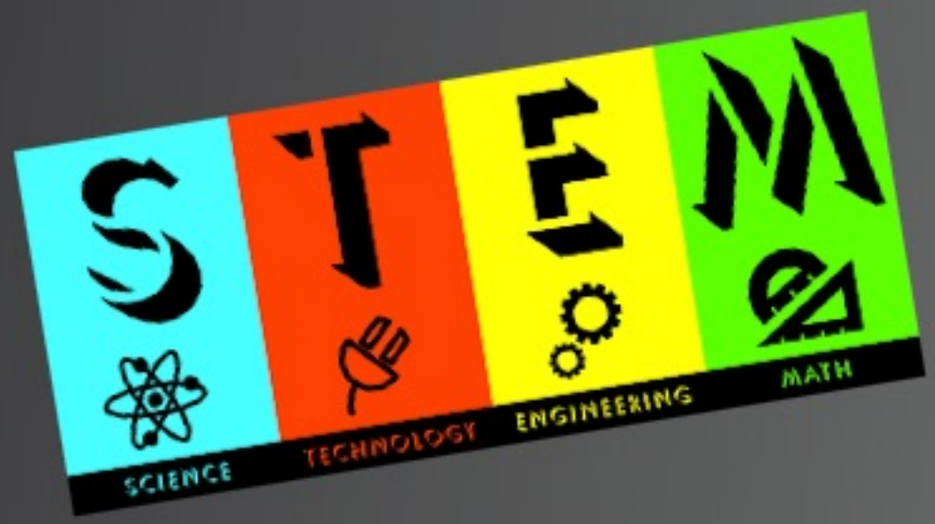
Gallery 2.3 MCS District PD Session



Chapter 3

S.T.E.M. UNIT DEVELOPMENT & IMPLEMENTATION

PD3 students conceptualized, planned, and implemented a four week S.T.E.M. unit for an area after school program. The unit was taught three times for a total of twelve weeks. Focusing on electricity and circuits, PD3 students created a variety of hands on activities and made use of several different technologies. The unit was differentiated for first, second, and third graders.



squishy circuits™

Makey Makey™

LAB

S.T.E.M. Unit

PLANNING PROCESS

- **Preparation**
- **Planning: Unit Lesson Plans**
- **Differentiation**
- **Assessment**

Early in the semester PD3 students were challenged to create a S.T.E.M. unit for children participating in an after school program. The students leapt at the challenge and constructed a four week unit focused on circuits and electricity. Each week BSU students created engaging lessons and activities that utilized different technologies, but did so in ways that allowed 1st, 2nd, and 3rd graders to learn in meaningful ways. They then taught the lessons and modeled the instructional strategies with technology for teachers and aids in the after school program. This chapter discusses the preparation, planning, implementation, and assessment of the circuits unit.

Preparation

Program faculty were approached by staff from the Muncie P3 after school program about the possibility of developing S.T.E.M. activities for 1st, 2nd, and 3rd graders in a four week rotation during the semester. Lessons would take place on Friday afternoons, function as a way to expose students in these early grades to Science, Technology, Engineering, and Mathematics (S.T.E.M.) content, and to model hands-on, creative teaching strategies.

In preparing to plan the unit lessons, PD3 students had to decide on what content to cover, how they wanted to teach that content, and what kinds of technologies may be available to support instruction and engage students in meaningful ways. They were not familiar with some of the new technologies available, and expressed concern in developing a unit without spending time with the technologies they might use with children in the after school program.

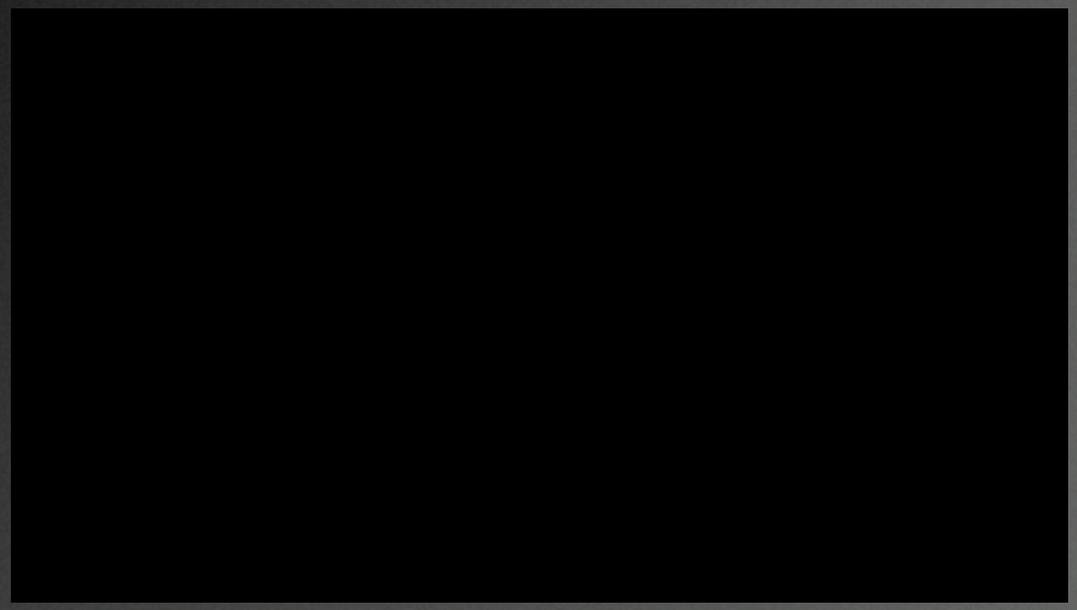
Following suggestions with the “Invent to learn” text and other readings profiling technology use with children, PD3 students spent time exploring a variety of technologies and discussed how they might be used with kids. Some of these technologies included augmented reality, virtual reality, 3d scanning and modeling, 3D printing, robotics, coding, and other technologies. This time to explore was vital in helping the PD3 students learn about the technologies, but it also helped them to think critically about how

Technology Exploration

different technologies might be used within teaching and learning contexts. They also asked questions about the types of instructional strategies they would utilize with the children. Once the PD3 students had spent some time exploring, they began to consider ideas for the development of a four week S.T.E.M. unit for the after school program.

Another element of their planning was to learn about the children they would be working with. To do this, PD3 students read about the history of the Whitely community where the elementary school is located, and where most of the children live. They visited the Civil Rights museum at Shaffer Chapel to learn more about the community's strong cultural and historical heritage, and how the community continues to lead several initiatives to improve the lives of people in Muncie Indiana. Watch the embedded video (Movie 3.1) to learn more about the Whitely community and the Shaffer Museum.

Movie 3.1 Shaffer Museum



The PD3 students also visited the Connection Corner. The Connection Corner is a Digital Media Center and branch of the Muncie Community Library The Connection Corner is located directly across from Longfellow elementary school and is a location for several children to go after school. Directors of the Connection Corner have established several digital activities for the kids including 3D printing, video editing, digital design, and audio recording. After the visit, PD3

students were excited about creating active and engaging activities for children in the after school program.

In order to learn more about context of the after school program, PD3 students toured Longfellow elementary school. While visiting the school, PD3 students were able to visit the classrooms and speak with teachers in the after school program. They learned more about the typical schedule for the children and discussed how they might differentiate the lessons so they would be successful in the elementary classrooms.

Planning: Unit Lesson Plans

The PD3 students and faculty brainstormed possible ideas for a instructional unit and utilized the Technological Pedagogical Content Knowledge (TPACK) model as a helpful tool in narrowing down ideas and to consider the variety pedagogical approaches and technologies we might use in the different lessons we would design. PD3 students examined state standards for each grade level, science and mathematics standards, and National Educational Technology Standards for Students (NETS-S) to help them identify what children should know and be able to do with content and technology.

Student ideas coalesced around circuits and electricity as the concepts they would focus on in their unit after they investigated a variety of standards, explored a variety of different technologies, and discussed learning theory and pedagogical strategies that provide children opportunities to construct their own knowledge. PD3 students wanted to create engaging lessons that allowed the children make connections with their prior knowledge and experiences, to scaffold the lessons and activities each week, to provide students different technologies to demonstrate their learning, and to model instructional practices for teachers and aids in the after school program.

PD3 students recognized that they were also working through a instructional design process in an active and constructionist manner. While planning and designing the lessons, PD3 students addressed several of the ISTE NETS-T and INTASC standards including ones focused on planning for instruction, designing digital age learning experiences, and modeling professional practices. An added element was that PD3 students were than able to actually enact the lessons and activities they had designed.

Some examples of ways PD3 students utilized different technologies in their planning included Google Docs to collaborate and edit each of the lessons. They also integrated digital photography, hyperlinks, youtube videos, and the Internet to locate additional resources into the lesson plans. In addition to the collaborative planning, they also gathered various materials (conductive dough, clay, foil, fuzzy sticks, tape scissors, etc... for use with the lessons.

Complete lesson plans can be accessed in chapter six.

APPENDIX 1: LESSON ONE: WHAT IS A CIRCUIT?

Week one of the S.T.E.M. unit focused on the basics of electricity and construction of a circuit. In their research and exploration, PD3 students located the “Squishy Circuit” materials that have been developed by Dr. AnnMarie Thomas at the University of St. Thomas in Minneapolis Minnesota. Squishy Circuits use conductive and non-

conductive dough, Light Emitting Diodes (L.E.D's), and a battery pack as a creative and playful way for young children to learn about the basics of electricity and circuits.

The lesson PD3 students developed involved both large group and small group activities. The elementary children were able to move and be physically engaged during the lesson. They also had creative independence to construct their own creators and circuits using the different types of dough. Check out some of the creative Squishy Circuit Creations in image gallery 3.1.

Gallery 3.1 Squishy Circuit Creations

1 of 16

APPENDIX 2: LESSON TWO: CONDUCTIVITY

The second lesson in the S.T.E.M. unit built off of the previous weeks work with squishy circuits, and focused on different types of materials and whether they are a conductor or a insulator of electricity. In order to engage the elementary kids, PD3 students developed a lesson that utilized Makey Makey construction sets so that the kids could run experiments and reinforce their understanding of circuits.

When connected to a computer via the USB connection, the Makey Makey's allows the user to transfer some keyboard controls to whatever is connected to the Makey Makey. Using alligator clips, the user can control the mouse click, direction keys, and other keyboard keys. The alligator clips are then connected from the Makey Makey to anything that is conductive. If the object is conductive it will take the place of the standard keyboard key to control the input to the computer. For example, a user may connect a banana to the Makey Makey and anytime the user touches the banana the computer curser adds a space.

PD3 students set up stations for small group work so that children could test a variety of objects and control whatever might be on the computer screen. As part of their planning, PD3 students thought that a fun way to engage the children would be to have they play a video game as a way to test conductivity. They investigated a variety of websites with video game emulators and eventually searched the Scratch website for a variety games and sounds that could be controlled with the Makey Makey.

In the first small group activity, elementary students tested items such as oranges, carrots, gummy worms, coins, erasures, wood and straws to see if they were conductive. For example, if the students were trying to move a character through a maze, the item connected to the Makey Makey would need to be conductive. If not, the character would not move. The elementary students also needed to apply their knowledge of circuits to make the character on the screen move. If they were not completing a closed circuit nothing would happen. As soon as they completed the loop, allowing electricity to pass from the computer, through them, and then through the conductive item they were touching, the character would move.

In the second activity, after school students rotated around the room to play different games located at each station. This allowed them to once again apply and transfer their knowledge to different situations and with different materials. Check out image gallery 3.2 to see some examples of how PD3 students and the after school kids created circuits and tested conductivity with Makey Makey's.

Gallery 3.2 Testing Conductivity with Makey Makey

1 of 12

APPENDIX 3: LESSON THREE: THE DESIGN PROCESS

The third week of the S.T.E.M. unit asked kids in the after school program to use their creativity, to collaborate, and to work through the design process, as they designed and tested their own electric vehicles. Since the previous two weeks had the children specifically focus on the characteristics of a circuit and to construct circuits out of different materials, the third week was intended to have the kids think creatively about the future of electricity and how they can be engineers and designers. Prior to the activities for the week, Teachers were provided a copy of "Going Places" by Paul and Peter Reynolds to read to students. The book inspirers children to use their imagination and to think creatively.

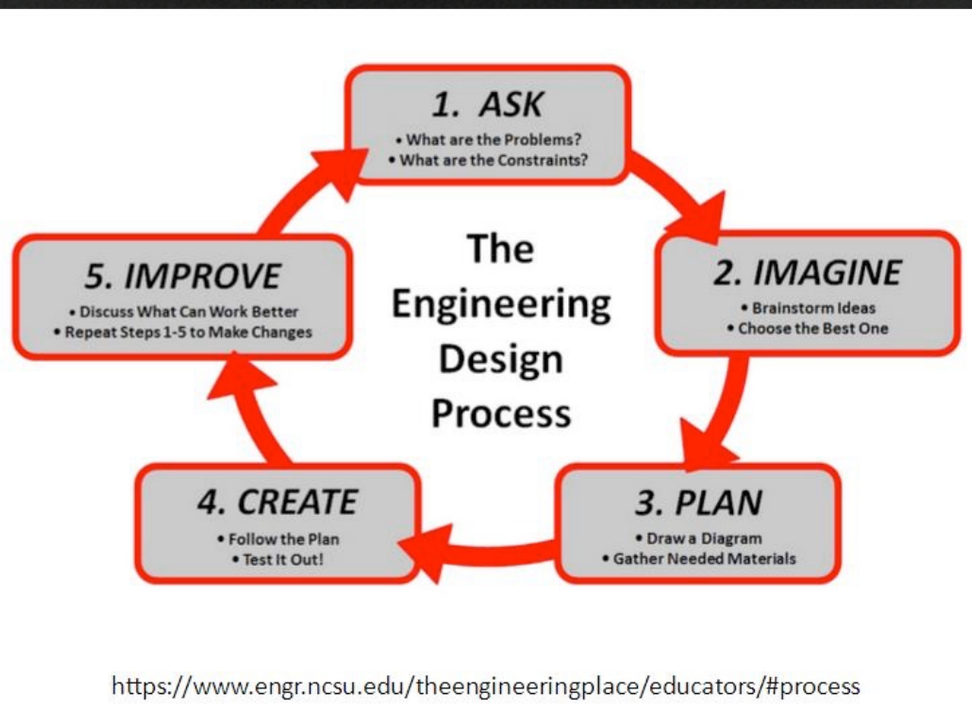
After reviewing the terminology and activities of the first two weeks, the group leader in the third week presented children with a challenge, "can they create a mode of transportation powered by electricity?" The criteria provided to each team was intentionally kept vague as to allow for the kids to have ownership over their creation. The few guidelines were given to the kids:

* The mode of transportation has to travel around a track and be driven by each member of the team.

* The mode of transportation much be constructed with the provided materials (things like paper cups, popsicle sticks, tape, cardboard, fuzzy sticks, etc...)

* The mode of transportation will use a Sphero robot as the power source for the vehicle.

Gallery 3.3 The Design Process: Electric Vehicle Challenge



https://www.engr.ncsu.edu/theengineeringplace/educators/#process

1 of 19

* The mode of transportation must be able to hold at least two lego mini-figures as the vehicle travels around the track.

* They must decide on a team name or name for the mode of transportation they design.

Children were then divided up into their perspective teams. Working with their team leaders (PD3 students or instructional aids) the children worked through an iterative design process. They began by asking questions about the problem they were trying to solve. They then brainstormed ideas for the design and had to decide which design would move to the next phase. From there, they drew sketches and gathered the needed equipment and materials. Next they constructed their mode of transportation and tested it to see how it would work.

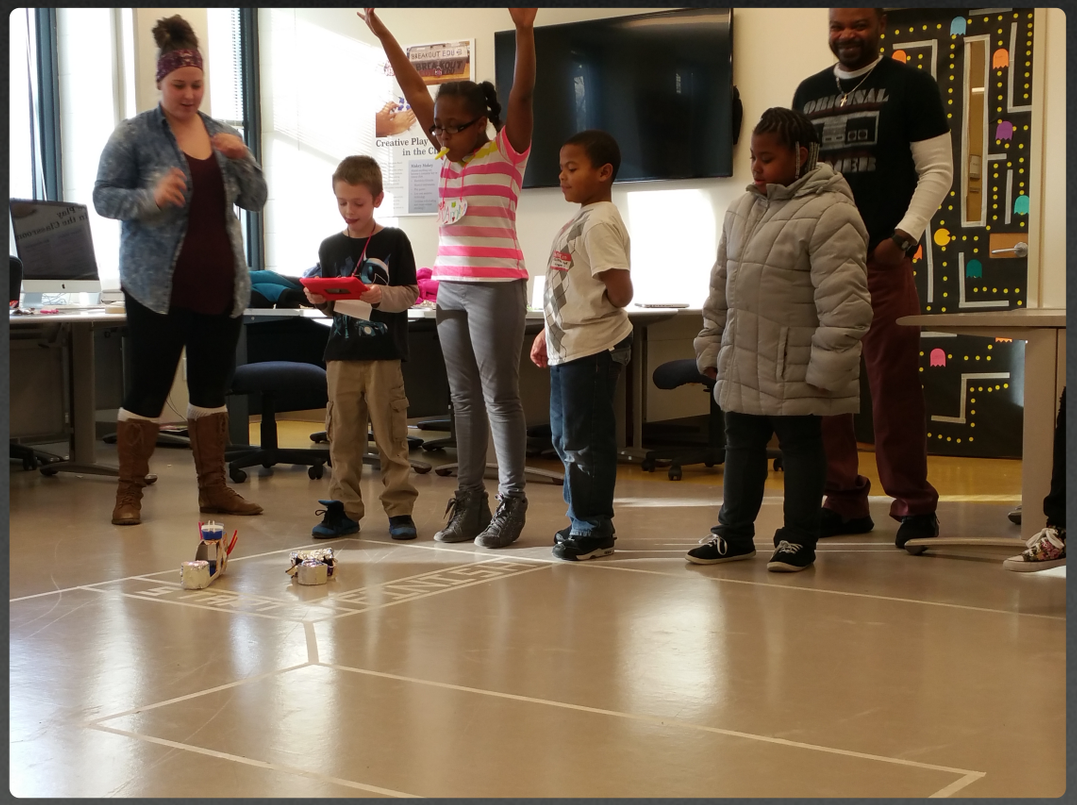
At this step in the process team leaders would connect an iPad to the Sphero robots so that students could practice driving as well as testing their designs with the power source of their vehicle. At the end of class time, teams were asked to share their initial designs and how they had modified or improved their designs. The session ends with a homework assignment for the kids to consider how else they might improve on their designs for the last week when they will race in the

Sphero Circuit! Image gallery 3.3 has several pictures of students sharing ideas, collaborating, and designing their vehicles.

APPENDIX 4: LESSON FOUR: RACING ON THE SPHERO CIRCUIT

On the final day of the S.T.E.M. unit, PD3 students, children in the after school program, and teachers participate in the Sphero Circuit Race. As kids came into the classroom, the room had been reconfigured so that a race track (constructed out of tape on the floor) was in the center of the room. Desks and other tables had been moved to the perimeter, and “pit” areas for each team are set up so they could

Gallery 3.4 Racing on the Sphero Circuit



1 of 22

completed any modifications or repairs to their modes of transportation. The teams are then given 15 to 20 minutes to make and test any final design modifications. Once the final modifications have been made, the teams were asked to sit around the perimeter of the track and some basic guidelines for the races are discussed. Good sportsmanship was stressed and the children participated in a conversation deciding appropriate behaviors during the competition. The remainder of the time was spent racing and having fun!

Differentiation

Lesson plans were modified for each specific grade level. Differentiating the lessons required PD3 students to consider the instructional contexts where the lessons would take place, the grade level of the students, the developmental ages of the children, materials and other resources. Also, each time a specific lesson was taught, PD3 students reflected on what worked well and what they would have done differently.

For example, the first round of lessons took place at BSU Teachers College while the other two rounds took place at the elementary school where the children attend school. Differences in the physical location of where the lessons took place impacted the time spent on lessons, classroom management, and resources. The third graders who came to campus had to travel from their school to the university. This travel time cut into the time the children had work on their activities. This changed once we started meeting the children at the elementary school. We had more time to work on the projects and the children were used to the regular routines of their day.

A specific example of how PD3 students differentiated their lessons was in the conductivity lesson. The first time PD3 students taught the lesson for the third graders they had the children construct their own controllers with the Makey Makey. After reflecting on the first time the lesson was taught, PD3 students decided to modify the lesson so that they would work along side the children to create the controllers. They also decided to have children rotate around the room so that everyone would get a chance to play different games and use different materials to control the computers. This allowed both the children and PD3 students to reinforce the main concepts of how to create a circuit and how conductors and insulators either block or allow electricity to pass through. PD3 students made additional modifications to differentiate the lessons depending on the individual students who were in their small groups.

Assessment

Assessment of 1st, 2nd, and 3rd graders was grounded in a constructionist paradigm. Students demonstrated their understanding through the construction of their own creations. Within each lesson of the unit the first, second, and third graders manipulated different materials and constructed different models to test their internal cognitive understanding of the concepts of electricity and circuits. Students tested their understanding about conductivity and the flow of electricity through the different creatures they made with squishy circuits, and through their demonstration of building game controllers with the Makey Makey's. Assessment of the design process was also done through the work of the students. As they constructed their electric modes of transportation they continually asked questions, imagined, planned, created, and improved their designs until it was time to race.

PD3 students intentionally planned the lessons to give the 1st, 2nd, and 3rd graders as much agency as possible in their learning. They allowed the elementary students to make choices, to collaborate, and to construct models of their understanding. The elementary students also drew from their prior knowledge and experiences as they participated in the different lessons.

Chapter 4

ADDITIONAL ACTIVITIES

PD3 students also participated in other instructional opportunities to share their knowledge and to model engaging, technology rich, instruction. These included attending a S.T.E.M. focused parents night at a local elementary school, a student sharing her expertise with 2nd & 3rd graders at the school she formerly attended, and co-teaching a BSU teacher education faculty advisor workshop on technology integration opportunities.

Storer Elementary Family Night

PD3 students were invited to share the work they had been doing with the S.T.E.M. unit at the Storer Elementary School parents night. During the evening, parents and children from the school explored a variety of stations. The evening was organized by BSU student teachers who were working at the school. Our stations focused on Squishy Circuits and Makey Makey's.

Children and their families spend time making a variety of creatures with the squishy circuit dough and LED lights. They also either played a maze game using conductive dough as the controller or playing an organ that used gummy worms and bananas as the keys. Parents also joined their children in exploring the actives we had set up for them.

Check out Gallery 4.1 to see some pictures from the parent's night.

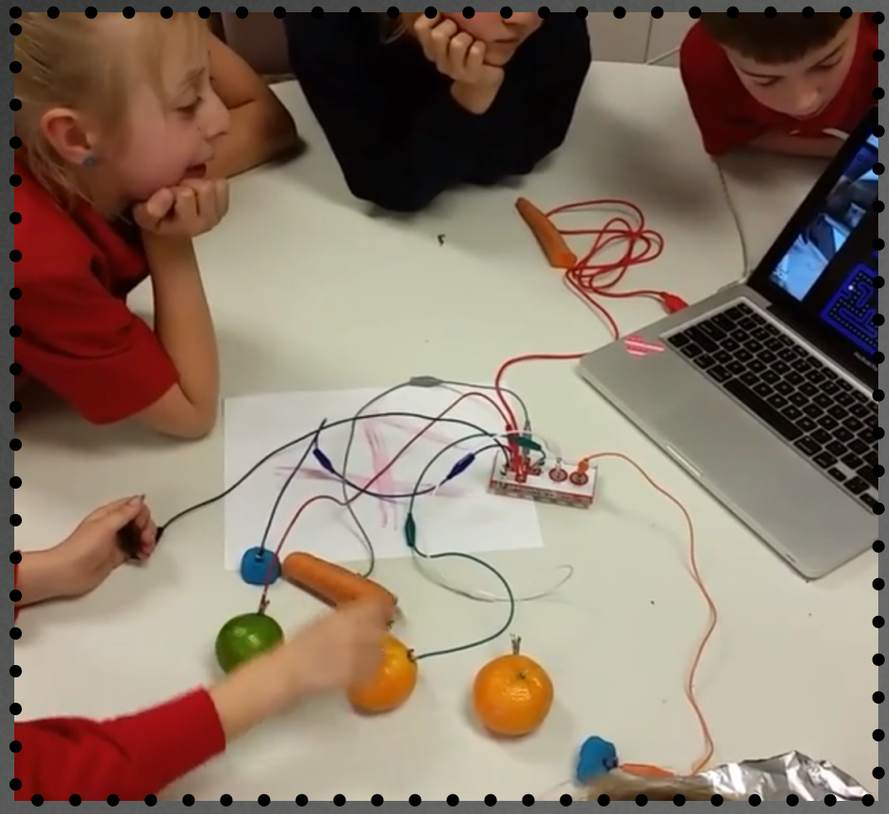
Gallery 4.1 Storer Family Night

1 of 12

School Visit

One of the PD3 students was invited back to the school she had attended to share the work she had been doing as part of the project with the computer education teacher. The student was able to meet with teachers and administrators, and then taught the Makey Makey lesson from the S.T.E.M. unit to second and third graders.

This was a wonderful opportunity to share and model the instructional practices and activities we had been talking about, and practicing throughout the semester.



Education Advisors and Faculty Workshop

Teachers College hosted a workshop for secondary education content advisors and elementary faculty to inform them of various calls for change in how technology is used within educator preparation programs (EPP's). Attendees to the workshop were given a 3D printed artifact connected to their particular content area, a folder with paper copies of the materials discussed during the workshop, and an iPad so that the participants could take part in a augmented reality tour of different technologies and how the technologies might be used within educational contexts. The organization of the workshop centered on engaging content area advisors and faculty about how they might think differently about technology use within their EPP courses.

The workshop began with a brief overview of some of the different calls to improved technology use by teacher education candidates. For example, the U.S. Department of Education office of Educational Technology challenged educator preparation programs to:

- Focus on the active use of technology to enable learning and teaching through creation, production, and problem solving.

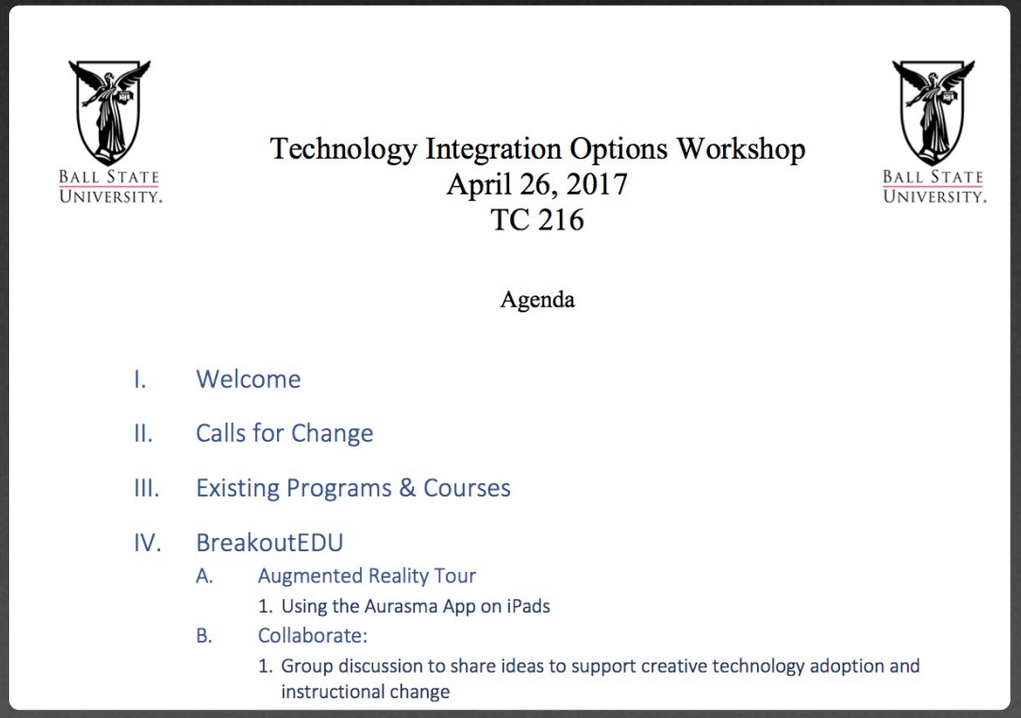
- Build sustainable , program-wide systems of professional learning for higher education instructors to strengthen and continually refresh their capacity to use technological tools to enable transformative learning and teaching.

- Ensure pre-service teacher experiences with educational technology are program-deep and program-wide rather than one-off courses separate from methods courses.

- Align efforts with research-based standards, frameworks, and credentials recognized across the field.

They then participated in a Breakout.Edu challenge to learn about some different technologies available to them and to provided feedback to Teachers College leadership about how the different content areas might use these technologies within their teacher education coursework. Breakout.Edu is a challenged-based activity that combines both physical and digital elements for learners. This challenge was focused on helping educator preparation advisors and faculty learn about how different technologies might be utilized within

Gallery 4.2 Teacher College Content Advisors Workshop



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content area courses and programs, provide teacher education candidates with opportunities to represent their knowledge in different ways and to provide alternative models faculty might employ when modeling different pedagogical approaches for instruction.

The advisors and faculty completed a Google form in order to get clues for completing the challenge. This feedback will be used to follow up with the faculty about how the Educational Technology program can support them in their technology integration efforts.

More information about the workshop can be found in the Gallery 4.2 and Movie 4.1.

Movie 4.1 Workshop

Chapter 5

REFLECTIONS

The PD3 project focused on the initial implementation of the Schoology learning management system for Muncie Community Schools. Students worked with a pilot group of teachers and reflected on the process of technology adoption and integration.

Reflections

RECOMMENDATIONS

- **Communication, Communication, Communication!**
- **Models of Practice**
- **Active, Engaging, & Purposeful PD**
- **Relationship Building**
- **Next Steps Chart**

Students within the Professional Development Differentiated & Digitized immersive learning program had several experiences that informed their future development as teachers, their understanding of the complexity of technology integration and adoption, and their understanding of the importance of building relationships with peers, teachers, and students. PD3 students synthesized their experiences in the development of their own digital texts created with iBook Author at the end of the semester. These digital texts served as a portfolio of their work throughout the semester, and a demonstration of how each student interpreted the projects, concepts, and additional activities they completed.

At the end of the semester, PD3 students were asked to reflect on their experiences, and to provide recommendations to future students and district leadership as to how they might carry on the work that began in the spring semester of 2017. Three themes became evident within the student reflections.

The importance of communication was the first theme. Communication represented much more then a transfer of information from one group to another, but rather became an overarching representation for the complexities of change, and the importance of developing a community for learning. An important element of this theme was the value of building relationships.

The second theme focused on the value of modeling instructional strategies that integrated technology in different ways. This theme also emphasized the importance of the co-construction of knowledge and collaboration in developing learning activities for teachers, children, and teacher education faculty.

The final theme connected with the nature and quality of professional development. Read more about each of these themes in the sections below.

Communication, Communication, Communication!

Communication was an important theme that emerged in different ways throughout the semester and in the work students completed. Readings during the semester emphasized the important roles of vision and communication between district leaderships, coaches, and teachers in order for change to be successful. ISTE standards for coaches, the concerns-based adoption model by Hall and Hord (2015),

and a modified Bronfenbrenner's ecological systems theory served as lenses for students as they tried to make sense of what they were experiencing. The modified ecological systems theory was particularly helpful in understanding how external forces beyond what the teacher might control in their classroom had an effect on the teachers technology use and adoption of Schoology.

In 2016, the Muncie community schools adopted a new strategic plan that identified several long standing issues the district would address in the coming years. Two of these included the improvement of district technology infrastructure (ie. strength and stability of wireless network, replacement cycle of digital technologies throughout the district), and adoption of a learning management system that would be used district wide. At approximately the same time, district teachers and administration were involved in a contract dispute and the district was in financial difficulty. These issues were exacerbated during the spring of 2017.

While the district made concrete efforts to improve the technology infrastructure and adopt the new learning management system, these efforts took place within a larger context that impacted teachers decisions to adopt new technologies. This context included an ongoing contract dispute which has lead to lawsuits, public protests, and legislative action. The ongoing financial issues led the Indiana state legislature to threaten financial and curricular takeover of the district. Due to civic action by the community, teachers, and district leadership, the state legislature backed off of a complete takeover, but still planned to appoint an emergency manager who would address district finances. These external issues lead to a lot of uncertainty by teachers and impacted the levels of trust and sense of community within the district.

Taking this larger context into account, PD3 students took care to focus on the importance of communication in their work with each other, and with teachers.

They worked hard to develop a learning community in a variety of ways. To begin, they asked a lot of questions in order to find out more about the Muncie Community Schools and how teachers utilized different technologies within their instructional practices. The PD3 students met with MCS curriculum director and with lead teachers who had been using Schoology to learn about the districts goals and how they could assist teachers in learning Schoology. They surveyed teachers district wide and within the Schoology pilot program to learn what the teachers knew about Schoology. In these surveys they also sought information about the kinds of professional development teachers found to be affective. The PD3 students took this information to develop the Schoology work room and to host an open house for teachers in order to communicate that there was face to face support for learning Schoology.

The PD3 students communicated with individual teachers who were part of the Schoology pilot. They initiated face to face introductions, followed up with emails, and scheduled individual meetings with teachers. In these individual meetings, PD3 students and the teachers communicated about the teachers instructional goals for learning Schoology and how these goals might be achieved. By the end of the semester, PD3 students were communicating with others beyond the

pilot group and helped the teachers who they had been working with move along independently in the use of Schoology. Communication was also important in other elements to help with Schoology adoption.

As students worked on the Schoology professional development course, they communicated with each other about resources, the design and layout of the course, and how they would share course information with teachers. Students debated about the most effective design for the course and reviewed different instructional design models for distance education. In designing the course, students shared webinars, videos, and other materials they found. They also reviewed each other sections of the course so there would be consistency between sections.

The importance of having clear communication was the major theme mentioned by PD3 students in the 2017 spring semester. Communication is vital for the success of any change initiative. Whether this is communication from district leadership to teachers, teachers with their peers, or university students and their community partners, lack of communication can lead to confusion, but open, transparent, and clear communication can develop a strong learning community where all stakeholders benefit. While teachers and PD3 students had little control over the larger contextual factors that influenced the learning community of the district, they worked to improve communication and to develop a learning community over what they could control.

Models of Practice

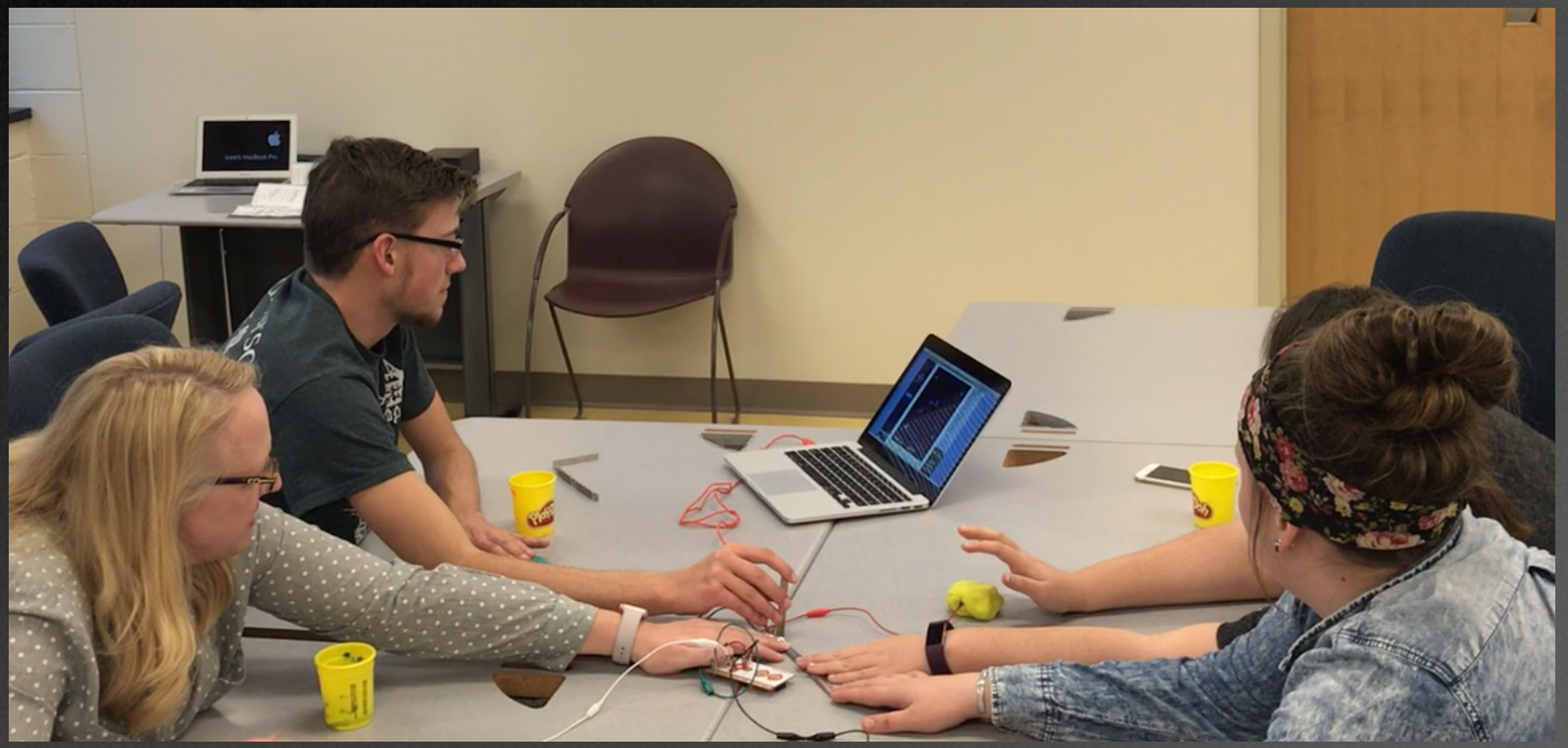
Being able to observe, participate in, and practice a variety of instructional activities was another theme PD3 students recognized in their reflections on the semester.

Unfortunately, educator preparation programs often do not model the types of teaching they advocate. Didactic forms of instruction dominate where content is delivered and candidates passively listen to what should happen in classrooms. Coursework is also frequently separated into “silos” that prevent candidates from making important connections that can help in their professional development. In contrast, readings and experiences of PD3 students emphasized the change process, and attempted to model constructivist and constructionist theory and pedagogies.

This process began by providing PD3 students with alternative models to the types of instruction they themselves had experienced as students. Foundational readings about learning theory, different models for technology use and adoption, and a critical examination of different National Educational Technology Standards were paired with activities that supported active learning with technology, time to collaborate, opportunities to construct meaningful representations of their new knowledge, and ways to share that knowledge with others.

This process provided PD3 students with opportunities to develop new understandings about teaching, learning, professional development, technology integration, and contextual factors that drive the success or failure of change initiatives. For example, PD3 students were able to observe and ask questions to teachers from

Avon high school about how the teachers were using Schoology. They observed Avon teachers using the LMS in engaging and active ways with their students. This ranged from writing prompts that led to larger classroom discussions, to the creation of digital centers where students used the LMS to focus on different activities. PD3 students came away from the experience with alternative views about how a LMS might be used by teachers and students. They had also constructed ideas about how teachers from different content areas might use the LMS in engaging ways. The students contrasted this experience with what they were learning about the challenges facing Muncie Community Schools, and used this knowledge to create professional learning opportunities for teachers in Muncie.



Another example is the development of the S.T.E.M. unit. The challenge given to the PD3 students was to develop a four week unit that engaged 1st, 2nd, and 3rd grade students in an active learning process focused on science, technology, engineering, and mathematical concepts. The PD3 students again applied the theories and ideas we had been reading about in order to construct the unit, but they also applied an iterative design process that was demonstrated by how they differentiated each lesson for the different grade levels.

PD3 students also recognized that the structure of the immersive learning project itself was modeling constructivist and constructionist pedagogies, as well as an iterative design process. Modeling the types of thinking, decision making, collaborations, and products advocated for by researchers, the BSU educator preparation program, and national teacher education organizations prepared PD3 students to be reflective critical decision makers in their future work. Students were leaders in the direction of their work throughout the semester and had ownership of the development and design of the various products they produced. This was evidenced through their collaborative development of the Schoology professional development course, lessons designed for the after school S.T.E.M. program, work with

teachers in the Schoology pilot program, planning of the district Schoology PD session, and design of their own digital texts.

An important factor in this process was time. Time to learn, time to design, and time to reflect were all vital in helping PD3 students recognize how these experiences and opportunities might provide alternative models of teaching, learning, professional development, and technology integration. Without time, the PD3 students would not have been able to process the changes they were experiencing and construct the professional learning opportunities they did for MCS teachers. They would not have been able to thoughtfully develop lessons for the children in the after school program, and they would not have been able to challenge their own prior conceptions. Time is an important factor that school districts and teacher education programs should build into any professional development initiative.

Active, Engaging, and Purposeful Professional Development

Reflections about the kinds of professional development opportunities available to teachers emphasized that teacher learning opportunities should engage teachers in meaningful ways. Unlike traditional PD experiences that are passive and emphasize transmission forms of instruction, PD3 students found that effective instructional strategies for teacher learning resembled effective instructional strategies for student learning. The learning for both teachers and students in the after school program supported active engagement with content.

Readings throughout the semester emphasized connecting prior knowledge to new knowledge through a process of active construction. The demonstration of an individuals understanding of that new knowledge is through the construction of different types of models. The work between teachers and the PD3 students culminated with teachers constructing specific elements of their profile, courses, or assignments within Schoology. By engaging teachers about their existing content, pedagogical practices, and students, PD3 students were able to introduce new knowledge about the learning management system in ways that related to the teachers existing knowledge and pedagogical practices.

PD3 students found that their work with teachers was most successful when they addressed specific needs and goals the teachers had identified. Because teacher time was limited, having specific plans and goals to accomplish allowed them to make the most of their time. Students and teachers set specific tasks to accomplish together and set timelines to get their work done. In the district PD session, teachers were asked to bring specific items to work on. This provided a context within the PD that allowed for teachers to define the kinds of tasks they wanted to accomplish, but to also have immediate support if they had difficulties or wanted to ask additional questions.

The following table provides suggested next steps for Muncie Community Schools and the districts adoption of the Schoology learning management system.

RECOMMENDATIONS FOR SCHOOLOGY ADOPTION		
Next Steps	**Proposals**	**Rationale**
Improve Communication	Provide bi-weekly or monthly newsletters focused on Schoology. Provide the access code to the Schoology PD course to all MCS teachers. Communicate clearly with building administration, teachers, families, & students about Schoology expectations & implementation.	Communication is vital in the success of any change process. Communication of district goals for Schoology, the types and amounts of support for teachers, and where teachers can go for support.
Engage Teachers Unfamiliar with Schoology:	Set a goal to reach 5-7 new teachers each semester in going deeper with Schoology. Emphasize how they can change teaching pedagogies through technology integration.	It is the responsibility of Technology Coaches to “create and support effective digital age learning environments to maximize the learning of all students.” (ISTE Standards).
Engage Families about Schoology	Begin to engage students and families district wide about the implementation of Schoology. Provide opportunities for families to learn about features within Schoology that will help them support their children.	In order to support raised expectations about Schoology use throughout the district, parents must be involved. Provide information sessions and hands on experiences that allow parents to log in and to check their child’s classes. Utilize community council meetings and other non-traditional venues to engage with parents.
Timeline	Begin mentoring / coaching work earlier in the semester and increase additional PD opportunities throughout the district. The more time spent with teachers, gives them more time to gather resources and learn about Schoology.	The more sessions teachers receive, the better support and more opportunities to master Schoology.
Ongoing & Follow-Up Support:	Keep teachers grouped by departments. Once a mentor/ coach is assigned teachers, allow them to relocate closer to the teachers, giving mentor/coach their own defined workspace. Have regular meetings with teachers.	Keeping teachers grouped by departments helps with the consistency of Schoology class structures. Allowing mentor/coaches to relocate closer to their teachers would allow them to embrace and support the school culture more and understand the limitations their teachers may have by observing their surroundings.
Continue & Expand MSC / BSU Partnerships	Continue & expand partnerships with Ball State, Teachers College, and the Educational Technology Program.	Partnerships and collaborations offer benefits to both MCS and to teacher education candidates. Candidates and BSU faculty can aid MCS in way where the district identifies its needs and BSU can come along side the district to make changes successful.

Chapter 6

APPENDIX

The appendix chapter contains the S.T.E.M. lesson plans developed by PD3 students for first, second, and third graders. The lessons focus on electricity and circuits, but also on creativity and the design process. The lessons were taught several times to children in an after school program.

Appendix

S.T.E.M. LESSON PLANS

- **Appendix 1: Week 1. What is a Circuit?**
- **Appendix 2: Week 2, Conductivity, is it a Conductor or Insulator?**
- **Appendix 3: Week 3, The Design Process, Creating an Electric Vehicle**
- **Appendix 4: Week 4, Racing on the Sphero Circuit!!!**

PD3 students developed a four week STEM unit for 1st, 2nd, and 3rd graders in an after school program at a local elementary school. The unit focused on circuits and electricity. It also engaged students in learning about the design process. Activities within each lesson included a variety of activities, small group work, and assessments where students constructed models of their learning that were then shared with others. Lessons within the unit were also differentiated for the different instructional contexts, the grade level of students, and the available materials.

Appendix 1

Week 1: What is a Circuit?

Goals (What is trying to be achieved at the end of the lesson):

* Introduce students to circuits and terminology about ciruits
* Introduce how circuits work
* Introduce formal knowledge/definition of circuits and the components of a circuit

Objectives (Performance):

* Students will demonstrate basic terminology when using squishy circuits
* Students will show basic circuit construction skills by building a circuit as a class and also individual circuits with the squishy circuits
* Students will be able to explain, in their own words, how a squishy circuit works
* Students will use squishy circuits to create a circuit of their own that demonstrates their understanding of how a circuit works

Standards (Content, Grade level, Technology):

Below are the Process Standards and Science Standards for First, Second, and Third, grade according to the Indiana Department of Education.

Process Standards

- SEPS.1 - Posing questions (for science) and defining problems (for engineering)
- SEPS.2 - Developing and using models and tools
- SEPS.3 - Constructing and performing investigations
- SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering)
- SEPS.8 - Obtaining, evaluation, and communicating information

Science Standards

- K-2.E.1 Pose questions, make observations, and obtain information about a situation people want to change. Use this data to define a simple problem that can be solved through the construction of a new or improved object or tool.

- K-2.E.2 Develop a simple sketch, drawing, or physical model to illustrate and investigate how the shape of an object helps it function as needed to solve an identified problem.
- K-2.E.3 Analyze data from the investigation of two objects constructed to solve the same problem to compare the strengths and weaknesses of how each performs.

International Society for Technology in Education (ISTE) National Educational Technology Standards

ISTE National Educational Technology Standards for Students (NETS-S), the following standard(s) is identified:

Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts, and make meaningful learning experiences for themselves and others

1. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits
2. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solution.

ISTE National Educational Technology Standards for Teachers (NETS-T), the following standard are identified:

Facilitate and inspire student learning and creativity - Teachers use their knowledge of subject matter, teaching and learning, and t technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

1. Promote, support, and model creative and innovative thinking and inventiveness
2. Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
3. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

Engage in professional growth and leadership - Teachers continuously improve their professional practice, model lifelong learning, and exhibit leadership in their school and professional community by promoting and demonstrating the effective use of digital tools and resources.

1. Participate in local and global learning communities to explore creative applications of technology to improve student learning

2. Exhibit leadership by demonstrating a vision of technology infusion, participating in shared decision making and community building, and developing the leadership and technology skills of others.

Key Terms:

For a handout of the key terms, use the Squishy Circuit Vocabulary sheet provided.

- Electron
- Circuit
- Open/Closed
- Types of Circuits: Parallel/Series
- Conductor/Insulator
- Ground
- LED - Light Emitting Diode
- Positive/Negative Charge
-

Materials:

The list provided below is broken up into various sections for the purpose of gathering materials to begin the unit, demonstrate the lesson, and make the circuit. Please note the quantity of materials vary based on class size and resources.

- Beginning the Unit
    - Computer/Projector
        - To play and view introduction video
    - Index cards, yarn, markers, hole punch
        - Make name tags for students if needed
- Demonstrating the Lesson
    - Introduction Video
        - Need to have access to youtube
    - Electric Ball
        - To show how electricity travels through things
- Materials for Squishy Circuits Activity

- LED bulbs
- Conductive Dough
- Non-Conductive Dough
- Battery Packs
- Batteries

Description/Process (What will be happening during the lesson?):

View the Week One Outline for a more in-depth outline that includes activities, questions with possible answers, and outlined schedule.

Introduction

Students are grouped based on tables

* Go around room and have students introduce themselves

Launch/Attention Grabber

- Make a human Circuit
  - Have student hold hands to make a circle.
  - Group leader is at one end next to the plugged in Electric Ball
- Group leader asks, What is a circuit is?
  -
- Identify some definitions we will use briefly
- Circuit, closed & open circuit
- Introduce lesson with students sitting on the carpet up front and show introduction video
-

Activity

Split back into groups

Each group will build squishy circuits alongside group team leaders

Instructor will lead a group discussion in...

What makes a circuit

open/closed circuits

conductive/non-conductive materials

Additional Learning: https://drive.google.com/open?id=0B3bvkKRNWGLNSS13WlJ1Smx2REk

Appendix 2

Week 2: Conductivity, is it a Conductor or Insulator?

Goals:

- Build on students knowledge from previous week and continue introduction to circuits and electricity
- Continue working with circuits
- Building more knowledge using Makey Makey
- Introduce formal knowledge/definition of circuits and the components of a circuit
- Clearly identity insulators and conductors

Objectives (Performance):

- Students will demonstrate basic terminology when using Makey Makey circuits
- Students will show basic circuit construction by building a circuit as a group and also individual circuits with the Makey Makey circuits
- Students will be able to recall terms and vocabulary from the previous lesson
- Students will use Makey Makey circuits to create a circuit of their own that demonstrates their understanding of how a circuit works
- Students will be able to determine what is conductive and nonconductive from a variety of objects

Standards (Content, Grade level, Technology):

http://www.doe.in.gov/sites/default/files/standards/indiana-third-grade-standards-2016-41116.pdf

Process Standards

- SEPS.2 - Developing and using models and tools
- SEPS.5 - Using mathematics and computational thinking
- SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering)
- SEPS.8 - Obtaining, evaluation, and communicating information

Science Standards

- 3-5.E.1 - Identify a simple problem with the design of an object that reflects a need or want.
- 3-5.E.3 - Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

International Society for Technology in Education (ISTE) National Educational Technology Standards

ISTE National Educational Technology Standards for Students (NETS-S)

Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others

1. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits
2. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions

ISTE National Educational Technology Standards for Teachers (NETS-T), the following standard are identified:

Facilitate and inspire student learning and creativity - Teachers use their knowledge of subject matter, teaching and learning, and technology to facilitate experiences that advance student learning, creativity, and innovation in both face-to-face and virtual environments.

1. Promote, support, and model creative and innovative thinking and inventiveness
2. Promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes
3. Model collaborative knowledge construction by engaging in learning with students, colleagues, and others in face-to-face and virtual environments

Materials:

- 2 Makey Makey kits per group. Each kit containing:
  - Makey Makey board

    - 1 USB cable
    - 7 Alligator clips
    - 6 Connector wires
- 8 computers
- Projector
- Bananas
- Foil
- Gummy Worms
- 8 Play Doh-2 containers per group
- Pennies
- Carrots
- Pipe cleaners
- Pencils with paper
- Wooden Dowel Rods
- Straws
- Pen with paper
- Silver Coins

Description/Process (What will be happening during the lesson?)

When the students enter the classroom, they will join groups from previous week. Students will break back into their groups. In these groups, they will build Makey Makey circuits alongside an instructor. The students will create a circuit board and then work as a team to play games on the computer like: Pac-man, snake and Mario-kart. The Makey Makey is a group exercise that each student will need to work together in order for success to be achieved on the video game. The students each will have control over a function of the game meaning: the up button, down button, right and left button. In these groups, they will discuss what makes a circuit, open and closed circuits, conductive vs. non conductive materials, and if there is time parallel circuits vs. series circuits.

Welcome/Introduction

- Students come in, find their seats and place coats on back of the chair (3 minutes)

- Overall introduction of Today's activity (Group Leader) (4 minutes)
    - Large Group Activity: Review of last week
    - Review Key Terms & New Terms
        1. Electrons: An electron is a negatively charged subatomic particle.
        2. Electrical Current: The flow of an electrical charge
        3. Conductors: Allow for the flow of electrons
        4. Insulators: Block the flow of electrons
        5. Circuit: a circular path that starts and stops in the same place.
        6. Open Circuit: if the circle is not complete
        7. Closed Circuit: A closed path completing a circle
        8. Electricity: The flow of electrons around a circuit
        9. Ground (Earth): A common return path for electrical current. Prevents user contact with with dangerous voltage

Transition Video: Makey Makey VIDEO (4 minutes)

https://vimeo.com/60307041

- Following video, inform students they will be working in small groups
- Discuss with students about the proper way to work in groups
- Have students identify specific behaviors for working well in groups and explain why those behaviors help the group accomplish its goals.
- Group leader informs the students that they will working with PD3 student team leaders and all of them will be doing some different experiments to test out whether or not some is a conductor or an insulator of electricity.

Small Group (10 minutes)

Activity One: What's Conductive Material?

In your already assembled Makey Makey, have students choose one item on the table that they think is conductive. In a group, test each item to see if it's conductive or not. Lead a deeper discussion by identifying the aspects of material that allows material to be conductive.

Activity Two: What's your power source?

After students choose various items that might be conductive or not, shift the conversation back to the parts of a circuit. Here, discuss what the power source, ground, could be to complete the circuit. Mainly discuss that the circuit is complete because we are completing the circuit ourselves as the ground.

Student Creations: (20 minutes)

Split students up into pairs and allow students to create their own Makey Makey circuits out of whatever they like. Give them time to test their Makey Makey. while we ask individual questions about their process or ideas. At this time students may try more challenging conductors, sources, etc... if they choose to.

Transition (6 minutes)

Watch “O say can you see” while Team Leaders set up games.
https://www.youtube.com/watch?v=Uiq0DTCJvy0

Team Game: (15 minutes)

Build a game controller for the group of students to play together. Have students construct their own arrow key for them to control and then spend the rest of the time playing the game together and working on their teamwork skills.

Team Game Link:
https://scratch.mit.edu/projects/31651654/ (This link is to Tetris)
https://scratch.mit.edu/projects/21113772/

Conclusion/Wrap Up: (5 minutes)

Bring students’ attention back to the front of the class and ask students what they learned about

- A circuit
- Conductors
- What’s conductive?
- An open circuit/closed circuit
- Energy sources

Appendix 3

Week 3: The Design Process, Creating an Electric Vehicle

Goals:

- Gain students interest by providing them with a prompt that connects with previous weeks discussions about electricity and creative problem solving.
- Continue building on knowledge learned from previous session by introducing more terminology regarding circuits
- Have students collaborate together to successfully solve the solution for their problem
- Construct the physical model of their problem

Objectives (Performance):

- Students will use process skills to determine what the problem(s) is that they need to solve
- Students will show understanding of the problem by constructing a model of their solution
- Students will be able to explain their thought process if asked
- Students will be able to use their model in the next lesson if successful

Standards (Content, Grade level, Technology):

http://www.doe.in.gov/sites/default/files/standards/indiana-third-grade-standards-2016-41116.pdf

Process Standards

- SEPS.2 - Developing and using models and tools
- SEPS.5 - Using mathematics and computational thinking
- SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering)
- SEPS.8 - Obtaining, evaluation, and communicating information

Science Standards

- 3-5.E.1 - Identify a simple problem with the design of an object that reflects a need or want.
- 3-5.E.3 - Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

International Society for Technology in Education (ISTE) National Educational Technology Standards

ISTE National Educational Technology Standards for Students (NETS-S)
https://drive.google.com/file/d/0B4P1LJfd4W4mZk5NVUxoS0ZoaVk/view?usp=sharing

Empowered Learner - Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences.

1. Articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.

Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others

1. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits
2. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions

Innovative Designer - Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions

1. Know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
2. Select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
3. Develop, test and refine prototypes as part of a cyclical design process

4. Exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

Creative Communicator - Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals.

1. Choose the appropriate platforms and tools for meeting the desired objective of their creation or communication.
2. Create original works or responsibly repurpose or remix digital resources into new creations
3. Communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations
4. Publish or present content that customizes the message and medium for their intended audiences

Materials:

- Introduction video that sets up the problem
- STEM Challenge handout
- Pencils for each student
- Computer
- Sphero
- Lids
- Foil
- String
- Popsicle sticks
- Fuzzy sticks
- Dowel rods
- Straws
- Tape
- Rubber bands
- Note cards
- Paper cups
- 4 pairs scissors

- Scrap boxes
- Balloons
- Paper Clips

Description/Process (What will be happening during the lesson?)

Introduction (5-7 minutes)

Students come in and get in the groups they have been working with for the past weeks

Introduce lesson by the introduction video or script*

Group Activity (33 minutes)

Instructors will guide the conversation by identifying the problem they are trying to solve

Facilitating a brainstorming time

Assign group roles (coloring role, constructing, etc)

Assist students if necessary when constructing the model

Testing of their model

Improving the model (if needed)

Conclusion (10 minutes)

Groups will come to the front of the class to share their design and describe what materials they used.

Additional Learning:

Bluetooth technology- Spheros are connected to iPads through Bluetooth.

Connect the precious circuit work the Spheros- specifically how they charge

Appendix 4

Week 4: Racing on the Sphero Circuit

Goals

* Finish design process and construction of electric vehicle.
* Race chariots
* Summarize the past 4 weeks-what did they learn?

Objectives (Performance)

* Students will demonstrate their knowledge of how to connect the Sphero to the iPad
* Students will construct a vehicle out of random materials that will connect to the Sphero
* Students will explain their design process, how their chariot works, and how they constructed it.

Standards (Content, Grade level, Technology):

http://www.doe.in.gov/sites/default/files/standards/indiana-third-grade-standards-2016-41116.pdf

Process Standards

SEPS.2 - Developing and using models and tools

SEPS.5 - Using mathematics and computational thinking

SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering)

SEPS.8 - Obtaining, evaluation, and communicating information

Science Standards

3-5.E.1 - Identify a simple problem with the design of an object that reflects a need or want.

3-5.E.3 - Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved

International Society for Technology in Education (ISTE) National Educational Technology Standards

ISTE National Educational Technology Standards for Students (NETS-S)

Knowledge Constructor - Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

1. Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative *pursuits*
2. Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions

Materials

- Spheros robots (Charged prior to activities)
- iPads (Charged prior to activities)
- Built chariots
- Tape Race track
- Chariot constructive materials- Dr. Clausen's black box of goodies

Description/Process (What will be happening during the lesson?)

Introduction (10 minutes)

1. Students will come into the classroom and gather in the front of the room.
2. Group leader will ask students what they remember about the design process.
   - Student will share their prior knowledge and provide some examples of how they went through that process the previous week.
3. Group leader will facilitate a conversation with students about continuing the design process and for the students to consider how they may improve the performance of their electric vehicles.
4. Students will be dismissed from the front of the room to their team "pit" areas where they are given 15-20 to revise their designs and test drive their electric vehicles.

Pit Time (15 - 20 minutes)

Race Guidelines

1. Once the final designs are ready to race, students will sit in their teams around the race track.
2. Group leader will discuss behavior expectations with students.
3. Ask students how they should want to behave so that everyone has fun.
4. Ask student to provide examples of good and bad behavior in this kind of setting.
5. Ask students what kinds of restrictions might be placed on those who do not follow the agreed upon behaviors and actions.
6. Group leader will review the race guidelines
   - One lap around the track for each member of the design team.
   - Each team member drives the vehicle at least one lap
   - Group leader also engages in safety guidelines
   - Stay off of the track area during the race
   - If a vehicle goes off the track, move out of the way carefully so someone does not get kicked or the vehicle does not get stepped on.
   - Be good sports. This competition is intended to be fun. Cheer on yourselves, teammates, and other teams!
7. Group leader identifies the race match ups

Ready to Race!!!

1. Group leader asks the first teams to come to the starting line and to sit in the order they are going to drive the vehicles.
2. Once the teams are ready, the Sphero Robots are connected and oriented to the iPad, and the cars are placed on the starting line the group leader will start the first race.
3. At the end of the tournament, teams get their pictures taken with their vehicles.

Clean up

1. Once the tournament is over ask children and others in the room to help pick up.
   - Pull tape off of the floor
   - Collect all remaining building materials
   - Collect Sphero robots
   - Collect iPads
2. Collect any remaining items so that the room is back to the way it was before the STEM activities for today started.

Chapter 7

REFERENCES

This final chapter provides references to the various theories, models, and research literature mentioned throughout the text. The authors have also included additional resources and information on materials used during the 2017 spring semester.

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