A Vision for Life Long Learning – Year 2020

By: Randy Hinrichs
Group Research Manager
Learning Science and Technology
Microsoft Research

Overview

Technology in education has two faces: one of transformation and one of hype. The printing press revolutionized access to education, and in the process an explosion in scientific inquiry was born. Teachers could finally produce and communicate content to a growing number of students entering an industrial revolution. Classrooms emerged as a great solution to disseminate content and augment interaction with faculty and other students. Traditional apprenticeships with experts polished the student to perfection.

Within a short period of time, the industrial workforce ballooned and with it the student body. The need to scale student to teacher interactions encouraged us to turn to other technologies: radio, television, computers, and the World Wide Web. Individually, these technologies couldn't increase the ratio of experts to novices, or significantly add to their real world experience. The "educational transformation" hype emerged around these technologies and they didn't deliver as their evangelists claimed.

> "I believe that the motion picture is destined to revolutionize our educational system and that in a few years it will supplant largely, if not entirely, the use of textbooks." (Thomas Edison, 1913).

> "Radio may come as a vibrant and challenging textbook of the air". (Benjamin Darrow, 1932, Founder and first director of the Ohio School of the Air).

> There won't be schools in the future…. I think the computer will blow up the school. … but this will happen only in communities of children who have access to computers on a sufficient scale." (Seymour Papert, MIT, "Trying to Predict the Future", Popular Computing, October 1984)

One thing Mr. Papert got right was that access to computers, especially ones that are connected to communities would have an impact on education. The transformative differentiator for the next generation is the programmability of our interconnected networks. With increases in software programmability, we increase interactivity, increase communication, increase learner adaptability, increase shared visualizations, increase shared laboratory access, and increase experiential learning. In 20 years, we're going to see an impact equal to the printing press. This time we'll see a global, diverse, educated workforce delivering dependable innovation, shared vision, and collaborative creativity.

The sweet spot for the use of technology in education may clearly be that software personalizes the learning experience, connects all the components, and emancipates publication for targeted and effective interaction. In the future, no one owns content as an end product. It is molecular at its origin. MIT will give away their content for free, other institutions will follow with interactivity innovations, and quality content will be consumed in chunks by whoever needs it. Through a filter of standards, tools and personalization templates (both for individuals and groups) we'll be able to aggregate learning content, the relationships between the content, and our context for using the content in such a way as it becomes part of our own personal value proposition when studying or working with others. The objective: obtain and create knowledge at the right time, in the right place, in the right way, on the right device, for the right person.

Learning 2020 – Innovative, Creative, Collaborative Workforce

Let's imagine where technology will be in 20 years to help us set a vision for taking advantage of this new power for education. Such an exercise will allow us to visualize a roadmap for getting there.

It Begins at Birth – Intelligent Toys

From the first few months of life, children play with toys that teach them various concepts. In 2020, toys begin capturing children's learning experiences by using embedded technology that records information about the child's habits, preferences and progress to provide parents with a better understanding of their child's development. Toys provide parents with the child's learning profile, sending private information to the parent's information appliance so they can use the information in the selection and purchase additional toys that will enhance the child's motivation and experience.

Preschool – Game Based Learning

Over the course of the preschool years, children increase their play in Learning 2020 by engaging in supportive virtual reality games in which they build on their psychomotor, reading, writing and math skills they learn in school. Interaction with other students and teachers in the environment helps identify learner strengths and deficiencies. The environments individualize around the children's content preferences, and create classroom activities that encourage children to expand their abilities through problem solving environments, complete with on-line personalized mentoring by parents and teachers. The games build critical thinking skills using simulated, situational environments that engage other members of the family and community to play along.

Because the parent is more involved, the access to outside content is monitored and manual personalization of student interest can be adjusted accordingly during prescribed home activities as well. The technology objective is to construct a safe environment for the child while engaged in technology driven learning experiences. For real world interactions, video playbacks of children engaged in learning activities are frequent and reviewed by student, teacher and parent.

The Early Years – Social Collaboration and Filtering

Auto-Recommended Group Formation

Since many parents send their children to kindergarten and traditional K-8 schools, while others home school their children, Learning in 2020 focuses on creating learning environments that facilitate communication and collaboration. Technology networks kids together in groups to learn and practice their combined skills. Whether children are working on art or science, they work with embedded technology that measures their performance. Capture technologies record student interactions, teacher guidance and parent profiles to provide individualized and group feedback. Continuous personalization ensures each participant brings something unique and cooperative to the group keeping membership optimal. Children communicate with ubiquitous devices that provide targeted feedback to each other while working in groups, identifying compatibilities and suggesting what questions to ask. Group communication is the core objective, with shared activities as the principal methodology.

Student Generated Interactive e-Books

Students use wearable technologies to exchange, collect, communicate and present information either posted to large screen displays, or holographic 3D environments. As they collect information, it automatically maps to the learning objectives for their skill group and displays cumulative data about the group's success in onscreen graphics for easy monitoring. Anonymity is crucial, as performance indicators supplant grades. The focus on learning is group accomplishment of tasks, with individual contributions sent to the teacher and the student. The environment queries the student when it doesn't receive adequate information and works to help students draw similar inferences that other kids drew during similar exercises. Videos are served up to the students when they don't understand how to do something.

Students complete most of their projects by designing reusable e-books rich with simulations to share their work with others, creating long-term digital portfolios to be shared throughout the years. Teachers help students enhance screen literacy skills by building interactive multimedia for reuse among other learning populations worldwide. Sharing is the key objective, and working in diverse populations is preferred.

Teachers share their activities, thoughts, and technology ideas with a virtual team of experts in business, higher education and other institutions. A strong focus on integrating workflow and student activities throughout the community is enhanced by technology communication systems and easy to use large screen displays that encourage teachers to work together in distances to align industry, institution and schools together in real time knowledge construction and practice.

Virtual Mentors

Teachers are mentors, still using their nurturing techniques in the learning spaces to socialize children. In addition, each child has their own virtual mentor that can be accessed anytime. The mentor follows the children's activities on-line, suggesting new ideas and dialoguing interactively to understand the student's emotions and competencies. When children go on-line, the experience is secure and private. On-line content is filtered by the virtual mentor, who constantly reports noteworthy events to the parents, teachers and other interested parties. Embedded assessment is constantly sent to the teacher, parent and mentor. The virtual mentor consistently maps to performance goals and adjusts student activities to keep kids more focused on learning rather than relying on test taking. Parents can participate in their children's activities wherever they are via wireless mobile video computing and emerging communication technologies.

Kindergarten 2020 Scenario

Alicia wakes up this morning excited about what the day will bring. Today, she gets to meet with her discovery group. This group of students has been pre-selected through learning traits collected by toys that she used prior to entering kindergarten and shared with the school upon enrollment. The group has similar interests and meets 3 days a week. Today, they are going on a virtual safari to Africa.

Alicia likes animals a great deal and the group is going to experience how elephant families are similar to her own. Upon entering the virtual safari, she immediately experiences the size and weight of the elephants as they are presented in a 3-D environment where she feels as if she could reach out and touch them. During the safari, the virtual mentor points out how elephants are similar to our families and how important the mother is to the survival of the babies. Alicia gets to name one of the baby elephants and she and her teacher send a message to her mom telling her of Alicia's new friend.

During the day, Alicia demonstrated two acts of kindness towards another student. She received a personalized award at the end of the day. A copy of the award was immediately forwarded to her parents. Her dad, while traveling, received notice on his cell phone that Alicia was recognized in school and calls up a video interface to share his excitement with her. When Alicia arrives home she finds balloons waiting complete with her mother's outstretched arms.

High School – Increased Community Communication

Personalized Digital Libraries in Project Based Learning

Once children become more familiar with study and communication habits, they need content to be served up to them even more effectively. Learning in 2020 combines the student personalization with the virtual mentor and sends the information out to coordinated work projects designed for community learning. Secured broadband video conferencing appears on every device, digital cameras capture visual content, workspaces grow more complex, and collaboration tools are linked directly to personalized digital libraries. These libraries stay with a learner for life. Digital highlighting, digital conversations, group note-taking and other personal annotations make the asset active throughout the individual's life and can be shared with colleagues at any time.

No longer the dusty box of papers in the basement, learners collect a kind of "clipping service" so that a trip back through memory lane becomes an updated re-immersion in the subject matter, a kind of academic band between learning experiences. As students work on building a motor, for example, large screen displays coordinate visualizations for them to work together. They see the visual designs, on their devices and they build the motor from graphical components that simulate what they'll be doing in the laboratory. All their notes, their conversations with other students, their workflow, their graphics and video captured during their research period are all recorded and stored for student review.

<u>Internet in Your Ear</u>

Since students are working more often in distributed groups, they need to be able to get information more effectively. Students work in groups and ask questions aloud, receiving information through earpieces that feed constant information and personalized entertainment upon request. As the students work on an experiment trying to figure out how electromagnetism works, for example, they talk through their devices to ask for definitions of words, or ask for a simulation to show them how something like Faraday's law works. Sometimes explanations don't work, so calling up a simulation can help them grasp a concept better. Once they think they understand, they apply the principle to the design and ask for feedback from teachers and co-workers.

Teachers can listen into conversations as well, and they control input when necessary for group messaging or for helping students stay on task. Centralized visualized displays are constantly updated to project student progress, tasks to be performed, and provide guided instructions for learning more about a topic and to help with task completion. Experts are available on-line to evaluate the engineering quality of the students' projects. They are also available to students when they are presenting results, so they can help them deliver their results more effectively. If students are buying materials for their products, the transactions are integrated into their digital financial records, approved by the appropriate person and delivered to the laboratories immediately.

<u>Ubiquitous Student Controlled Interfaces</u>

Voice recognition is the standard method of both input and output, occurring mostly outside the classroom where students spend much more time. Students work in laboratories communicating with devices that record student interactions, record hypothesis, previous student engagements, and direct communication links to communities that specialize in the use of the equipment and in the history of effective construction.

Underlying the user's experience is a ubiquitous interface that launches content based on what the student is working on. The interface is a 3D visual bar that can be visually refined to map to the user's experience. For example, if a student begins studying Computer Science, the visual bar identifies his learning objective, his location, his tools, his co-workers, his relevant e-mails, his notifications, the videos, related lectures and text, the experiments, the simulations, the top 10 reading lists, the polls, and the alerts for participating class members. Underneath, likes an assessment tool that reminds the students where to focus attention.

Students work in sophisticated visual environments deconstructing and constructing objects on the screen allowing them to question why things work the way they do. Imagine students using intelligent reusable visual components to build a plane that flies, a bridge that spans a ravine, or an electronic device that can actually be built by another team. As students work in simulated environments with smart learning objects, they begin to understand the underlying scientific principles, and each principle is measured and displayed to allow students to know where they are and what they need to work on next. Force feedback devices provide input that simulates real world instrumentation. Students develop a reason to learn math, and they enhance their communication skills by documenting and annotating their work for review by others.

Learning Style Adaptation

As students work in collaborative environments, the learning objects adapt immediately to their learning styles in 2020. The tools model the user throughout their learning career. It maps their preexisting knowledge to the kinds of learning objects that are useful to them for rapid learning, much like the toys they used as preschoolers. Now, in this stage of their learning careers, their emotional responses are being tracked to help them refine their ability to interact even more effectively with others.

So many automated processes have been built in for them: inquiry style, learning style, personalized activity selection, multimedia preferences, physical requirements, and favourite hardware devices. For example, if the student is in research mode, natural dialogue inquiry and social filtering tools configure a working environment for asking questions and validating hypotheses. If students like rich multimedia and are working in astronomy, they automatically connected to the Sky Server which access all the telescopic pictures of the stars, introduces an on-line expert talking about the individual constellations, and pulls up a chatting environment with other students who are looking at the same environment.

If the student is struggling with a concept, the intelligent tutoring services turn on automatically. If the student needs to practice a psychomotor skill or is restricted because of physical limitations, hardware devices are immediately recommended to assist the student, and locations at various schools nearby are identified for the student to use the equipment. If the student is having difficulty with complex processes or principles either assisted or augmented reality is initiated and the student jumps into a virtual world scenario that gives them an enhanced perspective of the problem and allows them to play the actor solving problems. This is especially useful in engineering and scientific solutions because they also reveal the math behind the phenomena, giving the student real world examples, with the theoretical supporting math. Discovering the visualizations of math can be highly contagious.

High School 2020 Scenario

Eddy's day starts when his Internet earring goes off at 6:30 with his favorite music playing. He wakes up, and sees his schedule for the day on his wall screen. He notices that he has early lunch today so he makes sure to bring a snack along with him. After getting ready, Eddy returns to grab his learning tablet and notices that he has received a bus alert with an exact GPS location. His bus is running 15 minutes late so he has some extra time to get ready. He tells his virtual mentor to identify his daily learning packet that he has received from school which contains all of his work projects, meetings and notes for the day. They are read to Eddy via voice in his earring.

Eddy has team deliverables due to be presented in his first class period. He will review the presentation with his team through his two way video tablet on the way to school. He compares his schedule to his teacher's schedule and picks a time he can log in for the remote meeting for a 1 on 1. His calendar is automatically updated with the new appointment and a message is sent to all the team members, including the teacher. Eddy's virtual mentor checks the bus online and announces to Eddy that it is just turning down his street. He gathers his tablet and his gym bag and heads out the door.

Upon entering the bus, Eddy's clothes scan his student number and the school is immediately notified that he has made the bus and will be conferencing in en route. Eddy arrives to school 15 minutes late, but has been in constant communication with his team going over last minute details for the presentation and they're good to go. His music comes up and he listens to his favorite song as he walks across campus. He arrives and joins the project team who are reviewing details about the Persian Gulf War that are relevant to Eddy's school mates in Egypt on this project. Eddy reviews a vision of the history of the discussion and watches as personalized information puts the discussion into context for him. A set of questions are automatically configured for him to review and a green light goes on indicating it's his turn to engage.

An alert appears on his tablet right before the end of the period, reminding him that he is to meet his science team outside today. Today in science, Eddy is completing his personalized learning project. This project was designed especially for Eddy's learning style and allows him to use an observation-based instructional process. While outside, Eddy works on the effects of light on plants, using his virtual biosphere to experiment. He collects real-time data from various laboratories throughout the world, helping him manage his unique ecosystem.

He begins a dialogue with plant specialists whom he encountered over the Internet. The software recognizes that Eddy struggles with some terminology as his interaction rate seems too low. His questions don't seem to map directly to *the content. His virtual mentor immediately provides support resources and appears on his screen ready to show and tell. The virtual mentor asks Eddy some questions and explains some of the concepts that he is having trouble with. After finishing the tutoring session, Eddy submits his project for team review again and receives an A, the standard grade of all high school students.*

Eddy heads to the cafeteria where he picks up his pre-ordered lunch and debits his student account. After lunch, Eddy has 3 more projects to check in on and then a free period. During his free period, Eddy has signed up to learn Chinese from a school in Beijing. Eddy signs in to the course and begins talking to his classmates via embedded cameras and a virtual interface for picking objects up. Students walk through the video/virtual city talking and discussing the environment around them. When Eddy doesn't pronounce his words right, a voice monitor appears and shows Eddy the right lip and tongue movements. He repeats and one of his virtual classmates tells him "most excellent".

After school is over, Eddy has basketball practice. Eddy's basketball is hooked to sensors that monitor the pressure on the ball, his trajectory and his travel speed before he makes a shot. During his bench time, his video glasses show him professionals making shots and highlights past games that he has played that he reviews during his next warm up. Eddy receives an alert that his mother has to work late today and that she's arranged for Eddy to go home with another mom, whose virtual mentor leaves Eddy a message, a picture of the car, and a time she'll meet him at a GPS designated location. Eddy arrives home after practice and calls his girlfriend. His snack is awaiting him in the refrigerator, calories, carbs and protein all listed in his personal health indicator. Eddy spends the rest of his event going over movie reviews with his girlfriend for their weekend date.

College and Lifelong Learning

College has changed a lot in twenty years, as college students work more often with industry partners, co-working on projects. College has benefited from improving the learning process over twenty years and students are ready to take on much more sophisticated experience working on their own rather than sitting in classes listening to lectures. They are more responsible for finding a person to work with to create solutions to real world problems. Industry and non-profit community organizations are excited about working with students as they share their workloads and help prepare students to gain work experience. Similarly, industry workers who want to learn more about various topics are happy to join teams of eager students with great ideas.

Scholastic reputation management might begin at the high school level, but it gets serious in college. Students study broader and deeper and require much more concentration and time on applying learning. All the tools for personalization, collaborating, communicating, and building are still available. The dominant technologies revolve around great visualization and programmability, laboratory tools, project management and ubiquity of tool access. Students are required to attend only the right lectures and can receive them in their ear or watch them on 2-way interactive video tablets; in addition, they utilize immersive visual environments in which they work on long term projects with customers who are actually working citizens.

Student projects are monitored with real time assessment monitors that map to the workflow metrics in the companies. Students are evaluated by their successful deliverables, their timeliness, their ability to work on teams, and their communication styles that have been monitored in process. Virtual mentors continuously adapt student interactions with their lifelong digital profiles, and map the effectiveness of their contributions to published company goals. Industry takes careful steps to identify recruiting requirements and detailed reports are shared between institutions to ensure student learning and return on investment.

Super Simulations and Sensors

Simulation technologies and powerful sensor technologies provide scaleable models for engaging in the learning by doing. Simulations allow students the opportunity to build integrated environments with objects in one environment that serve similar purposes in another environment. This level of programmability across multiple visual environments is the metric for successful development. As students move from the visual world to the real world, sensors in laboratories provide students with feedback as they reconstruct and deconstruct various objects in real time, with real materials. The laboratory environment becomes ubiquitous, and students spend the majority of their time working on projects.

Intelligent Laboratory Objects

Embedded technology now designs learning into any object used in education. Students receive physical components that instruct the student how to design, test, and connect them together. Students build robots frequently to perform various functions to prove their concepts. If the student fails to create a solution, he automatically remediates to a visual environment for practice and better visualization of key concepts. If the student still struggles with the content and actions, he is sent back to the original set of instruction and exercises through an on-line video conferencing environment. Internet based laboratories are the norm where students are able to run laboratory experiments wherever they find them, meaning that not all schools don’t have to budget to build exactly the same capabilities. Instrumentation is managed remotely and students work together in laboratory groups to learn how to use equipment effectively.

Project Management

Students write more software in 2020, not least because all scientific disciplines require increasing amounts of computing sophistication. So, they must be taught to identify opportunities and customers, manage their requirements, provide effective documentation, and manage source code, release management, testing and usability. Students manage several projects with outside customers through internet interfaces, virtual conferences, and shared workspaces. Task analysis software is personalized and everyone who is responsible for an action item is automatically notified, as well as all the related collaborators. Voice technology eases communication as students wear technology in their clothing allowing them to access both content and people wherever they are. Students are finally getting a grip on how to program software, teach programming to their co-workers or team members, and manage software projects.

<u>Higher Education 2020 Scenario</u>

Sumi wakes up in the morning, talks to her visual display on the wall and her virtual mentor brings up a visualized schedule for the day. Sumi has a videoconference meeting with her advisor at 10:00 and an economics project review to log into at 10:30. She logs into her project review venue from her room at 10:30. As the team leader (in this case the professor) moves from one key concept to the next, a Q&A session appears on the screen to check to see if Sumi understands the concepts.

The video session pauses as Sumi answers the questions, messaging to her co-workers for clarification. Sumi is struggling with one concept and her virtual mentor appears with more detail and a short video that was served up on the topic. The virtual mentor knows that Sumi is a visual learner and responds better to video with examples. After further explanation and follow-up questions, Sumi is still struggling with the topic, so a teaching assistant is notified and automatically schedules a meeting to help Sumi understand the material.

After 10-15 minutes Sumi renters the video conferencing meeting. The system summarizes the key points that she missed real time, including all student questions. She pauses the video and submits a question and a series of discussions return on topic. The answer she is looking for comes from one of the industry members that she has worked with before. She returns to the video. The session ends at 12:00 and Sumi heads over to campus for a lunch meeting.

As she bikes over to the restaurant, an audio notification sounds from a chip in her sun hat. The Health Sciences department announces a blood drive, and she sends a voice command signing her up for it. Her online schedule is automatically updated for a future reminder. Sumi eats lunch with a couple of friends, and conducts a virtual meeting with classmates in her Urban Planning project team. She's promised herself not to multitask like this when she's with friends, but she's got a deadline and it can't be helped. Sigh! Time is still the currency of the 21st century.

Her virtual project manager, a professional urban planner from a local firm, sends her great feedback on their combined project, including customer notes, a marketing video and graphical simulator showing the park improvements in the new housing development she's been working on. All of the voice commands she sends to the project manager are automatically logged and distributed to her co-workers.

Architecture class begins at 1:30 and Sumi attends in person as they are handling real building materials today. 3-D simulation software is provided at a study kiosk that allows Sumi to tweak her design and model and experiment with *different physical materials before spending time in the studio. She finds the name of a materials expert in her ubiquitous working interfaces, asks a quick reference question, makes a change to her virtual design and sends the list of materials to the studio. To help herself prepare, Sumi calls up previous projects through her course interface and reviews comments from her instructors, both in ink-written format and through personalized video feedback. She's such an overachiever. Some things never change.*

<u>Lifelong Learner 2020 Scenario</u>

Caramela registers for an advanced circuit board design course. She's having a problem in her response time and needs to learn more about crystallography. Based on her learning requirements and the course objectives, personalized academic material is downloaded into Caramela's choice of form factors (one for the car, one for reading on her tablet, one for her graphical environment). Her wallet receives the transaction receipts and her expense reports automatically reports to her company and the bill is paid instantly.

A mandatory session on campus is available via teleconference, and although Caramela is on her way to the airport at the time, the session is recorded and sent to her wireless audio device which she'll interact with on the plane. As she reviews and interacts with the material, she watches information automatically populate into her assessment monitor that she filled out with information on why she's taking this course. She identifies which content is useful to her, examines the auto-generated goal maps and aligns the information with her current projects. An e-mail is automatically generated for her to send to her co-workers, customers and teacher to update them on new ideas she has that could be related.

A notification from her instructor arrives on her cell phone with a reminder of the first online project he wants to discuss. Along with it come a research project outline, suggested contacts, and an analysis of how her current project that she identified as the reason to take the class relates to this project. The instructor reviews her task list and makes a few suggestions on how to work best with her virtual team.

A couple of days later, Caramela returns from Chicago and emails her boss with some suggestions for a decrease in resources for their project. She's figured out a clever way to solve one of their problems as a result of the first course interaction and evaluation of workflow for the project. She's seeing results already, cool! She decides to take a Q&A exercise to see how to best move through the rest of the material rather than watch the movie. She decides to work together with a couple of colleagues, who always share information on the topic she's reviewing. She returns home and spends the weekend with the kids.

Two Mondays later, she discovered that she did so well on the timed exam that the assessment tool suggests to her, the instructor and her colleagues, that she should probably move on to another interaction level. Caramela is quickly *able to advance to a simulated work experience via shared applications from a real-world 3-dimensional toolset accessible from her laptop. It's a lot easier to work on something you can see, she thinks to herself. She starts to take apart the virtual circuit board she's been working on, and the 3D environment explains what functionality has been eliminated. She inserts a new chipset that she programmed from working on her project in class, and the circuit board reflects much faster response time. She is enjoying this first week of her semiconductor course.*

In only the first week of her online class, Caramela has already demonstrated a level of skill to advance her to reach her career potential through a fully customized learning experience—accessible at her personal convenience and choice of device, personalized level of learning, and length of time to complete. She thinks she'll sign up for another.

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Author's Background

Randy Hinrichs is Microsoft Research's Group Research Manager for Learning Science and Technology. He manages a large scale Learning Science and Technology research project at MIT called iCampus, and runs a team of research developers who are building a .NET based learning research platform called the Learning Experience Project that is taking advantage of emerging technologies such as Internet2, multicast videoconferencing, wireless TabletPCs, gaming technology, web services and embedded technology. He is Microsoft's industry board member on the Accreditation Board for Engineering and Technology, IEEE Learning Task Force, the National Science Foundation's Corporate Foundation Alliance, ACM's eLearning Board, the American Society of Engineering Education and the International Network of Engineering Education and Research. He is one of the pioneers and a board member of the Learning Federation, a consortium of industry, government and universities focused on an international research agenda for LST.

He has been working as an educational technologist researcher for 25 years. He wrote two ground breaking books on using the web for education: Web Page

Design: A Different Multimedia (cognitive and interactivity design), and Intranets: What's the Bottom Line (creating learning organizations with intranet technology). He has testified before Congress for the Web Based Education Commission, participated in the PITAC Subcommittee on Learning. He frequently keynotes at many international web education conferences and continues to appear in many articles both as an intranet strategist and visionary on the web in education. His penchant is simulation-based technologies that enable activity based learning. His lifelong passion is to help teachers and students effectively use technology in education to enhance their learning.