

Active Learning Electronic Resources and Tools for Inquiry on Tablet Devices

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Abstract

The purpose of this paper is to present a research-based compendium of Active Learning Electronic Resources and Tools (ALERTs) for Inquiry Active Learning (IAL) and their uses in Education in general, and in Science Education in particular. In this paper, we focus on tools and resources that can be used on tablet devices, such as the ipad. The intention of the paper is to present a sample of tools that can be useful in accomplishing inquiry tasks. When students are involved in inquiry such as research, or project-based learning, they become active learners, and follow a question that they are motivated to investigate. Tools and resources become indispensable for inquiry tasks, and implementing them using easy-to-use applications on tablet devices can offer new opportunities for creativity. Although the number of applications is increasing in specific categories, such as, applications for presentation and applications for whiteboarding, and screencasting, yet applications for quantitative and qualitative data analysis are very limited in functionality, and make the use of stand-alone non-tablet devices still important for completing the inquiry cycle.

Introduction

In Science Education, different implementations of Inquiry-based instruction that engage students in activities, projects, cases, or research projects promote students' Active Learning (AL) inside and outside the lab or classroom. Engaging in any form of Inquiry Active Learning (IAL) involves a plethora of tasks and activities that can be carried out by the student alone, or by groups of students engaged in a community of learners. Making observations, collecting data, analyzing data, searching for information, solving problems, engaging in group discussions in a classroom or online, or constructing and presenting knowledge are all examples of IAL tasks and activities. Accomplishing these IAL tasks and activities necessitates using various tools that can be used to facilitate reaching the learning goals. Today, many standalone, community-based, as well as collaboration-centered Active Learning Electronic Resources and Tools (ALERTs) are available to help students accomplish the various Inquiry activities and tasks, and promote their AL in science. Open Educational Resources (OER), and Massive Open Online Courses (MOOCs) are examples of newly available learning resources that students can use in their IAL tasks and activities. Cloud-based collaboration, tablet-based apps, technological tools for flipped classrooms, interactive lecture response systems, and other Technology-Enabled Education (TEE) tools are examples of new tools that can engage students in AL, and more specifically IAL. Higher quality and successful accomplishment of IAL tasks and activities depend on students' knowledge of the appropriate resources and tools and their effective use. In many

cases, students, and teachers may not be knowledgeable about various ALERTs and their effective use. This gap may possibly hinder learning, decrease motivation, cause lower engagement, or contribute to lower achievement.

Purpose

The purpose of this paper is to present a research-based compendium of tablet-based ALERTs and their uses in Education in general, and in Science Education in particular. This ALERTs compendium would serve as an ideal learning tool by itself. Knowing about existing ALERTs, their capabilities, and their effective use can direct students towards the appropriate tools and resources, and help them conceptualize alternative learning strategies. Students can use the compendium when they are working on an IAL task or activity by themselves or within a community of learners. Science teachers can also consult the compendium to help them design IAL tasks and activities. Some resources and tools in the compendium may be more relevant to specific science disciplines such as physics or chemistry, while other resources and tools may be general for any discipline.

Context

The literature on Inquiry provides different conceptualizations of what Inquiry represents. One of these conceptualizations is that it “involves developing and implementing a plan to satisfy curiosity, collecting data, evaluating evidence, drawing conclusions, reflecting on strengths and weaknesses of the plan, and engaging in a new sequence” [1]. Enacting Inquiry requires many skills, techniques, and knowledge in order to perform the various tasks involved in inquiry. For example, in reference [2], 36 research skills were listed for inquiry as research. In our paper, the emphasis is on the tools (the ALERTs) that can help accomplishing various Inquiry Active Learning (IAL) tasks on tablet devices.

Methods

We searched three popular education technology websites for tools that can be used for different inquiry tasks. The websites are: (a) www.edudemic.com, (b) www.edutopia.org, and (c) www.classtehtips.com. We searched two mash-up websites, which are: (a) Pinterest (www.pinterest.com), and (b) Learnist (www.learnist.com). We also searched the Apple App store. In addition to these searches, we have included the tools that we use for various inquiry steps. We organized the tools according to their use in inquiry.

Data Analysis

The resulting tools and resources were categorized according to different tasks of Inquiry. During inquiry, students need tools to collect and organize information, create bibliographies, brainstorm ideas, refer to specific discipline-based material, consult peers, analyze data, write documents, create presentations, posters, collages, audio or video presentations, or blogs. All these tasks can be performed during an inquiry, and all of them require specific resources or tools to help students accomplish these tasks.

Results

In this section, we outline the tools and resources that can be used in inquiry.

1. Collecting and organizing information is essential for inquiry. Students who work on projects search for information that is relevant to their questions. The next step is for the students to collect and organize the information that they find and decide that it is important and relevant to their investigation. The following tools can help students collect, and organize the information that they find:
 - a. Pocket (www.getpocket.com): Pocket is an app that allows saving web pages, photos, audio or video.
 - b. Readability (www.readability.com): Readability is an app that allows archiving digital content for offline consulting.
 - c. Evernote (www.evernote.com): Evernote is a tablet-based app that allows the students to capture ideas, photos, recordings, or just about anything else on your their accounts, access it anywhere, and keep it organized.
 - d. Diigo (www.diigo.com): Diigo lets the student use web-pages like paper-based material, making it simple to highlight, bookmark, take notes, or even add sticky notes.
 - e. Pinterest (www.pinterest.com): Pinterest let students pin just about any image they find interesting on the Pinterest site. Many teachers are also using it as a place to collect great lesson plans, projects, and inspirational materials.
 - f. MentorMob (www.mentormob.com): Mentor Mob allows students to create a learning playlist, which is essentially a collection of materials that can be used to study a specific concept.
 - g. Learnist (www.learnist.com): Learnist allows combining resources such as videos, ebooks, maps, blogs, podcasts, surveys, and pages. The tool is like a collaborative multimedia and interactive ebook.
2. Managing a bibliography is a very important skill in inquiry. When a student completes inquiry, communicating the results is what demonstrates the work accomplished. The work that the student does is related to a field or a discipline, where resources are the building blocks on which the student builds the inquiry. Referencing the consulted work, and citing resources shows the student's the breadth of the information search and investigation. Many apps exist to help students manage references and bibliographies. Some of these apps are:
 - a. EndNote (www.endnote.com): EndNote is a classical bibliography management system that can help organizing references.
 - b. Sente (www.thirdstreetsoftware.com): Sente is a reference manager and database search tool. It allows reading and editing PDF files, as well as searching databases, such as Google Scholar or Web of Science.
 - c. Papers (www.mekentosj.com/papers): Papers is a reference manager and database search tool. It allows reading and editing PDF files, as well as searching databases, such as Google Scholar or Web of Science.
 - d. Mendeley (www.mendeley.com): Mendeley is a reference manager that also allows reading and editing PDF files.
 - e. Bookends (www.sonnysoftware.com): Bookends is a reference manager and database search tool. It allows reading and editing PDF files, as well as searching databases, such as Google Scholar or Web of Science.
3. Conducting inquiry requires discipline knowledge. Understanding discipline knowledge, and knowing gaps in the knowledge base of a discipline lead to more innovative inquiry

projects. The proliferation of university-offered courses in the form of Massive Open Online Courses has made consulting course content in many courses easy and feasible. Students who are motivated to investigate an inquiry, and lack specific course content knowledge can find this knowledge with more ease from various institutions that offer high quality course material. Some of the sites that offer the discipline-based knowledge are:

- a. Coursera (www.coursera.org): Coursera offers free courses from 62 universities, where students can take classes, watch lectures, and learn at their own pace
 - b. edX (www.edx.org): edX offers free classes from 12 universities in many subjects, such as biology, computer science and statistics
 - c. Open Learning Initiative (OLI) (from Carnegie Mellon University): OLI offers free online courses to anyone who wants to learn or teach.
 - d. Udacity (www.udacity.com): Udacity offers free online classes, as well as certificates of completion.
 - e. Udemy (www.udemy.com): Udemy is a commercial site that offers many practical professional development courses.
 - f. Khan Academy (www.khanacademy.org): Many students use this excellent collection of math, science, and finance lectures and quizzes to supplement their learning materials.
 - g. iTunes U (www.apple.com/education/iTunes-U/): iTunes U is a platform that students can use to access courses offered by many universities that use iTunes U to present their courses.
 - h. TED-Ed (ed.ted.com): TED-Ed offers a growing video library that educators can use to teach a lesson, or students can use to learn.
 - i. Youtube EDU (www.youtube.com/education): Youtube EDU offers students a large video library of educational material, such as lectures, speeches, and professional development training material.
4. Social learning is learning through a community of learners. Inquiry is deeply rooted in constructivist theories [3-5], Social Constructivist theories [6-8], as well as Socio-Cognitive theories [9, 10]. Websites and tablet-based apps have incorporated “social” features, where users can share and collaborate using different platforms. Some of the social learning tools are the following:
- a. Edmodo (www.edmodo.com): Teachers and students can take advantage of this social network Facebook-like environment, where classes can connect online.
 - b. Edublogs (www.edublogs.org): Edublogs allows users to create educational blogs. This is very useful for both students and teachers to share knowledge, as well as learn together, by asking questions, offering answers, materials, and links to resources.
 - c. Wikispaces (www.wikispaces.com): Share lessons, media, and other materials online with your students, or let them collaborate to build their own educational wiki on Wikispaces.
 - d. Quora (www.quora.com): Quora offers a social network site for asking and answering questions. It can connect students in useful discussions related to class material.
 - e. Openstudy (www.openstudy.com): Openstudy can help students work together on class material.

5. Analyzing data is an important skill in inquiry. Analytic skills include categorization and classification, comparing and contrasting, finding relationships, or plotting graphs.
 - a. Inspiration (www.inspiration.com): Inspiration is a tablet-based app that can help student create concept maps that translate their ideas into shapes and figures. Inspiration offers templates for qualitative analysis of a character, a plot, a civilization, an event analysis, or an innovation. This can be helpful for students who are guided to analyze their data.
 - b. Maxapp (www.maxqda.com/products/maxqda11/mobile-app): Maxapp is a qualitative analysis tool that enables users to use icons to code data.
 - c. Tagcloud (www.tagcloudapp.com) : This is an app that can generate maps (or word clouds), where the size of the most frequent words is proportional to the frequency of occurrence of the words in a text.
 - d. OmniGraphSketcher (www.omnigroup.com/products/OmniGraphSketcher) : OmniGraphSketcher provides users with tools to plot graphs on tablets
 - e. JMP Graph Builder (www.jmp.com/software/jmp10/jmp-graph-builder-for-ipad.shtml): JMP Graph Builder provides users with the ability to import data from Dropbox, and interact with the data in different ways to visualize and represent the content of the data.
 - f. Numbers (www.apple.com/ca/apps/iwork/numbers/): This is a native spreadsheet app from Apple. The app runs on the iPad, and offers classical spreadsheet capabilities, such as inserting rows and columns of numbers, sorting values, and representing numerical data in graphs.
6. Creating a model, a mind map or a concept map involves representing ideas and solutions through figures and relationships. Brainstorming is important in order to get the ideas out and represent them. When the ideas are represented, and have a form and shape, they are easier to express and communicate, and also share, and use for collaboration. This can also lead to refining the ideas, and discovering hidden relationships. Modeling is also an important task in inquiry. A student can model ideas at the stage of brainstorming, or at the stage of analysis or making conclusions about the inquiry investigation. Various tools exist for mind mapping, concept mapping, brainstorming and modeling. These tools share the common feature of allowing the user (or student) to represent ideas through shapes, and try to connect the shapes through lines that represent a link or a relationship. Today, many apps exist on tablets to help students accomplish the task of brainstorming, or modeling with ease. For example, the following apps offer students simple interface and tools for brainstorming and modeling:
 - a. Notability (www.gingerlabs.com/cont/notability.php): Notability is a tablet-based app that can simplify the workflow between teachers and students, who can use it to create, retrieve, annotate and submit work.
 - b. Penultimate (www.evernote.com/penultimate): Penultimate is a tablet-based handwriting app. The app allows students to draw, write, present concept, or model their ideas
 - c. Popplet (www.popplet.com): Popplet is a tablet-based app that allows students to brainstorm ideas, create mind maps, share, and collaborate.
7. Writing a report that explains the inquiry is important to communicate the steps taken in the investigation, the results, and the conclusions. In most cases, a written report or essay

is required from students, where they have to demonstrate their learning. Many apps exist to help students accomplish the writing task. Some of these apps are:

- a. Quickoffice (www.quickoffice.com): This app offers a complete office suite for the tablet.
 - b. Plaintext (www.hogbaysoftware.com/products/plaintext/): This is a simple text-editing app.
 - c. iA Writer (www.iawriter.com): This is a simple text-editing app.
 - d. PaperDesk (www.mypaperdesk.com): This is a text-editing app that provides simple handwriting capability in addition to typing.
 - e. Pages (www.apple.com/ca/apps/iwork/pages/): This is a native word-processing app from Apple. The app runs on the iPad, and offers classical word-processing capabilities, such as editing text, and inserting images and graphs.
8. Presenting an inquiry to audience shows many skills from students. Presentation requires first preparing a well-organized presentation, with appropriate content, language and graphics, and well-timed delivery. Presentation skills also include attention to audience, and communication skills. Many apps exist to help students prepare and deliver presentation. Some of these apps include the following:
- a. Haiku Deck (www.haikudeck.com): Haiku Deck is free and boasts intuitive design with easy-to-use interface, where students and teachers can access presentations directly from the app and via the web. Students can play their presentations directly from the iPad, email them, and share with Facebook and Twitter.
 - b. Prezi (www.prezi.com): Prezi is a tablet-based and online tool that makes it simple to prepare a presentation on a big canvas, and zoom in and out to explain concepts embedded in the presentation.
 - c. Slideshare (www.slideshare.net): With SlideShare, students can upload their presentations, documents, and videos and share them with other students and teachers.
 - d. Speaker Deck (www.speakerdeck.com): Speaker deck is a simple online tool that allows students to share their presentations.
 - e. PDF Slides (www.rtmsug.de/pdfslides): This app provides a simple way to show presentations from an iPad on a screen.
9. Creating an audio presentation, audio channel, a podcast, or an audio recording is now a way of communicating information related to the inquiry to audience anywhere in the world. Some tools are very easy to use, and can assist students in recording their narratives, commentaries, audio notes, or a final audio radio-like episode or podcast. Some of these tools are the following:
- a. SoundCloud (www.soundcloud.com): SoundCloud is an online audio library that offers what YouTube offers for videos. SoundCloud is also an app that can be used to record audio directly from a tablet, and upload it to an audio channel.
 - b. Audioboo (www.audioboo.fm): Audioboo allows students to create audio recordings, and upload them directly to the Audioboo website.
10. Creating a screencast is useful way for illustrating concepts, demonstrating ideas or procedural knowledge, and sharing them. Screencasts can be used by students to share their learning, or by teachers who can use them as whiteboards. Some of the apps that provide screencast functionalities are the following:

- a. Educareations (www.educareations.com): Educareations is an online tool for the iPad that lets teachers (or students) create screencasts.
- b. Showme (www.showme.com): ShowMe is a presentation and screencast creation app.
- c. Screenchomp (www.techsmith.com/screenchomp): Screenchomp is a simple whiteboard screencast creation app.
- d. Doceri (www.doceri.com): Doceri is a professional iPad interactive whiteboard and screencast recorder with sophisticated tools for hand-drawn graphics and remote desktop control.
- e. Baiboard (www.baiboard.com): Baiboard is an interactive collaborative tool for recording screencasts with many options for sharing, and exporting content.

Discussion

Inquiry is a multifaceted activity that involves many tasks. Inquiry normally starts with a question and follows an investigation to answer that question, then present and communicate the results. In every step and for every task during inquiry, various tools are needed in order to accomplish these tasks. In this paper, we presented a sample of tools and resources that can be useful, and help students in implementing their inquiry with more ease on tablets. We find that tablets can be useful learning devices when students use the appropriate resources and tools on them. Tools and resources become indispensable for inquiry tasks, and implementing them using easy-to-use application on tablet devices can offer new opportunities for creativity. Although the number of applications is increasing in specific categories, such as, applications for presentation and applications for whiteboarding, and screencasting, yet applications for quantitative and qualitative data analysis are very limited in functionality, and make the use of stand-alone non-tablet devices still important for completing the inquiry cycle.

References

- [1] Shore, B. M., Chichekian, T., Syer, C., Aulls, M. W. and Frederiksen, C. Planning, enactment, and reflection in inquiry-based learning: Validating the McGill strategic demands of inquiry questionnaire. *International Journal of Science and Mathematics Education*, 10(2011), 315-337.
- [2] Bromley, A. P., Boran, J. R. and Myddelton, W. A. Investigating the baseline skills of research students using a competency-based self-assessment method. *Active Learning in Higher Education*, 8(July 1, 2007 2007), 117-137.
- [3] Steffe, L. P. and Gale, J. E. *Constructivism in education*. Erlbaum, City, 1995.
- [4] Von Glasersfeld, E. *Radical constructivism: A way of knowing and learning*. Falmer, London, England, 1995.
- [5] Von Glasersfeld, E. *Learning and adaptation in the theory of constructivism*. Routledge, City, 1996.
- [6] Veer, R. v. d. and Valsiner, J. *Cultural-historical theory*. Blackwell, City, 1991.
- [7] Vygotsky, L. S., Davidov, V. and Silverman, R. J. *Educational psychology*. St. Lucie Press (Original work published 1926), Boca Raton, FL, 1997.
- [8] Vygotsky, L. S., Rieber, R. W. and Carton, A. S. *The collected works of L.S. Vygotsky*. Plenum Press, New York, NY, 1987.
- [9] Bandura, A. *Social learning theory*. Prentice Hall, Englewood Cliffs, N.J., 1977.
- [10] Bandura, A. *Social foundations of thought and action: A social cognitive theory*. Prentice Hall, Englewood Cliffs, NJ, 1986.