Assessing Technology as a Tool in History Education

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WPI and IIT Mandi

29th April 2019
Assessing Technology as a Tool in History Education

An Interactive Qualifying Project
submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

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Date: 29th April 2019

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This report represents work of WPI undergraduate students submitted to the faculty as evidence of a degree requirement. WPI routinely publishes these reports on its web site without editorial or peer review. For more information about the projects program at WPI, see http://www.wpi.edu/Academics/Projects.
Abstract

STEM students in India reflect a global pattern of science and technology students lacking interest or comprehension of humanities subjects. This project assessed the feasibility of using technology to augment world history lessons. We assessed the current use of technology for students and teachers using interviews and surveys on two college campuses as well as classroom tests. This project can be used to inform further study into the use of technology to streamline learning styles in Indian education.
Executive Summary

An educated and historically informed population is vital in creating a functional country that avoids repeating the mistakes of the past. Therefore, the standard of education includes awareness of world history, regardless of occupation to uphold political and historical literacy for the good of all. Despite this, Science Technology Engineering and Math (STEM) students are not gravitating towards or retaining the vital concepts taught in a world history curriculum. The fourth United Nations Sustainable Development Goal of providing quality education aims for "promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development" ("Education - united nations", n.d.). Education of history is how appreciation for culture and a global mindset is achieved. A challenge in this project was how the process of learning world history can be more appealing to STEM students.

This project engaged students at two college campuses in north Indian. Using tests and interviews, we tested if technology would make incorporation of visuals and interactivity more seamless (Harvey, 2010). The goal of our project was to assess the feasibility of developing a technologically enhanced visually attractive platform for teaching world history to STEM students.

Background

Amongst Indian higher education, the IITs are “premier engineering and technology universities” (Cheney, 2006, p. 24). The students that attend these of universities are among the primary stakeholders for this project, as they are STEM students that can benefit from broad perspectives.

Theories of learning styles says that certain people can absorb knowledge better depending on how it is conveyed. One study showed undergraduate STEM students performed better on average when taught in a “collaborative, simple problem solving” environment than in a textbook based environment (Pazos, 2010). There are platforms that can be used to enhance learning outcomes for history, including visualizations such as Geographic Information System (GIS). GIS is software that expresses statistical data on geographical maps (Knowles, 2008, p. 2). Visualizing history from a physical and geographical perspective can be difficult from plain text.

STEM students can be encouraged to engage with history by leveraging learning styles and personal interest, both of which have the potential to be addressed by the augmentation of technology. We have found that technology can be an effective tool for teachers by providing new ways to engage students and convey information. We also found that any addition of technology is not to be a substitute for teachers and their skill, but an extension of it, meaning that an effective lesson plan and implementation are still crucial.

Methodology

Objective 1: Confirm preferred learning strategies

To assess the preferred learning styles of STEM students we created sample lessons (one visual and one collaborative) and tested them on STEM students. About 20 students were given a QR code which linked to a 1-page reading exercise on the topic of Manifest Destiny during the Westward Expansion. Once they finished the reading, students were
split into 2 groups. The first group was shown a video. The second group was given a collaborative lesson. After the experiments, all students were sent an electronic exit survey on their phones and 5 participated in additional in-depth semi-structured interviews to solicit their thoughts on the lesson. Additionally, we sat in on classes and took notes on class engagement and productivity from the students as well as the professor.

**Objective 2: Assess access, familiarity and interest in technology platforms**

To assess access, familiarity and interest to technology platforms amongst STEM students at IIT Mandi, we visited classrooms to observe use of technology commonly used by students and teachers, including smartphones, projectors, internet, apps, social media, and so forth. We also interviewed students and teachers about their familiarity with technology. We investigated the viability of introducing new devices to the classroom, such as VR goggles. A survey was also shared with about 30 students at both IIT Mandi and Vallabh College to gain this information from students that we could not meet in person.

**Objective 3: Determine if technology can be used to enhance learning**

Based on our findings from objectives 1 and 2, we narrowed our optimal technology platform. We performed a second classroom test in a university history class with 55 students. We prepared and taught a lesson about the Corps of Discovery Westward Expansion Expedition. The class was studying Westward expansion but had not covered The Corps of Discovery, meaning data would not be affected by variation in prior knowledge.

A short video taken from the Internet was used to give a brief topic introduction before the students were split into groups. They were asked to bring up a GIS website on their personal laptops or devices which contained a map of the United States with information, dates, and locations of key events of the Corps of Discovery journey. The students were given questions about the topic and were tasked with finding the answers by locating the relevant event. Afterwards, the students were quizzed for retention and comprehension with a quiz and were given an exit survey on their opinions of the lesson.

**Results**

*Preferred learning strategies*

The students that participated in the classroom test reported that they found reading text to be boring, with many telling us they were done before they had actually completed the reading. They said a video held their attention more and that the collaborative lessons were helpful in helping them grasp the concepts.

Most of the professors we interviewed incorporated visuals and videos into their slideshows, as they can explain certain concepts and hold the attention of students better than traditional lectures. However, many emphasized a whole lesson could not be delivered through videos. About half the professors used collaborative or hands-on activities in their lessons. For the history professor interviewed, students were put in groups to discuss assigned readings.

Our interviews with IIT Mandi graduates and undergraduates and undergraduate students from Vallabh University in Mandi touched on learning preferences, difficulties, and general thoughts on classroom technology. We found that the students preferred a
wide variety of teaching styles and had a strong connection with handwriting notes from a blackboard lecture. Visuals and collaborative exercises were recognized as compliments to the lesson, which they greatly enjoyed.

**Access, familiarity, and interest in technology**

During our classroom lesson, we noticed all students were competent in the use of smartphones, being able to read a QR code and look at the lesson on their personal devices. All the professors used the projector and PowerPoint presentations, while only some would supplement the lessons using their own technological devices such as a personal laptop. In one university, professors complained of frequent power outages and loss of internet. Some professors incorporated students’ personal devices into the classroom. However, others were against this idea, feeling it was either unnecessary or would be distracting.

Students, when interviewed, all said that they were already using their phones in their studies. They recognized that IIT Mandi has access to the best technology in India. Some students admitted being distracted by their phones during class. In interviews, it was more significant among humanities than those STEM classes. The cell phones are only an issue with undergraduate students, as the graduate students have a mature outlook on their classes and pay attention to the lectures. Internet use findings are summarized below in Figure a.

![Figure a: How do you use the internet for school? (N = 63)](image)

**Technology for enhanced learning**

Every group successfully accessed the website within a couple minutes of writing the link on the board. Many students seemed initially unfamiliar with how the GIS site worked but became more fluent as class progressed. Because the majority of multiple-choice questions were answered correctly, it can be concluded they learned how to use the system within the allotted time. Some students began to use outside sources to answer questions, such as Google or Wikipedia. This was discouraged for accurate test results. Out of the fifty students, only three or four were consistently off task. On average, it appeared most students reached the last or second to last question, which was a short answer paragraph, but were unable to fully finish the quiz.
Additional findings

Some students were uncomfortable speaking English. All the professors noted this, as it is usually not their primary language. When asked, none felt an electronic translator, such as a phone app, was a proper solution to this issue. Instead, they felt it was best to become more proficient in English, as fluency will help them. When asked about their humanities courses, many of the undergrads said about half the courses they took were for personal interest and the other half they took due to requirements. The courses they were required to take they said they pay much less attention to and learn much less.

Discussion

We found that everybody already used some form of technology for their studies, such as an app or a YouTube explanation. Second, IIT Mandi offers the most cutting-edge technology in India and uses it to the fullest capability. Third, there is a very strong culture of interpersonal connection that is a crucial aspect of the classrooms here. Technology is a proper supplement for all lessons, but it is important to the students that it never replaces the interaction and friendship companionship that is so vital to the Indian school system. There seems to be a nearly universal agreement amongst all the students and professors involved in our project that STEM students at IIT Mandi, much like those in America, have a general preference for visuals and collaborative learning. However, we were surprised to find that many students at IIT Mandi struggle with English. This observation has additional implications for traditionally text-based learning in history studies. At the same time, professors prefer that student practice English and become fluent rather than use an external, technology-based translator, such as a phone app. Another surprise was that the intermittent power outages and internet access cutting out were the main impasse for professors trying to utilize the technology provided to them.
Project Outcomes

At the close of our study, we recommend a focus more on increasing visuals and collaboration in class rather than to simply adding technology for its own sake. Many of the participants we talked to feared that technology would decrease the face to face interaction between teachers and students and felt that would be a detriment to learning. We constructed the visual above to depict examples of smoothly incorporating technology into a lesson. We have outlined our recommendations specifically applicable to lessons in Figure b below.

We found little need for extensive additions for technology as many of those questioned seemed apprehensive to the idea of adopting a wholly new technology into their classroom as well as not seeing value in the effort required in implementing such a system. The most important thing in applying technology in the classroom is to make sure that in doing so the human element and traditional teaching remain and technology is used as a supplement and resource to increase the number of visuals in the lesson. Shared technology can be used to encourage collaboration. When students were given assignments in teams with shared laptops, students displayed normal team interaction.

Existing technology can be utilized more than it already is to streamline learning styles particular to STEM students. This can increase in-person interaction, achieving the goal of increasing the interest and comprehension of world history subjects. We also found that whatever technology is implemented needs to avoid being overly reliant on existing infrastructures, as they pose reliability problems that make professors apprehensive towards their utilization.
Acknowledgements

We would like to express our gratitude to the people who helped us during our time in India.

Dr. Gbeton Somasse and Dr. Ingrid Shockey, our advisors
Dr. Rajeshwari Dutt, the project's sponsor
The IIT Mandi campus and The Vallabh campus, for allowing us to interact with their faculty, staff, and students.
Rameez Raja Khan, Teaching Assistant
# Authorship

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1. History deserves a space in STEM education

Historians are often asked about the benefits of a deep understanding of world history (Corfield, 2008). It can seem arcane and inconsequential that the start of World War I was an assassination of a royal heir by a small revolutionary group, but it is illustrative of the idea that political actions have cascading consequences which have shaped the world and continue to do so. An educated and historically informed population is vital in creating a functional country that avoids repeating the mistakes of the past. Therefore, a complete education must include awareness of world history regardless of occupation for cultured and globally-minded population.

Despite its relevance, Science Technology Engineering and Math (STEM) students are not gravitating towards world history curriculum. The disconnect could come from a lack of student interest, or from less engaging styles of teaching history material. It is sometimes difficult to persuade students in STEM fields that learning history is important, as it often is not clearly shown how it directly benefits STEM careers. However, having a greater understanding of how the world works and has worked “opens us up to a fuller range of ways to both improve the world and find our place in it” (Ferro 23, 2011). The fourth United Nations Sustainable Development Goal of providing quality education aims for “promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture’s contribution to sustainable development” (“Education - united nations”, n.d.). History education is how appreciation for culture and a global mindset is achieved.

A challenge in this project was how the process of learning world history can be more appealing to STEM students. A study of undergraduates in the UK evaluated more deeply the educational motivation of STEM learners. Of the subjects, 72% chose a STEM major intrinsically, meaning they had a strong curiosity or true love for their degree. Conversely, 58% of students from the same sample chose to learn humanities for extrinsic motivations, meaning that their reasoning was based on the wants and needs of other people (González-Becerra, 2017).

This project engaged students at two college campuses in Himachal Pradesh, India. Using tests and interviews, we tested if technology would make incorporation of visuals and interactivity more seamless (Harvey, 2010). In particular, visually-based learning modules can be created and adapted to existing technological devices such as projectors, smart phones, or laptops in the classroom. STEM students could be taught important concepts of world history in a more interactive and visual manner, while enhancing the ability to teach vital concepts. Therefore, the goal of our project was to assess the feasibility of developing a technologically enhanced visually attractive platform for teaching world history to STEM students. To achieve this goal, we identified 3 objectives: 1. Confirm preferred learning strategies for STEM students; 2. Assess access, familiarity and interest in technology platforms; and 3. Determine if technology can be used to enhance learning. The completion of these objectives helped us to determine the feasibility of using a tech-enhanced platform for STEM students.
2. The drive for technology-based education

India is heavily invested in STEM education. As one expert noted, “India has one of the largest higher education systems in the world” (Kumar, 2011, p. 40). Furthermore, amongst Indian higher education, the IITs are “premier engineering and technology universities” (Cheney, 2006, p. 24). The students that attend these universities are among the primary stakeholders for this project, as they are STEM students that can benefit from broad perspectives. Many STEM fields focus on solving problems, so it is important that the students take a socially conscious approach to these problems. This means a grasp of cultural context and historical connections.

Leveraging how STEM students learn

Our preliminary research showed that STEM students learn differently than students of other majors. The theory of learning styles says that certain people can absorb knowledge better depending on how it is conveyed. While there isn’t an agreed upon set of such styles, studies have shown students tend to have a preference for how they are taught, often depending on their field, for our purposes we will refer to these preferences as learning styles.

One study showed undergraduate STEM students performed better on average when taught in a “collaborative, simple problem solving” environment than in a textbook based environment (Pazos, 2010). Another study by a mechanical engineering class at Northern Illinois University was designed around the use of a video game to teach numerical methods (Coller & Scott, 2009). The students used mathematical concepts learned in the class to create algorithms. This case study tested student engagement and interest in the course material using a video game seen in Figure 1.

Figure 1: Images of game used in study (Coller & Scott, 2009)
The subjects were given an incomplete video game program and asked to complete it with their own code. About half the subjects took the game-based version of the course, the other half in traditional lecture-based classes. The subjects were surveyed on how many hours were spent out of on each subject which can be seen in Figure 2.

![Figure 2: Effects of game-based learning on student engagement (Outside of class) (Coller & Scott, 2009)](image)

It can be seen that the game-based course had the most time spent on it outside of class on average, suggesting the integration of games provoked a deeper interest in the course.

Incorporating the video game into classwork and projects switches the purpose of learning from high grades to exploring a real-life application of material (Coller & Scott, 2009). Because the goal of history courses is to develop connections of the topics and the real world deep, making history subjects more tangible helps STEM students by appealing to a hands-on approach and making history subject seem more interesting and real.

**Use of apps in the history classroom**

In experimenting with using technology to teach, we found that teachers use mobile apps in conjunction with their lessons on social studies and history. One study recorded history teachers’ perceptions about a variety of hand selected apps that they used in their classes. Six apps were featured, and the report described their classroom application and the positive and negative feedback of the teachers (Waters, Kenna, & Bruce, 2016). Three are described in greater detail here.

The first app, called Explain Everything, facilitates the presentation of materials by allowing a teacher to display all kinds of content on the screen of an iPad. This “virtual whiteboard” takes the place of a PowerPoint on a projector while recording the teachers voice and the lecture itself. Within the app, students can also read and mark up items such as historical texts, as well as record and share their thoughts on certain topics. This app received positive feedback from teachers because it can replace expensive equipment such as smartboards, and it is also helpful in keeping students up to date if they are absent.

Next, Aurasma is an app that gives the user the ability to create their own virtual reality (VR), which could be helpful in presenting world history in a new media format.
This app received mixed reviews amongst the participating teachers, noting the large amount of time and effort to create a VR environment, as well as the high student engagement and enjoyment.

Finally, Class Dojo is an application that tracks the social interactive behavior of students using a points system. This could be incorporated into a history curriculum to mediate student collaboration in group projects. This app received poor reviews from teachers because the students became fixated on receiving points, which undermined the learning environment. One aspect of this app that the students enjoyed, however, was creating an avatar to participate in the class (Waters et al, 2016).

Apps like these can provide a teacher more freedom and power to teach by expanding the resources in a classroom. It is important to note that an app is only as effective as the teacher and class can make it. In the right application, technology can be an extension of a teacher’s natural ability to lead a classroom, allowing them to present enriched and interactive modules based on the same core concepts.

**Use of other platforms to teach history**

In addition to apps, there are platforms that can be used to enhance learning outcomes for history. These include more advanced virtual reality (VR) experiences, including visualizations such as Geographic Information System (GIS). GIS is software that expresses statistical data on geographical maps (Knowles, 2008, p. 2). Visualizing history from a physical and geographical perspective can be difficult from plain text. GIS has an added advantage regarding static maps in that it can be interacted with, updated with new data, and customized. The University of Virginia’s Center for Digital History created a project through GIS, The Valley of the Shadow Project, which compared social and economic data in The American Civil War. This was created with the goal to “make primary documents more accessible for research and teaching” (Knowles, 2008, p. 6). An image capture of the system in action can be seen in Figure 3.

*Figure 3: Valley of the Shadow GIS Video Archive (Ayers, 2007)*
Similarly, VR can be used to generate images, three-dimensional or otherwise, that gives the illusion of being in the location. ClassVR is an organization that provides VR hardware made for use in the classroom and apps, such as the History Times, a collection of wide-angle panoramic photographs of various historically significant sites (“School VR subjects”, 2018). Using VR headsets in conjunction with these images allows the user to feel as though they are in a different location or time period, which can add to their intrigue and emotional investment in the history subject.

Indian STEM students in secondary-to-higher education are already making use of technology as an educational supplement. For example, “the Ministry of Human Resources Development, Government of India launched the ‘National Program on Technology Enhanced Learning (NPTEL)’ in the year 2003. The aim of the NPTEL is to develop curriculum-based video lectures and web courses to enhance the quality of engineering education in India” (Kumar, 2011, p. 42). Furthermore, a study in 2015 found that around 70% of Indian students owns a Smartphone (Bandi, Bose, & Saxena, 2015, p. 90). These facts tell us that Indian students are comfortable with technology and that it is a viable medium to augment visual and problem-solving education.

In sum, STEM students can be encouraged to engage with history by leveraging learning styles and personal interest, both of which have the potential to be addressed by the augmentation of technology. We have found that technology can be an effective tool for teachers by providing new ways to engage students and convey information. We also found that any addition of technology is not to be a substitute for teachers and their skill, but an extension of it, meaning that an effective lesson plan and implementation are still crucial.
3. Data collection and Analysis

The goal of this project was to assess the feasibility of a technologically enhanced platform for teaching world history to STEM students. The objectives were as follows:

1. Confirm preferred learning strategies.
2. Assess access, familiarity and interest in technology platforms.
3. Determine if technology can be used to enhance learning.

To achieve these objectives, we used surveys, user testing, and interviews of the targeted STEM students, history professors, and education experts. Figure 4 summarizes the approaches used by objective.

**Figure 4: Flowchart for Methodological strategies**

**Objective 1: Confirm preferred learning strategies**

Our prior research indicated that STEM students prefer visual and collaborative lessons as opposed to reading and lectures. To confirm that preferences of our student sample at IIT Mandi was congruent with findings from the literature, we created sample lessons (one visual and one collaborative) and tested them on STEM students.

About 20 students were given a QR code which linked to a 1-page reading on the topic of Manifest Destiny during the Westward Expansion. This topic was chosen because the sample population was unlikely to have previous knowledge of the subject that would
have affected results. Once they finished the reading, students were split into 2 groups. The first group was shown a video discussing the painting shown in Figure 5 below.

![Figure 5: “American Progress” by John Gast, used in visual lesson.](image)

The second group was given a collaborative lesson where they were asked to perform analysis on key terms from the reading as a team. After the experiments, all students were sent an electronic exit survey on their phones and 5 participated in additional in-depth semi-structured interviews to solicit their thoughts on the lesson. Additionally, we sat in on classes and took notes on class engagement and productivity from the students as well as the professor.

**Objective 2: Assess access, familiarity and interest in technology platforms**

To assess access, familiarity and interest to technology platforms amongst STEM students at IIT Mandi, we visited classrooms to observe use of technology commonly used by students and teachers, including smartphones, projectors, internet, apps, social media, and so forth. We also interviewed students and teachers about their familiarity with technology. We investigated for the viability of introducing new devices to the classroom, such as VR goggles. A survey was also shared with about 30 students at both IIT Mandi and Vallabhb College to gain this information from students that we could not meet in person.
Objective 3: Determine if technology can be used to enhance learning

Based on our findings from objectives 1 and 2, we narrowed our optimal technology platform. We performed a second classroom test in a history class with 55 students. We prepared and taught a lesson about the Corps of Discovery Westward Expansion Expedition, seen being administered in Figure 6.

![Figure 6: Administration of classroom test (pictured: Luke Ludington) Photo credit Oliver Brochu](image)

The class was studying Westward expansion but had not covered The Corps of Discovery, meaning data would not be affected by variation in prior knowledge.

A short video taken from the Internet was used to give a brief topic introduction. Next, the students were split into groups and asked to bring up a GIS website on their personal laptops or devices. This website contained a map of the United States with information, dates, and locations of key events of the Corps of Discovery journey. The students were given questions about the topic and were tasked with finding the answers by locating the relevant event. Afterwards, the students were quizzed for retention with a multiple-choice quiz and tested for understanding with a short answer question. Finally, they were given an exit survey on their opinions of the lesson.
4. Results

Preferred learning strategies

This objective was achieved using the classroom tests, student interviews, and Professor interviews.

First, we looked into how STEM students prefer to learn. After a giving a basic lesson to a sample of 19 first year students at IIT, we asked them to fill out a survey. The results of the survey can be seen in Figure 7 and Figure 8, where the statement is presented and an option of 1 (strongly disagree) to 7 (strongly agree) is given. The Y axis represents the number of people who chose that number.

![Figure 7: I would have liked more team interaction (N = 18) (Collaborative red, Visual blue)](image1)

![Figure 8: I enjoyed this lesson (N = 18) (Data for visual and collaborative lessons)](image2)

We then held interviews with 4 of these students, 2 from each group. Both lessons were well liked by the students. The students reported that they found reading text to be boring, with many telling us they were done before they had actually completed the reading. They said a video held their attention more and that the collaborative lessons were helpful in helping them grasp the concepts.

We conducted semi-structured interviews with eight professors who taught a mix of STEM and humanities subjects, the outline questions of which can be found the Appendix. One of the main points of our interviews was the learning preferences of STEM students. Most of the professors incorporated visuals and videos into their slideshows, claiming they can explore certain concepts and hold attention better than traditional lectures. However, many emphasized a whole lesson could not be delivered through videos. About half the faculty used collaborative or hands-on activities in their lessons to make sure all students understood the lesson, rather than as a learning style on its own. For the STEM courses, the most hands-on activities in classes consisted of working through a problem on the board and asking students to work through the steps with the professor. In one case, students were put in groups to discuss assigned readings.

Our interviews with students around campus gave us great information on the learning preferences and difficulties, as well as their general thoughts on the classroom environment with and without technology. The following results are a record of the interviews conducted with IIT Mandi students (graduate and undergraduate levels), and
undergraduate students from Vallabh University in Mandi. We found that the students preferred a wide variety of teaching styles and had a strong connection with handwriting notes from a blackboard lecture. Visuals and collaborative exercises were recognized as compliments to the lesson, which they greatly enjoyed.

**Access, familiarity, and interest in technology**

During our classroom lesson, we noticed all students were competent in the use of smartphones, being able to read a QR code and look at the lesson on their personal devices. Over 100 students were involved in our testing, each having a smartphone. From the 29 students who responded to the tech survey, the most significant results are shown in Figure 9, Figure 10, and Figure 11.

The technology used in classes varied among faculty. All used the projector and PowerPoint presentations, some would supplement their own technological devices such as a personal laptop. An issue most of the faculty had at one university, was that the technology was unreliable due to frequent power outages and loss of internet. They work around this by either skipping over the affected part of the lecture or use personal laptops to display presentations. Some professors incorporated student’s personal devices into the classroom, such as mobile phones. However, those that did not follow this practice felt it would either be unnecessary or distracting.

All interviewed students said they used their phones in studies by watching educational videos on YouTube or looking up a quick fact. The graduate students commented that IIT Mandi has access to the best technology in India, and it is common knowledge that they must keep up with this ever-changing area.

When observing classes, students appeared distracted by their phones with social media, games, or anything else unrelated to the class. When this was discussed in faculty interviews, they almost unanimously noted it occurring in their classes, being more significant among humanities than STEM subjects. Few of the professors supported the idea of confiscating phones, claiming it would be an imposition, and professors felt students were mature enough to make their own decisions. Most professors noted it was mostly an issue with the undergraduate students, as the graduate students tend to be more mature and know how important the lectures are. Phone use, power outage issues, and Internet use findings summarized below.

![Figure 9: How much do you use your phone for academics (N = 29)](image)

![Figure 10: How students are delayed by lack of internet or power (N = 29)](image)
Technology for enhanced learning

About half the class came with a laptop. When they formed groups, typically of three or four, each had at least one laptop among them.

Every group successfully accessed the website within a couple minutes of writing the link on the board. Many students seemed initially unfamiliar with how the GIS site worked. However, they began to use it more fluently as class progressed. Because most multiple-choice questions were answered correctly, it can be concluded they learned how to use the system within the allotted time.

Some students began used outside sources to answer questions, such as Google or Wikipedia. While they were not explicitly told not to, they were encouraged to answer only what they could find on the map. Students worked on the test the whole allotted time with few exceptions. Out of the fifty students, only three or four were consistently off task and distracted. On average, it appeared most students reached the last or second to last question, which was a short answer paragraph, but were unable to fully finish the quiz.

Most students opted to scan the QR code for the exit survey with their personal phone and finished quickly, the significant results of which can be seen in Figure 12 and Figure 13, noting that not every student took the survey. The surveys in both classroom tests were formatted similarly.
**Additional findings**

The study uncovered two additional points about motivation to learn. First, it was noted during the test that some students were uncomfortable speaking English, especially in front of native speakers. All faculty noted that some students struggled with English, as it is usually not their primary language. When asked, none of them felt an electronic translator, such as a phone app, was a proper solution to this issue. Instead, they felt it was in the best interest of the student to be forced to become more proficient in English, as fluency will help them immensely in the rest of their lives.

Second, when asked about their humanities courses, many of the undergrads said about half the courses they took were for personal interest and the other half they took due to requirements. The courses they were required to take they said they pay much less attention to and learn much less.
Discussion

Overall, we found that it is common for students to use some form of technology to regularly enhance or support their studies. As seen in Figure 9, 79% of students who responded to the tech survey use their phone for academics for more than an hour a day. This is mostly with the use of a smartphone to use an app or to watch a YouTube tutorial or explanation, as seen in Figure 11. We also confirmed that all the students recognized that IIT Mandi and other universities offer cutting-edge technology in India, and they try their best to use it to the fullest capability. This was especially true for the graduate students who need more intricate software’s for their research. Finally, there is a very strong culture of interpersonal connection that is a crucial aspect of the classrooms here. Discussions and collaboration amongst students and with the professors are what not only improves conceptual learning but makes the time in class and at a university worthwhile for the students. Technology is seen as a helpful tool in the classroom, but also one that makes the student more goal oriented and promotes isolation. Technology is a proper supplement for all lessons, but it is important to the students that it never replaces the interaction and friendship companionship that is so vital to the Indian school system.

From the exit survey for the second classroom test, we can conclude that they found it to be more engaging than normal class as seen in Figure 12, and Figure 13 expresses that they collectively felt they better understand the geography of Westward expansion, suggesting GIS combined with problem solving can be useful for developing geographical understanding.

There seems to be a nearly universal agreement amongst all the students and professors involved in our project that STEM students at IIT, much like those in America, have a general preference for visuals and collaborative learning. However, we were surprised to find that many students at IIT Mandi struggle with English. This observation has additional implications for traditionally text-based learning in history studies. At the same time, professors prefer that student practice English and become fluent rather than use an external, technology-based translator, such as a phone app.

Limitations

Our project has several limitations that may have affected the results. First, our sample size was a random sample of college students from only two campuses. As seen in the differences in infrastructure and student background between IIT Mandi and Vallabh, different campuses yield different results. A sample of a wider variety of campuses would have given more insight.

Another limitation was the fact that none of us were experienced lesson-givers. A major part of our data came from two sample lessons we gave. These lessons employed learning strategies that we theorized would be beneficial. However, the control group for these lessons were the students’ regular classes, which are delivered by experienced faculty and are taken for a grade, rather than voluntarily. This could have easily skewed the results in favor of or against our lessons.

Quizzes and surveys were employed in the lessons to determine comprehension and retention, which were the main factors by which success was determined. However, because the classes were given to different sets of students, retention could only be tested
over a period of a one-hour class. Testing for comprehension was also limited to a short answer questions, which was graded by us, who are not experienced graders either.
5. Project Outcomes

At the close of our study, we recommend a focus more on increasing visuals and collaboration in class rather than simply adding technology for its own sake. Many of the students and teachers we talked to feared that technology would decrease the face to face interaction between teachers and students and felt that would be a detriment to learning.

Lessons

We have outlined our recommendations specifically applicable to lesson planning in Figure 14 below.

Figure 14: Learning styles and resource opportunities

Infrastructure

In order to increase the use of digital visuals aids via projectors (for which substitutes were rarely utilized) it would be beneficial to show faculty how to use the available uninterruptible power supplies (UPSs) and to extend their reliability and coverage. The use of visual aids by teachers in class was not impaired by knowledge or desire for visuals but rather it was their apprehension to the potential delays incurred by unreliable technology in the classroom. These intermittent and chronic issues ranged from power outages to inconsistent WIFI coverage throughout the academic buildings and as shown previously in Figure 10, this affects as much as 82% of students who responded to the tech survey once a week or more.

The current technology infrastructure, in its fully operational state, proved to be completely conducive to enhancing the learning strategies which we found STEM students to prefer. In classroom testing students were regularly enthused with using their phones and laptops to perform the tasks that we asked them to and at no point were we limited by hardware in our implementations of our lessons. Students were comfortable viewing material on their phones with nearly 80% of students (Figure 9) already using their phones for schoolwork more than an hour per day. We found little need for extensive additions for
technology as many of those questioned seemed apprehensive to the idea of adopting a wholly new technology into their classroom as well as not seeing value in the effort required in implementing such a system.

**Faculty options**

Professors could ideally find a manner of incorporating more visual collaboration in their classes rather than strictly incorporating more technology for its own sake. Rather than assigning a reading or talking about a topic for a time designing an interactive lesson engages students more. Technology should be seen as a catalyst for interaction rather than a replacement for class discussion and exercises. Tools such as GIS can be explored via shared laptops for creating circumstances that pushes students towards interaction.

We also found that whatever technology is implemented needs to avoid being overly reliant on existing infrastructures, as they pose reliability problems that make professors apprehensive towards their utilization.

Shared technology can be used to encourage collaboration. When students were given assignments in teams with shared laptops, students displayed normal team interaction. Professors expressed concern that incorporating phones and laptops in class would increase the amount students were distracted by them, but there was no increase in technology-based distraction between class tests using phones and those which did not. Professors should not be dissuaded from using personal technology in the classroom for fear of distraction.

In conclusion, existing technology can be utilized more than it already is to streamline learning styles to STEM students. This can be leveraged to actually increase in-person interaction, achieving the goal of increasing the interest and comprehension of world history subjects. This approach was different from that which we assumed in the beginning and is not technocentric, but rather utilizes technology as a tool within a classroom and allowing students to take full advantage of the face to face interaction implicit in current teaching methods.
References


Coller, B. D., & Scott, M. J. (2009). Effectiveness of using a video game to teach a course in mechanical engineering doi://doi.org/10.1016/j.compedu.2009.05.012

Corfield, P. J. (2008). All people are living histories – which is why history matters. Retrieved from https://www.history.ac.uk/makinghistory/resources/articles/why_history_matters.html


Appendix A: Poster created for open house

ASSESSING TECHNOLOGY AS A TOOL IN HISTORY EDUCATION

**Students:** Oliver Brochu, Luke Ludington, Zach Emil, Vishal Mahar(B16150), Rocky Verma(B16141), Gagandeep Singh (B16095)

**Sponsors:** Dr. Gbeton Somasse, Dr. Ingrid Shockey, Dr. Rajeshwari Dutt

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**Problem**

STEM Students are not engaged in their humanities classes.

**Goal**

Assess the feasibility of using technology to teach humanities at IIT Mandi. This is to support the UN Goal of improving education to have a world full of more knowledgeable people, by making history more eye-catching for STEM students.

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**Confirm preferred learning strategies**

STEM students prefer visual and collaborative learning to tradition-style lectures. This information was found in our initial research, then confirmed with an on-site test of the IIT Students.

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**Assess access, familiarity and interest**

IIT students have nearly universal access and familiarity with smartphones or personal laptops. They currently use these devices everyday and are very comfortable with their capabilities.

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**Define optimal technological platforms**

Projectors, smartphones and laptops are adaptable for collaborative and visual lessons in most classroom settings. An important finding is that including the use of personal devices does not increase the amount of distraction within a lecture.

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**Recommendations**

The use of technology to improve the education of world history is feasible given certain parameters. Technology must be used to supplement rather than replace a lesson, in order to enhance learning while keeping vital classroom practices intact.

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'As an IIT student I can say that we have the best technology in India...'

- IIT PhD Student

93% of students have access to a personal laptop

Many students use YouTube to review concepts.

There are projectors in almost every classroom.

Smartphones are used every day by students.

Online resources such as GIS maps can visually and interactively aid a lesson.

2.6 hours

Each day is spent using phones for educational purposes.

3.7 hours

Each day is spent using phones for leisure.

87% of students enjoy collaborative or visual lessons.

82% of students are interrupted by internet and power outages at least once a week.
Appendix B: Surveys, Interviews, and Exercises

This survey was given to the student subjects in the first classroom test.

1. What is your Name?
2. What is your e-mail address?
   Rank the following on a scale from 1(strongly disagree) to 7(strongly agree)
3. I enjoyed this lesson
4. I want all my history classes to be like this
5. I would have liked more visuals
6. I would have liked more reading
7. I would have liked more team interaction
8. I would have liked a more structured lesson
9. I normally think history is boring
10. I will remember what I learned in a week
11. I feel like I understand Western Expansion better
12. I better understand why these historical events happened

Classroom 1 Reading: Manifest Destiny
Manifest Destiny, a phrase coined in 1845, expressed the philosophy that drove 19th-century U.S. territorial expansion. Manifest Destiny held that the United States was destined—by God, its advocates believed—to expand its dominion and spread democracy and capitalism across the entire North American continent.

Despite the lofty idealism of Manifest Destiny, the rapid territorial expansion over the first half of the 19th century resulted not only in war with Mexico, but in the dislocation and brutal mistreatment of Native American, Hispanic and other non-European occupants of the territories now being occupied by the United States.

A major aspect of the conquest of the West was the removal of the Indians who dwelled there. Under the leadership of President Andrew Jackson, the Indians who remained East of the Mississippi were cruelly and violently driven from their homes and concentrated in reservations in what is now Oklahoma. The US Army crushed any resistance to removal. With the West cleared of this obstacle, westerners focused on developing new methods of transporting their goods to market. The canal and railroad systems, which grew up in the North, facilitated a much larger volume of trade and manufacturing while reducing costs a great deal. Great cities sprang up throughout the North and Northwest, bolstered by the improvement in transportation.

Classroom Test 2 Lesson Plan
Lesson Plan 4/19
Time: 50 minutes
Topic: Westward expansion

00:00 - Class settles, Prof. Dutt introduces us, our project, and the purpose of our class today.
00:05 - We explain the purpose of our testing and our project at IIT.
00:10 - Administer video to lecture group.
00:15 - Students get into groups and take out their laptops and go to the website, as we explain the lesson directions and goals.
00:20 - Let the people work in small groups with the GIS map and quiz.
00:45 - Conclude group work and Administer survey QR code or link.
00:50 - Class concluded.

Classroom Test 2 Exit Survey
This survey was given to the student subjects in the second classroom test. Rank the following on a scale from 1(strongly disagree) to 7(strongly agree)

1. I enjoyed this lesson
2. I want all my history classes to be like this
3. I would have liked more visuals
4. I would have liked more videos/a longer video
5. I would have liked more reading
6. I would have liked more team interaction
7. I normally am interested in history
8. I found this more engaging than normal class
9. I better understand Westward Expansion and the Corps of Discovery journey
10. I better understand the geography of the Westward Expansion
Classroom Test 2 Quiz
This quiz was given to the student subjects from the second classroom test in conjunction with the Lesson 2 GIS map.

GIS Quiz
Refer to the map when taking the quiz:
https://milboisservices.maps.arcgis.com/apps/webappviewer/index.html?id=d6928bf190024e20812cc07df8aa41a0b
Click on dots and land to reveal information

1. Describe the American's encounter with the Teton Sioux tribe (in South Dakota).

2. What mainly guided the route of the corps
Mark only one oval.
- Rivers
- Indian Settlements
- Mountains
- Pre-written maps

3. How did the Washington Indians (in current-day Portland, Oregon) describe the distance to the Pacific Ocean?
Mark only one oval.
- 1 month
- 2 Days
- 2 Sleeps
- Could not communicate it

4. Where did the Corps of Discovery depart from?
Mark only one oval.
- Utah
- Camp Wood
- Sgt. Floyd's Burial Site
- The Pacific Ocean
5. What Tribe did the Corps meet with in August, 1804?
   *Mark only one oval.*
   - Teton Sioux
   - Yankton Sioux
   - Mandan Villages
   - Cameahwait

6. Where did the Corps camp in July, 1805?
   *Mark only one oval.*
   - White Bear island
   - Gates of the Mountains
   - Yellowstone
   - Arikara Villages

7. The Corps had one death during the journey in August 1804. What site did this happen at?
   *Mark only one oval.*
   - Three Forks of the Missouri
   - Mouth of the Grand River
   - The Dalles Rapids
   - Sgt. Floyd’s Burial Site

8. What was the price of the Louisiana Purchase?
   Who was the land bought from?

9. What was the Gadsden purchase?

10. How long did it take the Corps of Discovery to travel past the Louisiana Purchase territory, into the Treaty of Paris territory?

11. How did the Louisiana Purchase in 1804 lead to purchasing the rest of American land up until 1853? Please give a short paragraph response.
12. Were the Corps of Discovery friendly or hostile towards the Native American tribes? Explain why.


13. About how long did the Corps of Discovery journey take? How might this have influenced the construction of an Intercontinental Railroad?


Classroom test 2 GIS map screenshot
**Student Semi-Structured Interview Outline**

This is the outline used when conducting semi-structured interviews with students.

1. How comfortable are you with English?
2. How do you feel you learn best?
3. Do you use tech to learn if so how?
4. What obstacles do you have when learning?
5. Do you take humanities courses to learn or pass?
6. Do you get distracted by phones in class?
7. Have you been in a class that uses tech?
8. How do you think tech can improve your education?

**Professor Interview Outline**

This is the outline used when conducting semi-structured interviews with professors.

1. Do you use technology in the classroom?
2. Why do/don’t you?
3. What kind?
4. What do you use the technology for?
5. Does IIT have sufficient technology for you to utilize?
6. Is IIT tech easy to use?
7. Do you notice students are distracted by phones in classes?
8. Would you consider asking students to give up their phones?
9. Would you consider asking students to use their phones as part of the lesson?
10. Do you incorporate visuals (pictures, art, graphs) into your lessons?
11. Collaborative and/or hands on activities?
12. Videos?
13. Does technology improve/make any of the above learning strategies possible?
14. Would better technology affect your decisions with any of the above learning strategies?
15. Have you noticed students struggle with English?
16. Have you considered using a translator?

**Tech Survey**

This survey was distributed electronically to students on campus.

1. What is your comfort level with English?
2. Do you own a laptop?
3. What technology is used for your classes? (choose any that apply)
4. What technology would you like to be used for your classes? (choose any that apply)
5. To what extent do you use your cellphones/tablets for academic work? (research, studies, etc.)
6. To what extent do you use your cellphones/tablets for leisure? (gaming, social media, etc.)
7. What sort of academic work do you use the internet for?
8. Would you be willing to use your phone to participate in class? Ex; Responding to lecture questions.
9. How do you imagine using technology for school?
10. Do you ever find yourself distracted during a lecture?
11. What is the main source of distraction during a lecture?
12. How would your class engagement change if your cellphone/tablet was used as part of a lecture?
13. How often is your homework/lecture delayed by lack of internet access or power?

**Important Links**

Manifest Destiny painting video: [https://www.youtube.com/watch?v=jo2jhL8_d4k](https://www.youtube.com/watch?v=jo2jhL8_d4k)
Lesson 2 GIS map: [https://mlibgisservices.maps.arcgis.com/apps/webappviewer/index.html?id=dd928bf190024e20812cc075d8a41a0b](https://mlibgisservices.maps.arcgis.com/apps/webappviewer/index.html?id=dd928bf190024e20812cc075d8a41a0b)