

ZAPTION: A PLATFORM TO SUPPORT TEACHING, AND LEARNING ABOUT TEACHING, WITH VIDEO

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Digital video has exploded on the web, and many assume it will play a major role in education in the future. Just watching a video, however, does not necessarily lead to learning. Realizing the potential of video for learning will require new technologies that make video interactive, engage learners, and enable video to be embedded into routines of teaching. Zaption, a new video learning platform, is one such technology. In this article we describe the platform, and then discuss its potential for teaching, and for learning about teaching, with video.

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1 Introduction

In recent years we have seen an increasing emphasis on more ambitious goals for education. Memorized facts and skills are no longer sufficient in the emerging global knowledge economy. Instead, students need to acquire the kind of flexible knowledge that can serve as a foundation for innovation and performance in novel and rapidly changing situations. Despite many years of efforts, however, educators have yet to find ways to provide richer, deeper learning at scale. Although many have placed their hopes in technology to enable breakthrough kinds of teaching and learning, most technology-delivered education to date has fallen short. It is relatively easy to design online systems to support the practice of rote skills and facts, but much harder to create the kinds of rich learning opportunities required for deeper learning.

The recent and rapid emergence of online video has been suggested as one potential solution to this problem. Founded just eight years ago, YouTube now hosts billions of hours of video, and it is widely thought that video will play a major role in education and learning in the future. Just like previous innovations, digital video has yet to have an impact on processes of teaching and learning in the classroom, for at least three reasons: (1) watching video can be a passive experience, whereas learning requires more active engagement; (2) even if students are actively engaged, there is no easy way to elicit students' individual responses to a video, or to give them feedback on those responses; and (3) there is no easy way to feed students' responses back to teachers as formative assessment data to guide subsequent instruction. In short, the potential of video is great. But unless we can find ways to turn watching video into an effective learning experience, and embed video effectively into the routines of classroom teaching, its potential is unlikely to be realized.

2 Zaption: A New Platform for Video Learning

Zaption's video learning platform specifically addresses the problems outlined above, and optimizes the use of video for teaching and learning. Co-founded by the lead author of this paper, the platform is designed with issues of real, classroom practice in mind and is built upon research on learning and pedagogy. The core of Zaption's platform is the video learning Tour. A Zaption Tour is created by taking one or more video clips (e.g., from YouTube or another online archive); adding interactive elements such as questions, slides, and discussions; and then publishing the Tour online for students, directly on Zaption's website, or on any learning management system or classroom website. Students view the Tour, either for homework or in class, respond individually to the questions and prompts, and get feedback on their responses. Finally,

the teacher uses Zaption Analytics to receive immediate and actionable data showing (1) whether students actually watched and engaged with the video, and (2) how students responded to the questions and prompts. Teachers use this formative assessment data to plan follow-up activities, thus closing the instructional feedback loop.

Unlike the experience of simply watching a video, either alone or as part of a class, Zaption Tours have the potential to result in three outcomes: (1) greater student engagement with the video; (2) greater student learning from the video, especially the deep learning and conceptual understanding called for in new, ambitious learning standards; and (3) greater interest, motivation, and curiosity to learn more about the subject of the video.

2.1 A more detailed look at the platform

The Zaption platform currently consists of three main applications: *Tour Builder*, *Tour Viewer*, and the *Analytics Dashboard*.

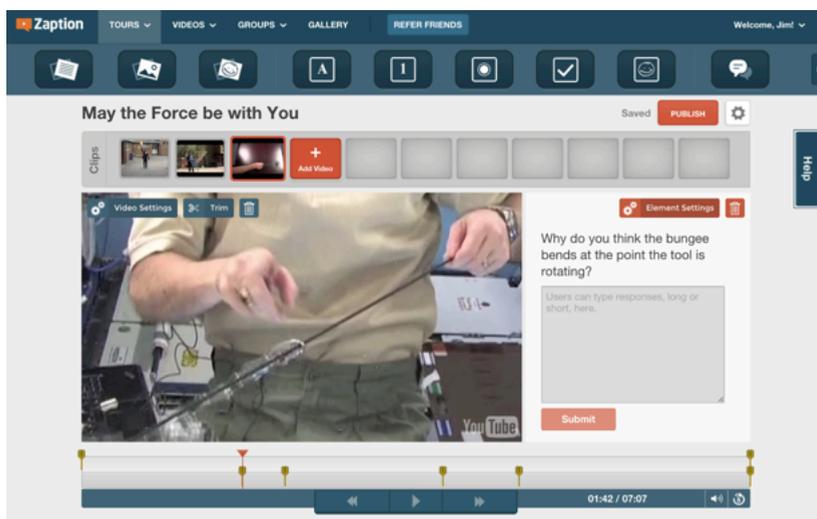


Fig. 1 - Zaption's Tour Builder interface.

Tour Builder. Zaption's Tour Builder (see Figure 1) creates and publishes Zaption Tours. The Tour Builder is a web application that runs in any modern browser (including Chrome, Firefox, Safari, and Internet Explorer) and on either a Mac or PC computer. The Tour Builder's easy-to-use drag-and-drop interface allows teachers or content developers to quickly turn any online video (or videos) into an interactive Zaption Tour.

The interface makes it easy to:

- **Search for a video** or videos aligned with a learning goal; trim videos to just the part with which they want students to interact; drag videos around into any order and arrange them on a clip-line (right above the video window in Figure 1);
- **Add interactive elements** at any point in the video. Interactive elements are represented by the icons arrayed across the top of the interface: text slides, images, open response questions, multiple choice questions, discussions, etc. Currently there are 11 elements, with more under development;
- **Score answers** to multiple-choice, numeric, and check-box questions, and **provide feedback** based on students' answers; and, coming soon, scoring and feedback for open response questions;
- **Branch** to different points in the video based on students' responses or choices.

Tour Viewer. Once the Tour is designed, a single push of the Publish button produces the Zaption Tour and opens the viewing interface. Tours are distributed to students in a variety of ways: by sending a link in an email, embedding it in a class website, or as an assignment in a learning management system. The Tours can then be viewed using a web browser (see Figure 2) or Zaption's new iOS app for iPhone and iPad.

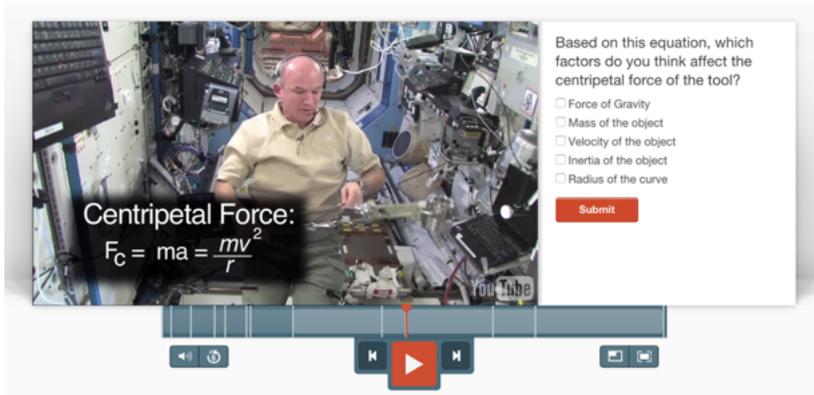


Fig. 2 - Zaption's Tour Viewer as implemented on a web browser.

Analytics Dashboard. When students view the Tour, their behaviors and responses are captured in Zaption's database, and then sent immediately back to the teacher in Zaption's Analytics interface.

The analytics interface is divided into three parts: an overview, a page for each response element, and a page that summarizes the activity of each viewer. The goal throughout is to provide actionable insights into students' engagement and learning that the teacher can use immediately to guide instruction.

The overview page (see Figure 3) displays a variety of statistics on student access and engagement: how many students viewed the tour, how much of the video did they watch, how many of the questions did they answer, how much skipping around did they do, etc. Each type of question element has its own analytics display, one of which is shown in the figure. There is also an overview page for students, showing each viewer's progress. These are just examples of Zaption's rich and comprehensive analytics. And, for teachers who want to use the data in a different way, all responses can be downloaded to a spreadsheet, or sent using standard LTI protocols to their learning management system's gradebook.

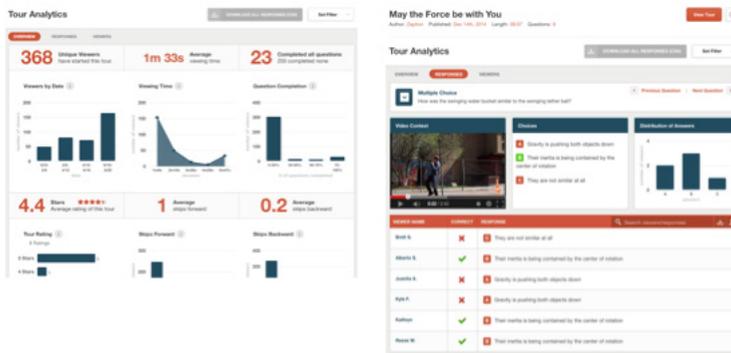


Fig. 3 - Overview page (left) and multiple response question (right) as presented in the Zaption Analytics interface.

Interoperability. Zaption was designed to play well with other technologies. This is accomplished through a full API for third-party integration (zaption.com/api) as well as single-sign-on (SSO) via LDAP or LTI.

2.2 Zaption implementation in authentic educational settings

Currently, Zaption is being used across a wide variety of settings: K-12 classrooms, higher education classrooms, adult training settings, and fully online courses.

Rather than replacing core curriculum, we designed Zaption as a supplementary learning experience to accompany regular instruction. As seen in Figure

4, the implementation is guided by teachers' immediate learning goals for students. Teachers either create a learning tour using Zaption's Tour Builder, or, more commonly, select a pre-made tour aligned to their learning goals. Tours are assigned either as homework or as an individually paced in-class activity. Teachers monitor students' engagement and responses using Zaption Analytics, and then implement follow-up instruction based on those responses. The goal is to augment the quality of teaching by scaffolding a rich and engaging conceptual learning opportunity into a teacher's instructional practices.

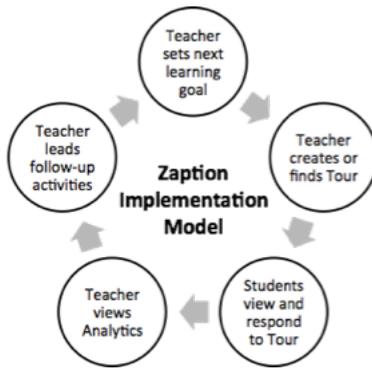


Fig. 4 - Implementation model

The most common use case for Zaption is a hybrid one in which students first respond to online Tours individually (either at home or in class), and then participate in follow-up activities design to deepen their learning. We developed this hybrid learning model for two reasons: first, it is a way to embed Zaption into teachers' normal routines, a critical feature for broad adoption and effective implementation. Second, we believe that this hybrid model has the greatest potential to produce deeper student learning and understanding of content.

2.3 The theory of change, and theoretical and empirical support

Zaption's platform is based on the assumption that video has the power to engage learners, and although it is not the best way to learn everything, it can be a highly efficient way to learn certain things (e.g., things that are hard to portray without the richness of moving images). A long line of research supports both of these assumptions (Wisher & Curnow, 2003), and teachers have used video for many years as a supplement to their instructional activities. However, unlocking the power of video for mass education has been difficult until recently due to the lack of widely available video content and the lack of tools that make it easy to engage learners with videos in the context of high

quality learning activities.

The Internet, and the explosive growth of YouTube in particular, has solved the first problem. It is now possible to instantly find and access virtually any video on the Internet, as well as to shoot and easily share your own video for educational purposes. However, tools for using video to promote learning have been slower to emerge. Although video does have the power to engage and motivate students, cognitive science tells us that passively watching video will not necessarily lead to deep learning (Clark, 1994; Mayer, 2009; Chi, 2009). The development of deep learning requires engagement in active knowledge construction, making connections to prior knowledge and to novel situations in order to develop flexible transfer of knowledge. Although some students may do this kind of active construction naturally, most will not expend this extra mental effort unless prompted to explicitly.

Zaption's platform is designed to fill this gap – to change the experience of video from one of passive watching to active learning. In addition, Zaption provides a means of integrating video more effectively into teachers' instructional routines. First, by requiring individual students to respond to prompts embedded in a video, Zaption turns watching a video into a more personalized, active experience for every student. Second, by providing student response data immediately back to the teacher, Zaption closes the feedback loop, enabling teachers to use student responses as formative assessment to guide subsequent instruction. As a tool for formative assessment, Zaption allows students to demonstrate what they do and don't know without fear of wrong answers. The purpose of Zaption is not to produce a summative statement about how "smart" a student is, but rather to provide both student and teacher with information about students' understanding and misconceptions. This formative feedback can help the student better understand where she needs further clarification, and can help her teacher see which problems and patterns are common to many students, informing how instruction might be targeted to address them.

Zaption's theory of change is represented in Figure 5. This model, supported by theories and empirical findings from the learning sciences, outlines the causal chain that links watching a video on Zaption to deeper learning.

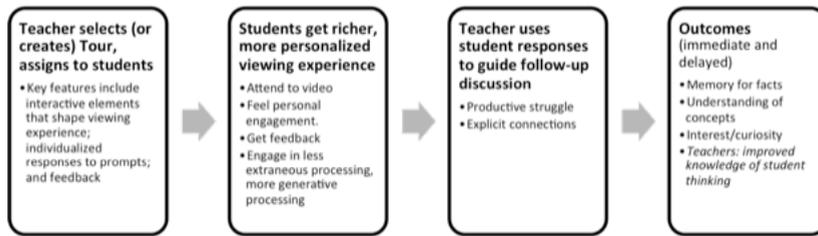


Figure 5 – Zaption’s theory of change.

Starting from the left, our theory of change begins when a teacher decides to incorporate video into their instruction. Although some teachers will create their own Zaption Tours, most will search for a Zaption Tour that is aligned with their specific instructional goal, and if they find one, either use it as is or with minor modifications. Taking a Zaption Tour differs in three key respects from simply watching a video. First, interactive elements are added to increase the quality of the viewing experience for purposes of learning. Second, students are asked to respond individually to prompts embedded in the video. Third, students are provided with feedback on their responses (by showing them if an answer is correct or not, how other students answered (anonymously), or how an expert might answer the prompt).

These critical features of a Zaption Tour produce a different viewing experience when compared to simply watching the same video content. Students watching a well-constructed Tour are faced with two specific tasks: to understand the video’s content, and to connect the content to prior knowledge - what we might call deeper learning. Both goals are facilitated by reducing extraneous processing, managing essential processing, and fostering generative processing, all features shown in a large body of work to improve learning from instruction, specifically from multimedia materials (Mayer, 2009; Chi, 2009; Bjork & Bjork, 2011). The goal of good instruction for long-term learning should be to make learning difficult in ways that will benefit your memory and understanding, rather than in ways that simply make learning more frustrating. This means that essential and generative processing - mental work that is central to understanding the content and building connections with it - should be encouraged, while extraneous processing - mental work that is not central to the task at hand - should be reduced. Zaption’s interactive elements support these goals in many ways. For example, elements can be used to make video lessons self-paced, to highlight key information, to present additional information via words and/or pictures, to cut out seductive details from existing video, and to prompt students to make connections to things they already know. These fea-

tures effectively engage students in more generative processing.

Besides producing more generative processing of the video, the individual response component of Zaption serves three additional purposes. First, it can have a motivational effect on students, making them feel more engaged with the video and connected to the teacher (who presumably is reading the responses that students write). Whereas students might tune out when watching a video as a group, the requirement of individual response produces more sustained attention to the video and a feeling of accountability. Recent research has also shown that interpolating questions throughout a video can reduce mind-wandering and improve students' retention of online lectures (Szpunar *et al.*, 2013). Second, Zaption's feedback features provide students with information on their current level of understanding. Feedback has been shown in a large body of research to promote learning (Shute, 2008).

The third purpose of Zaption's individual response component is to provide detailed and actionable information back to the teacher (the third box in our logic model). Based on the hybrid implementation model we are studying in this project, teachers are expected to use student responses to engage in follow-up discussions with the class to support learning. Based on the work of Hiebert and Grouws (2007), we hypothesize that teachers' discussion will be most effective for producing deep understanding when they engage students in productive struggle with important concepts, the connections to which are made explicit in the instruction.

Finally, the enhanced video learning experience supported by Zaption - interactivity, individual responses, and follow-up discussion - is hypothesized to produce significantly better outcomes - both right after taking a Zaption Tour and after a delay - than simply viewing video alone. The student outcomes in which we are specifically interested are: (1) memory for facts presented in a video, including both declarative (knowing that) and procedural (knowing how) knowledge; (2) understanding of concepts (i.e., deeper learning outcomes), which might be measured by looking at transfer of ideas to novel situations/tasks; and (3) interest and curiosity in the subject, which might be operationalized by simply asking, "Would you want to watch another video on this topic, or would you prefer to move to a different topic?" We also posit a teacher outcome: teachers will become more knowledgeable about students' understanding of content.

3 Using Zaption for Research

Zaption was designed not only to support teaching with video, but also to support research. Specifically, we are using Zaption to pursue two different - but related - research agendas. In the first, we are using Zaption to study how people

learn from video, and how to optimize learning from video. In the second, we use Zaption as a laboratory model for classroom teaching.

3.1 Using Zaption to study learning from video

We have recently started using Zaption as a means of pursuing two kinds of research on how people learn from video. One approach focuses on understanding the processes that unfold as learners interact with an instructional video. The other approach focuses on optimizing learning from video. Throughout, we are interested in how students' interactions with instructional video affect three broad types of outcomes: memory for factual information, understanding of core concepts, and interest in the subject matter.

Foundational work on learning from video. Under the first approach we are using the theories and methods of cognitive psychology to develop and test a series of hypotheses about how people process, represent, and learn from the contents of authentic online video. Our research questions can be organized into three broad categories: (1) How do students process and represent the content of an instructional video? (2) How do students use the content of the video to deepen their understanding of core concepts in a domain? And (3) How do student characteristics affect how they process and learn from the video? We draw on a variety of theories and findings from cognitive psychology to guide our work. Chief among these are the literature on text comprehension, and especially work inspired by Kintsch's (1988; 1994) integration-construction model of text comprehension; and the large body of studies resulting from Mayer's (2009) cognitive theory of multimedia learning. Using Zaption's prompts and analytics, we can gather data on what students are attending to and thinking about as they watch a video lesson unfold. Because Zaption is being used in a variety of educational contexts, we are able to conduct many of our studies in authentic settings and using authentic materials.

Optimizing learning from video. In our foundational studies, we are developing and testing hypotheses about how individual variables (such as ordering of content, types of interpolated prompts, etc.) affect outcomes of interest. Although understanding the effects of individual variables is important, learning environments such as the kinds of video learning Tours we are researching, often are not best described as a collection of variables. Instead, they may be best seen as systems, in which videos, interactive prompts, students, teachers, and so forth are combined to meet a particular instructional goal within a specific context of use. Optimizing learning from video means optimizing the performance of a system, and for this we draw on the methodologies of systems

improvement as pioneered by Deming, Shewhart, Juran, et al. (Langley *et al.*, 2009). First developed in the context of industry and manufacturing, principles of improvement science have now been applied successfully in healthcare (Kenney, 2008). More recently, a number of researchers are exploring application of these principles to improving education (Bryk *et al.*, 2010).

The first step in systems improvement is to identify a process for improvement. That process must be repeatable, so that it can be implemented, studied, altered in some way, and implemented again. Zaption Tours can be thought of as such a repeatable process, that is, a system designed to structure interactions of students with video content in order to achieve an instructional objective. In our research group we plan to apply improvement methodologies in order to create research-tested guidelines that can be used to design video learning experiences. We anticipate producing at least two sets of guidelines, each oriented toward a particular type of outcome (in one case to spark interest, in the other, to produce deep understanding of target concepts). For each outcome, and based on theories and outcomes produced by foundational research, we will experiment with various types of videos, content and placement of interactive elements (e.g., open-ended and multiple choice responses, threaded discussions; placed before a Tour or after a demonstration), and implementation models (e.g., as homework vs. in-class activity). Our goal will be to find out what mix of video, elements, and implementation strategies produce optimal outcomes.

3.2 Using Zaption to study classroom teaching

It seems straightforward to use Zaption as a tool for studying how people learn from video. Less obvious, perhaps, is a second line of research we are planning: to use Zaption as a means of studying the processes that transpire and shape learning in traditional face-to-face classrooms. Zaption, in this use case, functions as a laboratory model for a far more complex and hard-to-study situation, the classroom. Just as the development of the airplane was greatly accelerated by the invention of the wind tunnel (Bradshaw, 2005), we believe that online platforms such as Zaption can serve as a wind-tunnel for the study and improvement of classroom instruction.

The study of teaching and learning in classrooms has been hampered by the complexities of the context. Think about what is required to test out a new pedagogical strategy. First, you must find a way to train a sample of teachers to implement the new strategy. Because students are nested within classrooms, random assignment must be done at the classroom level. And, even if you are able to implement the strategy with fidelity in a number of classrooms, measuring the way individual students process and respond to each component of the new strategy is almost impossible to do.

Zaption and other online platforms provide a way to deliver well-specified instruction and to randomly assign individual students, even within a classroom, to receive different versions of an instructional intervention. The processing of the instruction by individual students can be measured using Zaption analytics and well-placed prompts. Granted, the instruction is on video, not live; like all lab models, it is not perfect. But as with the wind tunnel, the costs of failure are much lower, and the potential for rapid testing of incremental improvements much higher, than for research in traditional classrooms.

Conclusion

Zaption has the capability to draw out the untapped potential of video to support learning primarily because it changes the structure of students' interaction with video. What has so far been characterized by passive watching with minimal discussion or review can now be made personal, interactive, and informative for both teachers and students. From an educator's perspective, Zaption can be a tool to track engagement, participation, and common problems or misunderstandings. Rather than waiting for data from large-scale educational studies (or advice from professional development sessions), instructors can collect information on their own students, in real time, to actively improve their own teaching.

Educational researchers can also benefit from using Zaption as a "wind tunnel" to study classroom instruction. Although video is not a perfect model of in-person teaching, it is a close proxy that has many advantages from a research perspective. Because Zaption Tours can be randomly assigned at the student level (rather than at the classroom level), we are able to carefully control and study the effects of various teaching techniques without the enormous cost and risk of running a large randomized controlled trial. Zaption also presents a compromise with traditional laboratory studies of learning: whereas many such studies present learning in somewhat contrived situations, Zaption can be incorporated directly into teachers' existing instructional practices, lending ecological validity to our findings. Rather than convincing teachers to change the way they teach or constructing laboratory tasks to mimic classroom learning, video allows us to study learning as it might naturally occur in a hybrid classroom and still control instructional manipulations with fidelity. The use of video and an appropriate wind tunnel in which to study it - Zaption - could result in the boom of digital and online learning that has long been predicted.

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