Macro-contexts: Establishing the Where, Why, and How of Learning

EDUC 804 Tradition Paper

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Anchored instruction is the brainchild of a prolific group of researchers who worked out of the Learning Technology Center (LTC) at Vanderbilt University in Nashville, Tennessee. When they published as a team, the group referred to themselves as the Cognition and Technology Group at Vanderbilt (CTGV). Headed by John Bransford, this team set for themselves some rather daunting goals—chief among them was finding a way of overcoming the problem of inert knowledge (Whitehead, 1929). It is the purpose of this paper to explore anchored instruction as a tradition of research and development in the field of Education Technology.

Early work in the tradition used excerpts from popular motion pictures like *Swiss Family Robinson*, *Raiders of the Lost Ark* and *Star Wars,* in testing memory retention and retrieval. (Bransford, Sherwood, and Hasselbring, 1988; CTGV, 1997; Van Haneghan et al., 1992). One of the first major projects to employ video as a wider context for learning took as its anchor the energetic 12-minute opening to *Raiders of the Lost Ark,* in which the main character, Indiana Jones, is in a South American jungle attempting to retrieve a golden statuette. This video clip was used to build lessons in several different subjects including mathematics—which is quite a feat since there really is not any math naturally occurring in the scene. Students watched the clip and were then given the scenario of planning a return trip to the jungle to retrieve some of the other artifacts Indiana left behind and were tasked with making some calculations. Using measurement standards found within the movie, students were asked to determine things such the relative width of the pit that would need to be crossed in the cave—which spans approximately 2 Indianas (Bransford, et al., 1988; Bransford, Kinzer, Risko, Rowe and Vye, 1989).

Van Haneghan et al., of the CTGV team working on anchored research projects in the fields of math and science, note, "Movies were chosen because they are very entertaining to watch, widely available, and low in cost. Furthermore since they do not contain fixed instructional segments they can be used flexibly for different ages and for a number of different topics." (1992, p. 18) Out of the CTGV's early work using excerpts from popular Hollywood blockbusters, two primary research projects emerged that were referred to as The Sherlock Project and the Jasper Project. The Sherlock Project was so-called because its primary anchor was the movie *The Young Sherlock Holmes*. For reasons of comparison and contrast, and because the one movie could not continue to sustain student interest, a secondary anchor, namely the film *Oliver Twist*, was added to the project. The aims of the project were to enhance literacy by promoting the improvement of writing composition and reading comprehension skills while also addressing a social studies goal of looking at the social conditions and technology of 19th Century Victorian England (Bransford et al., 1989).

One result of the initial work with movie excerpts like the aforementioned Indiana Jones sequence was the discovery that anchoring math and science lessons within a pre-existing movie segment, while effective, was incredibly challenging. Thus the CTGV undertook to design and produce their own series of macro-contextual videos in which to anchor math and problem solving activities (Van Haneghan, 1992)—and so began the Jasper Project. The Jasper series is the result of a seven year effort on the part of the ninety-nine member team at Vanderbilt. It began with two videos that were written, produced, and directed by a member of the CTGV team, whereas the rest of the series were professionally produced. Each adventure runs approximately 15 minutes and ends in a challenge or problem to which students are charged with finding a solution (CTGV, 1997). All 12 adventures deliver an engaging short narrative in which the main character—who, contrary to the series title, is not always Jasper—has an authentic dilemma that takes about 15 steps to fully address. To provide a simplified synopsis of the first video, Jasper buys a new boat that has no lights. He is out on the river and needs to get home before dark. To further complicate matters, Jasper needs to buy gas, but is low on cash. With a large number of variables to consider, students are charged with determining if Jasper has enough time to stop for gas and still make it home before dark, and further, whether or not he can afford to buy enough gas, with the funds he has, to get him home safely.

Based on the work of these two projects, the CTGV put forward a series of complementary design features that interact to create a model anchored instruction environment. The first design element is that of the video-based presentation format—and more specifically of randomly-accessible video which the research group favored over video tape because of the ability to quickly and easily locate particular scenes. The team begins their arguments in favor of a video-based anchor by noting the power of video for increasing the retention of information over either purely auditory or textual deliveries (Bransford et al., 1989). While they allow that anchors may come in other forms, the CTGV asserts that video is the most successful format (Bransford et al., 199; CTGV 1990; 1992b; 1992c; 1993; Van Haneghan, 1992). Early research on the Sherlock Project included tests of visual versus textual anchors. *The Young Sherlock Holmes*, available in both book and video formats, provided an opportunity for the team to evaluate what medium of video specifically contributed. The CTGV argued that because the story is written for children—and is therefore a more simplified account—it makes it a poor anchor as it lacks the richness of information that the movie experience provides (Bransford et al., 1989; CTGV, 1993).

When asked to justify why writing composition ought to be anchored in a video as opposed to text, the group takes the following rather compelling stance, "…the video presentations set the stage for *generating* text and language. The experience of seeing scenes and attempting to generate words for describing them is different from the experience of reading passages containing these words" (Bransford, et al. 1989, p. 44). The authors further add, "…one of the major advantages of our video-based instruction over our control group instruction is the spontaneous use of new vocabulary. The video medium provides a natural context for encouraging students to actively use vocabulary to describe what they see" (Bransford et al., 1989, p. 44). Additionally, the CTGV asserts that the video format is exceptionally important for those children whose reading skills are not as strong and whose comprehension of the story is therefore diminished (Risko, Kinzer, Vye, Rowe, 1990).

A second design principle is that of the anchor taking shape in a narrative format—ideally one that presents a challenge or a problem that must be solved. For language arts and social studies curricula, it is not unusual for material studied to be presented in lengthy narrative form. For mathematics and science, however, this is a little more novel. Typical word problems do not tend to contain a lengthy, complicated story. The CTGV's claims to authenticity and reality are, to a very large degree, linked to the narrative element. While undeniably fictitious, the story in each adventure is designed to be plausible and to contain a situation representative of the kind of complicated problem any average person might encounter in daily life.

"Students have to generate the problems to be solved and then have to find relevant mathematical information that was presented throughout the video story" (CTGV, 1990). The Jasper series is often referred to as a problem finding as well as problem solving series (CTGV 1990, 1992b, 1993; Van Haneghan 1992.). All anchored instruction programs are designed to be generative. The main thrust of generative learning is that it is open-ended, leaving students to identify the problem, break it down and then determine what they need to know and to do in order to solve it. Whereas in the Jasper series there was a specific challenge given at the end of the video, for students working with a pre-existing movie, generative learning is accomplished by having them decide what to follow up on and explore out of the narrative. Students working on the Sherlock Project were able to generate questions from out of the narrative based on their own interests. For example, a student might be curious to understand why it is in stories that poison arrows are shot into a victim's neck as opposed to another part of their body (CTGV, 1990; Vye et al, 1990). The generative learning design element is one in which anchored instruction really shows its constructivist roots in that it reflects the concept of active rather than passive learning.

In the case of videos designed specifically to be anchors, as is the case with the Jasper series, all the relevant information needed to solve the problem is carefully sewn into the narrative. Complementing the notion of generative learning is an additional design feature that the CTGV refers to as 'embedded data'—where all the information needed to solve the various adventures, along with a significant amount of *irrelevant* material, is woven into the story. Students are therefore charged with assessing the embedded information to determine what is, and what is not, useful to them in their quest of identifying and solving the multilayered problem.

More so than the lessons that are built around pre-existing movies, videos like those in the Jasper series that have been specifically designed, have the feature of complex problem solving. Problem solving is seen as a way to make knowledge useful and robust. It is asserted that when it is employed in aid of solving a problem, knowledge becomes a tool for future use (Bransford et al., 1988). When broken down, solving each Jasper challenge requires about 15 steps. The CTGV argue that the only way a pupil can learn to deal with complexity is to be faced with it and guided through the process of breaking a problem down into simpler pieces (Van Haneghan et al., 1992). This particular design feature is often used as the main premise in the argument that anchored instruction provides a degree of authenticity that is said to be lacking in the traditional classroom—it is asserted that the adventures students are challenged with solving reflect the kind of multifaceted problems an expert might encounter in the real world.

Like others in the field, the CTGV researchers were interested in designing instruction that would promote broad transfer. Based on what is known of how we access knowledge, it was determined that the individual adventures were not likely to foster transfer on their own, but that a series of analogous problems showed promise to do so. "Evidence from other research projects suggests that an explicit emphasis on analyzing similarities and differences among problem situations, and on bridging to new areas of application, facilitates the degree to which spontaneous transfer occurs" (CTGV,1992, p. 252). On this basis, the final series of 12 Jasper videos can be broken down into four topics—trip planning, business planning, geometry, and algebra (Vye, 2002). For each topic there is a series of three analogous video adventure stories[1]. For example, the adventures related to trip planning—which involve calculations of distance, rate, and time—include "Journey to Cedar Creek", "Rescue and Boone's Meadow", and "Get Out the Vote" (CTGV, 1997). It is anticipated that by working on the same kinds of problems in different narrative contexts and then, further, moving on to the different groups of problems—such as business planning, students will be shown what can and cannot be transferred, while also illustrating the kind of analogous thinking that is necessary for transfer to occur. Even further opportunities for transfer are provided on each video disc in the form of a set of analogs and extensions to each adventure (CTGV 1992a,

[1] Much of the literature published by the CTGV describes *pairs* of related adventures as that appears to have been the plan from the start. However, the final series of twelve is actually made up of 4 sets of adventure *trios*.

1992b, 1997). These adjuncts to the adventures provide a number of "what if" situations that let students manipulate variables within the story.

The final design feature is referred to as cross-curricular or integrated instruction. There are two sides to the research team's arguments regarding this feature. Bransford et al. write, "We have found it useful to envision ways to achieve Skinner's goal of learning twice as much in the same amount of time and with the same amount of effort" (1988, p. 189). At first glance, this is an odd statement to come from a group that espouses the philosophy of learning less in more depth. However, what the researchers are suggesting is that while learning problem solving and math, a student can also be learning about science or history—so on the one hand it is essentially a multitasking strategy. Delving deeper, other members of the team see it as something much more integral to achieving their primary goal. Vye et al. write, "Integrated instruction may help overcome the problem of inert knowledge because it helps students to understand that problems often require the applications of knowledge from so-called different domains, and provides opportunities for students to inquire about situations where a particular concept or skill is applicable" (1990, p. 4). The opportunities are therefore included for the teacher to direct students' attention to different subject areas that are touched upon in the video. For example, one of the Jasper videos deals with a trip in an airplane, which opens the door for discussion of the science or history of flight.

The CTGV acknowledges that their research is firmly grounded in constructivist learning theory and further note that they owe the seeds of their work to Dewey's theme-based learning and Gragg's case-based approaches, both of which they assert are examples of verbally delivered anchors (CTGV, 1992). The team also notes their indebtedness to Dewey for understanding that knowledge is a tool and that as such it is essential to know when, where, and how to use it (CGTV, 1990; 1992c).

In everything that they published, the CTGV team stated that their broad goal was to develop a method of instruction to address the problem of inert knowledge. Attributed to Whitehead, who first mentioned it in an essay in 1929, inert knowledge is that which can often be recalled when one is specifically queried, but which is not spontaneously called upon as a tool to be used in problem solving—even when it is entirely relevant to the issue at hand. In the decade and a half prior to work beginning on anchored instruction, research in the field of cognitive psychology on the topic of inert knowledge yielded some very interesting findings. A number of researchers, Bransford included, were particularly interested in the relationship that context plays in the learning process (Bransford and Vye, 1989).

Using a large body of cognitive research from the 60s through the 80s, the CTGV decided to tackle the problem of inert knowledge by trying to design the kind of instruction that is likely to result in knowledge that is *conditionalized*—where the learner acquires the knowledge in a useful context, and further, is aware of various 'conditions' of the applicability of that knowledge (Bransford & Vye 1989; Bransford, Brown, & Cocking, 1999).

This team referred to the sum of their work, as *anchored instruction* because the instruction, and resultant learning, is designed to be anchored to—or situated in—a very specific, authentic, problem-solving context referred to as a macro-context. The term 'macro' reflects a wide range of things including the rich narrative nature of the context, the sustained time spent working with it (up to several months), and the shared nature of it as something that is watched by an entire group of students with their teacher.

Grounded in constructivist epistemology, anchored instruction espouses the view that new knowledge is built onto knowledge that the learner has already acquired. This often poses a conundrum, how does one learn something brand new if one has nothing onto which to connect it? When learners lack sufficient prior knowledge, information is treated as facts to be memorized rather than tools to be used. Anchored instruction seeks to deal with this problem. In relation to the Sherlock Project, Vye et al. provide the following example, "[I]f students are not familiar with Victorian England, it would be difficult for them to create a mental model of a story set in this time period." (1990, p. 5). The authors add that using a video anchor "enables students to take a processing shortcut since video directly provides much of the information needed to create a mental model" (1990, p. 5).

In addition to their interest in combating inert knowledge, the research team was also concerned with infusing authenticity into classroom activities (Bransford et al., 1990; CTGV 1992b; 1992c). The CTGV were very obvious in linking their efforts to the emerging work on situated cognition as presented by Brown, Collins and Duguid (1989). In a 1990 article entitled, "Anchored Instruction and Its Relationship to Situated Cognition", the research team writes, "Our anchored instruction projects simulate apprenticeships that comprise authentic tasks." (p. 6). Cognitive apprenticeship is an attempt to retool the notion of traditional apprenticeship to make it work in a classroom environment. This generally entails the students being involved in the kind of realistic activities that an expert in a field might engage in out in "the real world" (Collins, Brown, and Newman, 1987). An additional aspect of the design that draws from the work on situated cognition is the fact that the macro-context is intended to serve as an environment for cooperative learning.

Group learning plays an important role in anchored instruction and draws on the notion that outside of school, problems are seldom solved by a single individual, but rather by a community.

The degree to which anchored instruction really is situated was called into question very publicly in an article in Educational Researcher (Tripp, 1993). The team formulated a response in which they reaffirmed their conviction that anchored instruction is situated and is a form of cognitive apprenticeship (Moore et. al, 1994). However, the apprenticeship argument they make is tricky, and the research team knows it, as is evidenced by the following, “Yet for whom are these tasks authentic? We designed the Jasper discs to help students learn to think mathematically, but our instruction does not focus on the kinds of experiences one might expect from an apprenticeship to a true mathematician” (CTGV, 1990 p. 7). Instead, the CTGV maintain that students are apprenticing as a well-informed adult, like a parent who helps his or her child to understand the kinds of skills needed to deal with problems in everyday life. (CTGV, 1993).

Over the years, a number of other anchored instruction projects have emerged from the collaborative LTC team at Vanderbilt which really is not surprising considering the size of the research team. In addition to the Sherlock and Jasper Projects, the group has developed: The Scientists-in-Action series, the Your Explorer Series, and the Adult Literacy Program (CTGV, 1997). Also not surprising, considering the team of nearly 100 researchers who were involved at different points, is the number of anchored instruction studies that the CTGV conducted over the years. Studies involving the Jasper series far outnumber any of the other series or projects as it was given a broad trial that spanned nine of the United States. The results of these and other tests are very encouraging. Across the board, the results seem to indicate that anchored instruction—whether using a pre-existing movie or a specially designed video full of embedded data—is successful (CTGV, 1992a; 1997; Risko et al., 1990, Van Haneghan et al., 1992; Vye et al., 1990).

Interestingly, a number of studies have been completed within the last couple of years by researchers not associated with the now disbanded Cognitive Technology Group at Vanderbilt. One study, conducted in 2003, is particularly noteworthy as it chooses to question the validity of the team's assumptions about generative learning by putting what the CTGV referred to as Instruction Model 2 and Instruction Model 3 to the test. After much observation of, and collaboration with the various teachers who implemented the Jasper series in their classrooms, the CTGV research team went to great pains to promote their assertion that in order for anchored instruction to be most successful, a generative teaching model needed to be strictly adhered to. They contrasted this model with one in which the teacher, who by dint of keeping his or her students from going too far astray, creates an overly structured environment in which the students are not given free reign to generate all possible solutions to the problem—even ones that will ultimately not help them to reach their goal (CTGV, 1992; 1997). Conducted by two researchers at Fordham University, the study (which was very small scale) based instruction around two of the Jasper adventures that related to business planning. The authors report that their results yielded no appreciable difference on problem solving skills between the students taught following the generative model over those taught using a structured model. Further, their data show something else that is rather interesting. The authors note a significant difference in favor of the students who received the generative instruction on an "authentic project" that students produced after the instruction and formal assessment. In this case it took the form of an actual business plan to raise money for a proposed class trip. (Serafino & Ciccehlli, 2003).

A couple of other noteworthy studies have been conducted in recent years in Asia. Due to language and cultural differences, the two research teams—one in Taiwan (Shyu, 1999) and another in Korea (Lee, 2002)—produced their own anchors according to the design features as detailed above. The Taiwanese researchers included an additional element to their study. In order to determine what impact the element of video really brought with it, they tested three groups—a control, a group learning from a video anchor, and then a third group using an anchor in book form. While in both studies, the students working with anchors outperformed the control groups, the Taiwanese researchers noted that the difference in performance between those who learned with a video anchor over those using the book was negligible (Shyu, 1999).

This tradition sets itself apart from others in the field in that the technology it employs is predominantly video-based compared to the others that are all heavily computer-mediated. At the time the CTGV were doing their initial research and formulating their ideas, it was determined that computer technology was not yet widespread enough for it to be universally accessible. Video, on the other hand, was seen as an option that could be implemented on a broader scale as it was seen to be both budget and teacher friendly (CTGV, 1993).

Anchored instruction does share a certain amount of theoretical ground with the Goal Based Scenario tradition in that both are concerned with relevance, authenticity, and problem solving “real world” style. Additionally, both traditions attempt to address the extent to which learning is context-based. Using anchored instruction vernacular, one might argue that Schank’s GBS simulations are anchored around a series of *micro*-contexts in the form of the many experts who share their expertise as called upon while proceeding through a GBS simulation. While the CTGV allowed that simulations would make effective anchors for instruction, they did not feel experienced enough with the technology at the time, nor did they believe that most schools had the necessary equipment to run sophisticated simulations when their development first began (CTGV, 1993).

In as much as it is setting itself up as a form of cognitive apprenticeship, anchored instruction is also based on a philosophy of *learning by doing*, but certainly does not hold the same view of learning by trial and error that is such a necessary part of Schank's work—anchored instruction is more about reasoned decision making (CTGV, 1993.) While the anchored instruction notion of generative learning encourages learners to be active in figuring out the problem and trying out various different solutions, and also, while teachers are cautioned against making their instruction too structured thereby robbing the students of opportunities to experiment—the notion of teacher as a mediator whose job it is to provide support and scaffolding for learners to slowly become more and more independent, is more akin to the general philosophy behind Anderson's Intelligent Tutoring Systems (ITS), than Schank's GBS work.

Additionally, anchored instruction relies heavily on cooperative learning which separates it quite distinctly from both the GBS and ITS, and on that front puts it on common ground with the computer supported cooperative learning (CSCL) tradition. CSCL also connects with anchored instruction on the notion of links across the curriculum (Scardamalia et al. 1989).

Anchored instruction shares a certain amount of theoretical ground with each of the other research and development traditions in this field and there are links throughout the literature made between anchored instruction and the other traditions—even LOGO. "LOGO is an excellent medium for learning, but it is also somewhat limited given the general goals we have in mind." (Bransford et al., 1988, p. 195). This comment is made in the context of extension projects the team played with that incorporated software called PRODUCER which reportedly allowed students to cut together their own simplistic movies using canned footage from the various Hollywood movies they used in the study (Bransford et al., 1988).

Additionally, members of the CTGV authored an article in 1992 proposing how the general concept of anchored instruction might be applied to the design of intelligent tutoring systems in the form of an "anchored tutor" (1992c). In the 1990s, work on simulations began to take place at Vanderbilt as an extension to the Jasper adventures. Designed by Susan Williams, the first simulation project was intended to engender "what if" scenarios that are seen to develop more "flexible knowledge representations" that in turn foster transfer (CTGV, 1993 p. 60). A second simulation, also built to allow the students to engage in extended scenarios, contains a number of design features that reflect shades of the GBS and—even more strikingly—similarities with Anderson's work on Intelligent Tutoring Systems. In particular, the simulation monitors the thinking of the students in a way that is akin to the knowledge tracing design feature of the ITS systems (CTGV, 1993).

Another striking mix of anchored instruction with other traditions comes in the form of the CTGV's implementation of what have been referred to as the SMART Challenges. Standing for Special Multimedia Arenas for Refining Thinking, SMART started off as a form of game show like scenarios in which students were given an opportunity to "test their mettle" by working to solve problems that required an understanding not only of the Jasper adventures, but also the related extension problems. Soon, the SMART Challenges became more about establishing connections and less about assessment. "We are attempting," the CTGV writes, "to use distance learning technologies (e.g., teleconferencing and two-way video conferencing) to help teachers change the existing cultures of their classrooms by linking them with other classrooms and community members throughout the country who are pursuing a common goal" (1993, p. 65)

On the same theme of transforming the classroom into a learning community, another project that combined anchored instruction with other traditions in the field was the joint endeavor, Schools For Thought, which created an approach to teaching that combined anchored instruction with CSCL in the form of knowledge building using the CSILE environment.[2]

The Cognition and Technology Group at Vanderbilt have disbanded and the Learning and Technology Center no longer exists. John Bransford left Vanderbilt in 2003 to accept the title of the James W. Mifflin University Professorship and Professor of Education at the University of Washington, Seattle. The propinquity of Bill Gates' empire to that particular institution of higher learning leads one to wonder if perhaps Bransford has bigger fish to fry and anchored instruction is doomed to slip away quietly into the annals of Educational Technology research and development history.

However, the fact that anchored instruction is linked with so many other of the traditions in this field, coupled with the notion that other researchers around the world have kept the tradition alive by continuing to research the subject, leads one to conclude that there is room for the tradition to grow and move in new directions while also maintaining the integrity of what the CTGV began. With the frenzy of interest at present in simulated role-playing games, it is possible that anchored instruction might get a new lease of life and be swept off in that direction.

[2] Fostering Communities of Learners, an approach to literacy, science, and social studies developed at the University of California, Berkeley was also a component of Schools For Thought.

Whether it fades into the background or comes back to the fore, there is still much that can be learned from this tradition and taken forward for use in future research and development in the field. Anchored instruction has enjoyed a rather widespread implementation in classrooms compared to some of the other traditions. One reason for this is no doubt a result of the simplicity of technology employed. Rather than designing a processor- and RAM-hungry computer-based anchor, the CTGV opted for the relative simplicity of videodisc technology. Therefore, rather than demanding one station per student, its implementation merely required one video player per classroom—which also made it much lighter on the budget.

Another reason might be attributed to the fact that the design is relatively flexible and scalable and can be adapted to many subjects at all grade and experience levels. The philosophy behind the design is such that an educator has a number of options. The easiest option would be to use one of the video adventures from one of the series designed by the CTGV. This is somewhat restrictive as they do not have videos for all subjects and the video series are somewhat pricey. Educators may alternately select a suitable movie to use as a video anchor. To aide in this process, there is a set of guidelines published by a member of the CTGV team entitled, "Implementing Anchored Instruction: Guiding principles for Curriculum Development" that details how best to select an anchor and build a lesson around it. (McLarty, 1989). The final option open to educators involves the design and production of a video anchor that complements the curriculum. It is noted that most educators will not have the time nor access to materials and equipment—much less the skill to produce their own video anchor, but the CTGV have provided a blueprint in the form of the seven design features at detailed above. As this is what allowed the two aforementioned Asian researchers to build their own video anchors, it is clear that this option--while challenging--is viable for those with the means and ability to do so.

There is perhaps also a cautionary tale to be learned from the Jasper videos both in the sense that they have a “shelf-life” and that they are very much affected by the time and place in which they were produced, in this case Nashville in the late 80s—a time when the music video was just emerging and video styles were changing and maturing at a rapid pace. Today’s grade 5 students have grown up watching Hollywood productions, slick children’s television programs, and fast-cutting music videos. As such, they are much more sophisticated viewers than children at that age in 1988 when the videos series was first produced. Times and technology change rapidly; any instructional design using technology needs to take that rapidly changing technology into consideration.

In conclusion, the notion of building a lesson in a semantically rich video narrative is genius in its simplicity. Taking students in a plane to learn geography, although possible—really isn’t feasible. At the same time, one might argue that taking students to visit another time in history is made possible by showing them a powerful movie. Choosing the right anchor is of course key, as is properly grounding a lesson in the story world, but using the undeniably powerful D-Day scenes from *Saving Private Ryan* might make the study of World War II history a great deal more meaningful especially in coming years when there are no veterans left to tell their stories. For many students, reading Shakespeare is an act of frustration. Hearing the words trip lightly off the tongue of a popular Hollywood actor may make it seem not quite so difficult.

For over a century we have been captivated by all the different stories that can be told by rays of light dancing on a screen. The entertainment business capitalizes on this to the tune of billions of dollars each year. Why shouldn't education capitalize on it too?

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