Supporting Problem Solving with Case-Stories Learning Scenario and Video-based Collaborative Learning Technology

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Abstract

In this paper, we suggest that case-based resources, which are used for assisting cognition during problem solving, can be structured around the work of narratives in social cultural psychology. Theories and other research methods have proposed structures within narratives and stories which may be useful to the design of case-based resources. Moreover, embedded within cases are stories which are contextually rich, supporting the epistemological groundings of situated cognition. Therefore the purposes of this paper are to discuss possible frameworks of case-stories; derive design principles as to “what” constitutes a good case story or narrative; and suggest how technology can support story-based learning. We adopt video-based Computer-Supported Collaborative Learning (CSCL) technology to support problem solving with case-stories learning scenarios. Our hypothesis in this paper is that well-designed case-based resources are able to aid in the cognitive processes undergirding problem solving and meaning making. We also suggest the use of an emerging video-based collaborative learning technology to support such an instructional strategy.

Keywords
Case-stories, CSCL, problem solving, social-cultural psychology

Introduction

I remembered a lesson once that I taught about reporting skills in English. As the pupils did not have a similar experience, I brought in an 8-min video clip of “The Titanic”. It featured the ship sinking and the terror the passengers faced. The pupils were then able to “see” for themselves a disaster in action. The lesson achieved its objective and the pupils could write a report on that disaster and in fact, they even interviewed one another, pretend to be the survivors of that disaster. Those pupils have left school already for the secondary education, but they could still remember this episode of their life and often remarked about it being so “real”. (Abstracted from a teacher’s reflection log)

Constructivist learning pedagogies have been increasingly gaining attention in the last few years. Several related instructional models have appeared, the few prominent ones include the constructivist learning environment (Jonassen, 1999), goal-based scenario (Schank, 1993/1994) and anchored instruction (Cognition and Technology Group at Vanderbilt, 1990, 1993). These models have few striking similarities: using authentic problems as the learning focus; using technology to support the learning process; and using stories, cases, or scenarios to provide the contextual information. However, the issue of what makes a good stories or cases is not elaborated. In this paper, we propose the adoption of Burke’s dramatic model (1969) as a guide for designing good stories in relation to problem solving.

Stories have been shown to be potentially effective for clarifying uncertainties and problem solving (Hernandez-Serrano & Jonassen, in press) as they provide some form of ‘narrative intelligence’ that is found in cultures (Randall, 1999). Learning psychologists believe that stories are stored in our long term memory as episodic memory (Tulving, 1993) which are indexed by space and time and encoded with contextual information. Episodic memory is proposed as a complement of semantic memory. Episodic memory consists of episodes and events and temporal-spatial relations among these events. Episodic memory is therefore responsible for recalling larger pieces of information, such as scenes or stories. The memory organization or episodic case memory is the
most important aspect in designing efficient case-based reasoning. It should reflect the conceptual view of what
is represented in the case, taking into account the indexes that characterize the case (Kolodner, 1983).

Some psychologists are even arguing that acquiring an experience indirectly, by listening to and understanding a
story of what other people go through is tantamount to experiencing the phenomenon oneself (Ferguson et al.,
1991). Therefore, presenting the experiences of skilled problem solvers in any field to novice problem solvers in
that field can provide learners with important scripts about how to solve problems. Case libraries made available
to students while they are learning or problem solving can scaffold memory by providing representations of
experiences that learners have not had (Hernandez-Serrano & Jonassen, in press).

Problem Description

The problem which we would like to highlight in this paper is that most literatures do not specify what makes a
good case or story. The justification for cases or stories suggests that stories are able to help learners interpret
them in new situations, applying the principles which undergird these cases. Reasoning from stories or cases
supports “inferences necessary for addressing the kinds of ill-defined or complex problems that come our way in
the workplace, at school, and at home” (Kolodner, 1997, p. 58). Our aim is to describe a framework as to what
constitutes a good case or story for problem solving. The use of stories in problem-solving education increases
problem-solving skills, helps address misconceptions, and contributes to the changing of attitudes (Brown,
1992). Therefore the purposes of this paper are to:
1. discuss Burke’s framework on stories;
2. derive design principles as to “what” constitutes a good case story or narrative; and
3. suggest how technology can support story-based learning.

Narratives as Instructional Tools

Social cultural psychology emphasizes that the use of narratives, stories, and historical accounts of one’s culture
can significantly impact on the notion of cultural epistemologies and beliefs. Stories and narratives are
‘instructional’ tools for teaching values and morals (see Vitz, 1990). As such many educationists have adopted
the traditional view that stories, myths, poems, and other narrative material as powerful models for values
education of the young (e.g., Tappan, 1998). Stories also help to make sense of people’s lives in a cultural setting
(Kilpatrick, 1992).

We are suggesting that there should be more research as to how narratives can be used through educational tools
via media such as the Internet. Narratives and stories are a powerful means of instruction because the learner can
associate with the context, plot, characters, and elements manifested in them. Basically, one of the ways
instructors can scaffold learners through the societal Zone of Proximal Development (ZPD) via the use of
narratives and stories, embedding different voices and perspectives (Matsumoto, 1996). Narratives are one
means to connote activity (cultural) systems in context. Activity systems try to depict the human agents
involved, the tools used in mediating tasks to be achieved based on purposes, and the rules and division of labor
involved (Jonassen & Rohrer-Murphy, 1999).

According to Wertsch (1998), the basic cultural tool for generating the historical representations is language. In
particular, he focused on narratives as a particular form of language used in history. Bruner (1996) similarly
advocates the use of narratives, where they can be interpreted based on hermeneutical principles. According to
Bruner (1996), the “narrative construal of reality” (p. 130) contains notions such as (a) a structure of reality, (b)
generic particularity, (c) actions have reasons, (d) hermeneutical composition, (e) implied canonicity, (f)
ambiguity of reference, (g) inherent negotiability, and (h) the historical extensibility of narrative. These notions
are important because learning is not the same as merely learning the subject, but rather the culture of the subject
with about the ‘narratives’ and attendant non-rational meaning making that goes with it (Bruner, 1996).

From a similar perspective, Burke (1969) uses the notions of drama to connote a context of motives, namely: Act
(i.e., identifies what took place, in thought or deed), Scene (i.e., the background of the act, the situation in which
it occurred), Agent (i.e., person or kind of person who performed the act), Agency (i.e., what means or
instruments was used), and Purpose (i.e., objectives, motives, and goals). Within the above notions, motives are
being surfaced and multiple perspectives of interpretation are involved. The starting point of Burke’s
‘dramatistic’ method is that it takes human action as the basic phenomenon to be analyzed. In Burke’s case, the
notion of action is coupled with that of “motive”; he was fundamentally concerned with “what is involved, when we say what people are doing and why they are doing it” (Burke, 1969, p. xv).

According to Ricoeur (1981/1998), the plot grasps together and integrates multiple and scattered events into one whole and complete story. The “plot” is a construct of human time (with an intended purpose by the author), whereas the “story” is a sequence of events, situations, and settings in natural time. The “plot” is a set of arguments organized in terms of human time, albeit not necessary in sequential historical order. In other words, we are advocating that case stories are adopted in problem solving with intended purposes or “plot”. Not all cases are useful in particular instances of problem solving or learning. For the purpose of supporting problem solving, the central intend of the story adopted needs to be articulated, and designers needs to select stories or create stories with clear intended goals and motives. In the next section, we propose a set of instructional design questions based on Burke’s model to create good stories for the intended purpose of supporting problem solving.

**What constitutes a good story for problem solving?**

Adopting Burke’s dramatic model, we propose the use of Act, Scene, Agent, Agency, and Purpose as essential components of a good story. A plot constitutes these five notions of Burke’s framework. The following are guiding instructional design questions for the selection of case stories in any particular contextual situation in problems solving:

**ACT** – what took place in thought and deed
1. What are the outcomes of the case story?
2. Do these outcomes or acts relate to the problem solving acts of the problem being represented?
3. If the outcomes differ, would the learner be able to make the cognitive associations in order to transfer the case story into the current problem context being solved?

**SCENE** -- the background of the act, the situation in which it occurred
1. Is the background context of the story case similar to the problem case being presented?
2. If the story context or scene differs, would the learner be able to see the associations?
3. What are the reasons for the choice of scene? Are there a series of scenes which scaffold the learner through levels of problem solving?

**AGENT** -- person or kind of person who performed the act
1. Are the persons in the story and the functions played similar to the problem solving scenario being presented to the learner?
2. Would the learner be able to relate the agents in the story to the agents presented in the problem scenario?

**AGENCY** – the means or instruments used
1. Are the tools and means used in the case or story similar to the ones which the learner has to use?
2. If the tools differ, would the learner be able to translate or relate to his or her own context? What kinds or hints can be provided to the learner?

**PURPOSE** – Objectives, motives, or goals
1. What are the main goals of the case or story which is being adopted?
2. Does the purpose of the story or case tally with the purpose of the problem being solved?
3. Are there multiple goals within the story which will create confusion in the learner?

When designing case-stories, educationalist or instructional designers could adopt the suggested questions, as posed above, in a relatively structured manner based our framework. These guiding questions would provide the basis of contextualizing stories within rich and situated contexts.

**Case stories and Problem Solving**

So, why could stories be used as case supports in problem solving? The issue of transfer in learning, that is transfer of story or case elements to the problem solving context, is crucial. To Dewey (1933), encountering a problem is the beginning of real thinking or learning. Dewey (1933) regards the need for clearing up confusion; of straightening out an ambiguity; of overcoming an obstacle; of covering the gap between things as they are and as they may be when transformed as the germ purposes of a problem. Thus, supporting the problem solving process is critical to learning. And hence the use of stories is one way through which parallels are drawn from
facts in the story to the facts as presented in the current problem. The story allows for the learner to engage in compare and contrast between elements of the story and the problem presented.

In the process of problem solving, the learner or learners must inherently draw out the dimensions of the story (Act, Scene, Agent, Agency, and Purpose) with that of the problem. With such a compare and contrast, the learner should then draw the possible implications that the story can contribute to the current situation. The learner should then – following the case-based reasoning approach – develop an explanation of why the story was successful or unsuccessful in the story in addressing the issue at hand. With this explanation or mental model being formed, transfer could be made to the current problem solving context. Thus the process is three-fold:
1. Compare and contrast between story and actual problem adopting Burke’s framework;
2. Draw implications – mental model or explanation—from the story and relate it to the problem context; and
3. Apply the lessons learned to the current problem being solved.

In other words, the learner has to be a reflective thinker. He or she should be able to identify the similarities and the differences between the case (story) and his / her own problem situation. Due to the different contexts (case story and the problem at hand), the learner has to be able to make the relevant changes or transfer before he/she can apply the “new learning”. Metacognitive thinking is needed in this case. Otherwise, it may be merely a low-level “rule” based kind of learning or transfer.

To sum up, a good case story should be able to show the consequence of an action. In other words, learners when viewing a case needs to connect between the “plot” and the consequences of the plot. A good plot allows the learner to relate to the case situation at hand. In the event that the learner has not seen the relevance of the story, scaffolds within the learning environment should be facilitated to assist the ‘transfer’ process. Problems of relevance and transfer occur when learners do not relate to the Agents, Agency, or Purpose of the case in relation to their own specific goals.

A good case story should also invoke a learner to recall relevant or appropriate experiences or cases similar to the case example (if the learner possesses relevant prior example accounts). These self-reflected may be even more significant to the learner compared with case stories provided by the learning environment. A good case may also help to stimulate the learner to develop appropriate thinking dispositions, for example compare and contrast, relevant to solving the problem. Such thinking dispositions would then help the learner to narrow down the choices or eliminate “wrong” choices. Dewey (1902/1990) refers to the notion of psychologizing subject matter by relating curriculum content to the learners’ experiences and making the learning personal. The adopting of a good case approach which the learner can relate to is a good example of psychologizing the subject-matter with ideas relevant to the learner.

Many issues remain for teachers in preparing good cases and stories for learners. Time is needed by teachers to understand the ‘stories’ (prior experiences) of the learners and relating or psychologizing subject matter in the curriculum with relevant cases-stories. The video-based mathematics problem solving case story as described above is one example of a teacher having spent time in designing the problem solving video. Moreover, students in schools also need sufficiently allocated space and time to work on these cases and stories in problem solving. In other words, they need time to experience their teachers’ attempt to “psychologize” the curricular content (Deng, 2001).

**An Examples of Stories in Problem Solving**

The benefits and positive effects of situating instruction as cases and stories have been shown in numerous studies known as anchored instruction (Bransford & Vye, 1989; Bransford, Sherwood, Hesselbring, Kinzer & Williams, 1990; Cognition and Technology Group at Vanderbilt, 1990, 1992a, 1992b, 1993). We argue that the Jasper adventure series produced by the Cognition and Technology Group at Vanderbilt (CTGV) are motivating because they possess the important elements of good stories according to Burke’s framework. The Jasper series present believable stories set in authentic contexts (scenes) that have interesting characters (agents), challenges (acts), and extensions to a variety of curricular areas. To solve the problems faced by the actors in the stories (purposes), the students find information that was presented as part of the story. The Adventures of Jasper Woodbury materials provide a common context for instruction, an authentic task, and a chance to see that school knowledge can be used to solve real problems.
Extending the success of Jasper series, we suggest the use of stories to support problem solving. For example, to help elementary pupils engaging in a complex mathematics problem of planning the budget of a class outing, we could develop a story video. The scenario is set in a context which is familiar to students, i.e. planning a class outing. The story is believable because it is set in a local school situation which is familiar to the students (Scene). The story begins with the teacher telling his/her class pupils that they have been rewarded with a class trip to a place of their choice for doing well in the examination. The students in the video decide that they want to go to the East Coast for a cycling trip (Scene). The teacher forms a working committee made up of six students to plan for the trip (Agent). One of the planning dimensions involved transportation. Two students in the committee are assigned to source for quotations to charter buses for the trip (Agency). They collect four quotations and using the relevant mathematical concepts, figure out the total costs for each quotation and select the “best” vendor (Agency). The teachers, students, and actors in the video can be real people in the school (Agent). Both relevant and irrelevant data can be thrown into the clip. This is done on purpose for pupils to discuss and select the relevant information to solve the problem. All the similar data needed to solve the problems are embedded in the story (Purpose). Students will be able to review the movie anytime to identify important data by clicking on the rewind and play buttons.

Scaffolding Problem Solving with Technology

Having discussed the design of case stories for problem solving, we shall now focus on the scaffolding role of technology. The notion of scaffolding students to move from their current state of problem-solving competency to a more advanced level has been recognized by Vygotsky (1962). Scaffolding can be achieved in multiple ways, including prompts, hints, comments, explanations, questions, counter-examples and suggestions. The common feature is that the teacher provides the learner with support or assistance necessary to complete a task that would not have been completed without the help. Through scaffolding, the teacher models problem-solving behavior so that students can appropriate and internalize the strategy to become independent problem solvers.

In supporting complex or ill-structured problem solving, it is important to engage the learners in social negotiation to reveal multiple views and perspectives and to select and justify optimal solution based on reasoning and evidence (Jonassen, 2003). Computer-Supported Collaborative Learning (CSCL) offers opportunities for both peer and mentor electronic guidance and feedback that stimulate student discussion and internal reflection. Analysis of empirical studies about the effectiveness of CSCL (Lehtinen, et al., 1999) offer evidence that CSCL environments are helpful for higher order social interaction and as a result better learning in terms of conceptual understanding, metacognitive knowledge, skills and changed beliefs and attitudes. However, technologies that specifically support the use of case-stories are not commonly available. In the following section, we review an emerging video-based CSCL, Conversant Media®, as a possible solution that supports problem solving with case-stories.

Technologies which Support Case-Stories

Conversant Media®, a server-based application software developed by Laboritories of Information Technology (Singapore), consists of a digital video player, some administrative tools, and a collaborative discussion board (Lourdasamy, Khine, & Sipusic, in press). It uses video technology that supports situated learning and historical narratives as it captures audio, real-life video images, and rich contextual information. The use of video can help to gain and focus learner’s attention and facilitate qualitative understanding of the events that are being depicted. Digital videos have the added advantages of rewind and replay of any segments in the video (Duhaney, 2000), and the ability to obtain any frame of still images. It allows the learners to freeze, review, and analyze the video footages frame by frame.

Once the user launches the software and selects a video clip, the screen shows a media player on the left hand portion and a commentary frame on the right hand portion of the screen. Each line in the commentary frame represents the title of a comment, which can be clicked to open and view the comments in the bottom card display frame. Each video has a unique time-code which is inherited by the attached comment. Clicking on the comments title, automatically displays the card and brings the video to the attached frame (See figure 1). Unlike other text-based discussion board, it allows viewers to watch the video footages and attach a comment to a specific location on the video.

While viewing a particular segment of the video, if the user is ready to post a comment, the video can be stopped. By using the “comment” button, a commentary can be created in a dialog box and submitted to the
system. The commentary is recorded and the author (commentator’s name) is displayed along side the title of the commentary. In this manner other users are able to add their own comments or react and reply to other users’ comments. As each comment is added, a mark is drawn at the corresponding time code position on the timeline for playing the video. Over time, it becomes possible to locate “hot spots” on the video where higher densities of comments are located.

Figure 1. A screen capture of Conversant Media

Another feature that attempts to encourage better commentaries is the peer rating system. Every card that is open by a discussant, has to be rated before the user is allowed to proceed. Rating is done on a 1 to 5 scale of overall value and informativeness of the comment. Once the user rates the commentary, he can close the window to proceed to other tasks. The combination of the spatial display of comments attachment locations and the results of peer ratings of the comments allows discussants to keep track of the online discussion. Such an annotation track also allows users to retrieve the records of the commentaries from the database easily.

An Example of National Education with Video-based Narratives and Supporting Collaborative Technology

To concretize the above instructional strategies and supporting technology, we suggest a sample module on National Education (subject related to issues belonging to citizenship and the nation) revolving around the water issues in Singapore for grade 9 students. The following sections relate an example of how teachers can construct lessons on the issues of National Education.

Learning Objectives for the First Lesson

- Describe the major events occurred during the longest water rationing exercise in Singapore from April 1963 to February 1964.
- Describe the impacts on various aspects of life in Singapore.
- Derive the implications about water supply in Singapore and its impact on the country’s progress.

Activities

- Students are to produce a timeline of the major events that happened during that 1963 water rationing exercise; produce a mind map on the impacts on various aspects of life in Singapore; participate in online discussion and write a short essay on the implications of water supply issues in Singapore.

Supporting Technology

- Video Narratives. The video narratives can be produced incorporating Burke’s five scaffolding notions so that beliefs and values can be made explicit and public for consideration. More specifically, a video
narratives on the water rationing exercise in Singapore can be produced (Figure 2), which among other events, including the major events that happened in chronological order (Act), the background information of the occurrence of severe drought (Scene), how the government implemented measures to address the problem (Agent), the use of water rationing measures (Agency), and the rationales for doing so (Purpose). The proposed approach of using video-based narratives is similar to the Jasper experiment (Cognition and Technology Group at Vanderbilt, 1993) where authentic mathematical problems are presented through video in real-life contexts. Students were required to identify the problem and to solve it (in groups).

![Figure 2](image.jpg)

**Figure 2.** A video narratives on the water rationing exercise in Singapore in 1963

- **Video-based CSCL**
  Using Conversant Media®, the instructor can provide appropriate feedback by monitoring the students’ discussions. Instructors and teachers would be able to pose relevant and thought provoking questions based on the motives undergirding agents in the context of their actions. As a result of discussions centering on the video-based narrative of some historical event, students may be required to produce their own interpretation of the scene or event. The purpose of such a personal account would be to forge what existed in another person’s account (as envisaged by the video) and constructing one’s own interpretation, or perspective—the process of appropriation (Bakhtin, 1981). Although the proposed video-based narrative on-line environment is designed to exhibit one particular narrative at a time, students may invoke past videos observed (related to the current video narrative at hand) and interject multiple views to produce an account or action.

Fundamentally, the above video-based narrative on-line environment creates a knowledge-construction situation with themes of discussion generated according to Burke’s categories of act, scene, agent, agency, and purpose. In other words, each of these categories can be a discussion thread. Within each of the discussion threads, learners can mark (and un-mark) segments of the video that is under discussion and title them with meaningful descriptions. When learners review what was discussed, the marked video segments would be presented according to the discussion nodes.

**Follow-up Activities**

- **After the initiation lesson, a more in-depth study of the issue may ensue.** A class can be assigned the role of a working committee with the over-arching goal of submitting a proposal to achieve sustainable supply of water in Singapore in the next 50 years. A brainstorming session can be conducted during which key strategic actions can be identified. The class can then be divided into sub-committees to explore these key areas. For example, there can be an Education Sub-Committee that looks into strategies to educate the public on water conservation, a Technical Sub-Committee that investigates the various technologies to obtain water from the environment, a Public Utilities Sub-Committee that plans the water-reclamation infrastructure in Singapore, and a Foreign-Affairs Sub-Committee who work out negotiations plans with neighboring countries on supply of raw water.

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Conclusion

This paper focuses on designing good stories as case-based resources for problem-centered learning. Based on Burke’s dramatic model, we proposed a set of instructional design questions for each essential component of a good story: Act, Scene, Agent, Agency, and Purpose. We also suggested the use of a video-based CSCL technology to support problem solving with case-stories learning scenarios. However, much research remains for how stories can be an integral part of learning. The social cultural research points to the value of culture’s narratives in cognition. We hope that this paper has in some ways contributed a framework for constructing an effective story for problem solving and meaning construction.

References


