Introduction:

Traditionally learning is conceived as taking place inside the head of the individual. The belief is that learning is the result of the modification of mental structures when the individual assimilates new information or experiences. This notion of learning, however, is fast being overtaken by the view that learning is not merely based on individual cognition. Rather it is increasingly viewed as a collective and social process. However, despite the advances made in enabling more effective modes of learning to take place, we have not yet been able to evidence group knowledge and make it measurable. The notion of what constitutes learning and how we are able to measure it is notoriously difficult. Traditional means of assessing individual learning are controversial and there is much debate about how we may effectively assess how much a person knows. This problem is exacerbated in a group scenario where collective measures of learning must now be used to assess how groups form knowledge.

Thus an exploration of the issues that surround the formation of group knowledge and how we may assess and measure it is proposed. Specifically, a study that seeks to account for the following research questions will be undertaken:

- What exactly is group knowledge? How is it formed and evidenced?
- And how may we reliably make judgments about whether a group has made some form of progress in increasing its knowledge and understanding?
Furthermore, this study will also apply the principles of how group knowledge is evidenced and assessed to a case study. In particular, this research explores the means by which group knowledge is formed in an undergraduate Business School class. This class utilizes an online learning environment that employs Social Tagging. Basically, the learning environment allows the user to organize and display online content with meaningful keywords or tags. This study will thus make the argument that the tags use function as a useful proxy for knowledge being formed within the class. As such, a case will be made for Social Tagging as a viable means to visualize, facilitate and assess group knowledge formation.

**The Distributed Cognition framework:**

A key idea that this study hopes to put forward is that learning is very much dependent on the external environment as it is on individual cognition. Here, learning is seen as a collective process where individual knowledge is transformed as a result of interacting with classmates and artifacts found in the learning environment. Influential to this view of learning is Ed Hutchins' notion of how knowledge can be represented, communicated, and transformed across a "Socio-Technical System". [Hutchins, 1995]. In this theory, Hutchins argues that any analysis of group cognition needs to consider both the tools/systems employed and their users as a unified system. The reasoning for this is that the cognitive burden of processing new information is distributed across both the members of the group and the artifacts or tools employed in the task at hand.
Building on this notion of the socio-technical system, the notion of learning in a group is further developed with the notion of Distributed Cognition. Learning is seen as a collective process where individual knowledge is transformed as a result of interacting with other individuals, artifacts and systems that are in the environment. According to Flor & Hutchins, such a view of distributed and collective learning can be defined as the "propagation of knowledge between different individuals and artifacts and the transformations external structures undergo when operated on by individuals and artifacts." [Flor & Hutchins, 1992]. This is especially significant to the technologically enabled classroom environment. Here knowledge is produced through the interaction with both classmates as well as artifacts in the class' physical and online learning environment. In the following sections of this paper, we will now look at how distributed cognition can be applied to better understand group knowledge formation and how we may assess that knowledge.

The formation of Group Knowledge:

A useful way to thus think about how Group knowledge is produced within a socio-technical system is to consider how information comes to be transformed and represented in the group before it is recognized as a shared knowledge and understanding. In particular, I have identified two key areas where the transformation of information into group knowledge takes place: the use of intentional redundancy in the storage and representation of information and the notion of the iterative learning loop.
A key element for turning information into group knowledge is the use of intentional redundancy or "cognitive overlaps" in the way information is stored and processed for the group. Here the responsibility for the processing of information does not just lie with any one aspect of the socio-technical system. The individuals within the group are just as much "repositories of knowledge" as the technology, artifacts and routines utilized within the group. This idea is illustrated by the analysis of how information about the aircraft's speed is stored and represented in multiple ways within the cockpit of a commercial airliner. Seen in this light, the processes that are involved in the complex task of remembering the different speeds for the landing approach is not confined to any one individual or system in the cockpit. Rather, the pilots and their tools "become a property of a larger system" [Hutchins, 1995] where they function as "repositories of knowledge" [Argote, 1999] for the larger group. Thus, in order for these "repositories of knowledge" not to become 'isolated silos', information or knowledge that is crucial to the group's functioning can be seen in the overlaps between what each individual or system knows. This way shared understandings, or Distributed Cognition, can emerge from commonly held information across different elements of the social-technical system. An analysis of cognition within the cockpit needs to take into consideration both the technical systems employed and their users as a unified system.

Another key idea for how group knowledge is formed can be seen in the notion of the iterative "learning loop" in a group's processing of information. [Russell et al, 1993]. This idea is linked to an understanding of the sensemaking processes that are at play in the formation of knowledge and. Here, elements of a group iteratively make sense of new
information by updating and modifying their prior understandings. This learning loop is key to our understanding of how group knowledge is formed as it explains how individual knowledge becomes instantiated and held in common. Essentially, the individual knowledge shifts to accommodate the ideas of others in the formation of group knowledge. This process can be seen in the following illustration. Individuals working together on a collaborative task are likely to possess different kinds of knowledge and so will engage in interactions that will allow them to pool the various resources to accomplish their tasks. In this pooling together of individual knowledge, what happens is that the group knowledge begins to be formed as each individual in the group begins to makes sense of each others’ understanding through an iterative learning loop.

Thus these two ideas behind the formation of group knowledge can inform the design of a system where we are able encourage the formation of group knowledge and make it obvious. This can be done through making apparent the "cognitive overlaps" in the group's understanding as well as providing for avenues where individual knowledge can be transformed into group knowledge.

**How may we assess group knowledge formation?**

As mentioned at the start of this paper, the assessment of Group Knowledge is a particularly difficult task. However, given our consideration of how group knowledge is formed, through “cognitive overlaps” and ‘iterative learning loops’, a useful to manifest the shared understanding held by a group might be through the use of Social Tagging systems.
Tagging describes the activity of marking online content with keywords, or tags, as a way to organize content for future navigation, filtering or search. This act of assigning keywords to tags to categorize an object is an act of knowledge production as it makes apparent the mental models, or internal representations of knowledge, that one use to associate with the object. The argument being made here is that by allowing students to associate keywords to objects we are enacting the associative structure of knowledge formation. Here, new knowledge is formed in the allocation of tags, as the individual has to make sense of the new object by associating it with prior understandings and classification of objects. Studies of early childhood learning indicate that the ability to categorize new objects based on prior known characteristics is evidence that learning is taking place and new knowledge is being formed. [Pauen, 2002]. Thus, the use of tags can function both as a way to facilitate the formation of new knowledge as well as evidence of how this knowledge is formed.

Social Tagging takes the principles found in the act of assigning keywords online and makes it a shared and collaborative activity by making the tags publicly visible. It is proposed that Social Tagging systems employed within a learning community can both facilitate and provide evidence of knowledge formation within the group. The basis of this analysis is founded on the notion that the "tags" function as a "repository" of the group's knowledge. [Argote, 1999]. This notion, put forward by Argote, suggests that individual knowledge can be brought out and shared with the group through the use of shared artifacts. In the case of this class, the tags with which individual students
categorize online content functions as an indicator to how that particular student has made sense of and assimilated the material being taught in the class. Having the tags made public and shared with the class, other students are able to tap on the knowledge being formed by the individual student. Learning in the class thus takes place through an iterative "learning loop" [Russell et al, 1993] where the students in the class update and modify their representations of knowledge through encountering and instantiating the use of tags that the other students have employed. This learning loop is key to our understanding of how Social Tagging can be used to form group knowledge, and as a result individual learning as well.

Thus, the use Social Tagging facilitates the sensemaking efforts of the individual and the learning community through the collective act of associating keywords with documents/artifacts and by sharing those terms with the rest of the community. The use of Social Tagging systems also provide learning communities with a means to visualize and be made aware of the tags used by the group. By extension, this provides learners with an indication of the patterns of cognition taking place within the class on a particular topic. Based on this theoretical consideration, it is proposed that Social Tagging is a viable means with which to make apparent knowledge formation within a group in order to empirically assess it. In order to validate this claim for the use of Social Tagging as evidence of group knowledge formation, I now propose a study of the application of Social Tagging in an actual learning environment.
The Case Study:

This paper puts forward a case study of the use of Social Tagging in an undergraduate Business School class. The aims of such an analysis if to put forward a practical methodology whereby Social Tagging can be used to empirically evidence and evaluate group knowledge formation.

The BIT 320 Remix:

Business Information Technology 320 (BIT 320) is a Database and Information class being offered at a large midwestern university. This class utilizes various technologies to create a shared online space in which group learning can occur. The class has been dubbed the “BIT 320 Remix” by the instructor based on Lawrence Lessig’s notion of a “remix culture”. [Koman, 2005]. Lessig describes a society that allows and encourages efforts to improve upon, change, integrate, or otherwise remix the work of copyright holders. The class goals are to convey the latest principles in Business Databases and Information systems through a philosophy of “learning by doing”. Participation in the class is mandated through the weekly submission of 5 blog posts and 10 bookmarks to the class “remix” site (see http://thecomunityengine.com/bit320/remix/) that aggregates all the students’ contributions. Students maintain individual blogs and social bookmarking accounts, and are encouraged to contribute their knowledge by sharing relevant links, questions, answers, and observations of the material being taught in the class. This open sharing of
information is promoted to create a vibrant learning community where group knowledge is built collectively through the efforts of the individuals in the class.

The formation of group knowledge is facilitated in the class through the use of Social Tagging systems. The goal of the instructor is to create a system where students are able to make contributions so that they are aware of each other and are able to find pertinent information from the pool of contributions. Students in the class are encouraged to assign categories, or tags, when contributing their blog and URL submissions. Unlike more orthodox and controlled forms of classification, Social Tagging allows the users in the community to assign any keyword/category that they view as relevant. Various visualizations, such as the use of tag clouds helps members of the class to be made aware of the current and most frequently submitted topics/posts are by way of the tags. This paper argues that Social Tagging is a means by which new information submitted to the class is made sense of by the entire community. [Weick et al, 2005].

A proposed method for assessing Group Knowledge formation:

According to Bowker and Star, the act of classifying and categorizing objects has not only symbolic value but also that of material significance. [Bowker & Star, 1999] For instance, early categorizations of homosexuality associated it with being an illness. This act of categorizing homosexual individuals as being ill had material consequences for the individual, but also the social, political and cultural implications of this classification extended well beyond the bounds of medicine. Using this illustration as a guide, this plan for empirically evidencing and assessing group knowledge formation in BIT 320 seeks to
take into account a “Distributed Learning” mode of analysis. As such, a variety of methods are proposed to analyze how Group Knowledge is formed with Social Tagging systems.

a) **Content analysis** of the students’ blog and bookmark contributions will be related to the tags. This is to verify that the Tags used reflect an appropriate vocabulary for the content that they are representing. It is expected that multiple terms will be used members of the class for a particular content type/topic. Examining the range of vocabulary used, and the overlaps found in the terms, for a particular topic will allow insight into the group knowledge being formed around particular topics.

b) **Analysis of relative frequencies and patterns** in tag use will provide an indication of two contrasting effects: the popularity of certain topics, and the stabilization of certain tags used to categorize particular topics. Patterns in the use of tags will also reveal insights in to group cognition. For example, having a certain topic tagged differently by two distinct clusters of the class might indicate opposing viewpoints on a particular topic. This analysis will be aided with visualizations of the tags, such as tag clouds. As such, what will emerge from this analysis is the evolution of the class’ knowledge as it progresses through the term.

c) **Social Network Analysis** will be used as a method to surface the interaction patterns of the students in the class. This method, proposed by Newman and Girvan, describes a set of algorithms used to measure and discover community structure, or natural divisions of densely linked nodes, in networks. [2004]. Here, the an analysis of the tags being used by the class and how they are linked to other tags will provide an indication of Group Knowledge based on keywords. The rationale for this is that each
tag represents an individual student’s knowledge. Social Network Analysis thus provides the ability to analyze the patterns of tag adoption through visualizations of the frequency and popularity of certain tags. Ideally, popular tags will emerge as clusters with the use of this method. These visualizations would thus provide a picture of what topics are popular and are widely adopted as tags in the class. One conclusion that can be made from this analysis is that clusters of popular tags give an indication of the state of internal knowledge that the class is using to associate with the online content.

d) Additionally, by analyzing the interaction patterns based on individuals in the class, Social Network Analysis is able to give a picture of the community structure in the class through visualizations called sociograms. These visualizations help us to identify key "idea leaders" in the class who generate tags that are adopted by a large proportion of the students. We are also able to visualize key "idea receivers" or students who are more than likely to adopt the tags of others. This is important to the ability to assess the formation of group knowledge because of the notion that knowledge formation is a social activity. As such, being able to picture who generates the ideas and who is likely to adopt them will allow insight into the dynamics of group knowledge formation for BIT 320. It is speculated that different groups would have different patterns of group knowledge formation.
Conclusion:

In conclusion, what this paper has set out to do is to make a case for the viability and effectiveness of using Social Tagging as a means to evidence and assess Group Knowledge formation. At present, this paper lacks an empirical justification for its proposal. It is hoped that what paper has presented, provides a useful foundation on which to build an empirical study for the use of Social Tagging in the classroom. Future steps to take would be to actually carry out the methods of analysis provided for in the last section of this paper.

References:


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