# Web 2.0 supported collaborative learning activities: Towards an affordance perspective

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Web 2.0 provides social software that is intuitively appealing for supporting collaborative learning. However, as revealed in our pilot case study, simply making Web 2.0 tools available or even mandating their usage does not guarantee that students will use the tools for collaborative learning. Even the use of a framework such as Activity Theory to guide the design of the unit did not ensure collaborative learning mediated by the technology. We propose that an affordances perspective may offer the guidance needed.

**Keywords**: affordance, web 2.0, collaborative learning, activity theory, learning design.

## Introduction

Complex social networks are not new, however due to recent technological developments social networking has emerged as a dominant form of social organization (Barry, 2002). Technology has allowed individuals to form communities based on their shared interest rather than kinship or locality. The birth of Web 1.0 enabled networks of computers to be linked together. Nowadays computer-mediated communication networks link people into computer-supported social networks, hence Web 2.0.

This significant proliferation of the Internet has shifted our paradigm of community and interaction and opened up new possibilities in the workplace and learning environment. Either within the corporate boundaries or in academic settings, in the virtual and networked organizations, people are working with shifting sets of supervisors, peers, and subordinates (Barry, 2002). Web 2.0 provides the social software to both inspire and support these new ways of interacting. In the educational realm, Web 2.0 is particularly attractive for the support it can potentially provide for collaborative learning.

Despite the intuitive appeal of most Web 2.0 technologies, our preliminary observations in this case study reveal that simply making Web 2.0 tools available to students does not guarantee their utilization or the improvements in learning outcome. Many claims have been made about web 2.0 tools, but many were made without strong evidence (Mason & Rennie, 2008). There is still a need for deeper conceptualisation of the relationship between web 2.0 tools and teaching-learning processes (Carsten et al., 2008) to clarify how and through what mechanism web 2.0 tools support learning.

Initial attempts, such as the work by Mason & Rennie (2008) tend to be centred on the technology itself and provide informal ways of looking at each individual tool closely as a separate phenomenon. A fully conceptualised framework is needed to refocus the investigation towards components of a learning activity and addresses issues such as choice of modalities, group interaction and social negotiation of meaning. This paper seeks to lay the foundation argument for that framework based on Norman's (1988) notion of affordances. The framework acknowledged that Web 2.0 tools are embodied within the new social interaction phenomenon and can pervade every aspect of a learning activity.

In this paper we present preliminary findings of the usage of Web 2.0 in a pilot case study of a team-based project unit. We begin with a brief introduction to Web 2.0, followed by an explanation of Engeström's Activity Theory which was used to guide the redesign of the unit. The case study revealed haphazard and varying usage of the wiki which had been provided

to support collaboration. An affordances perspective is presented and discussed as a means of aligning the tool with the learning goals, followed by our final conclusions.

## Web 2.0

Awkwardly named, the term “Web 2.0” was first coined in a brainstorming session with no clear definition attached to it. The term was given the misleading numerical “2.0” designation, which would normally indicate a new major software release that was replacing a previous version.

**Table 1: Web 1.0 Vs. Web 2.0 by observation (expanded from O’Reilly, 2005)**

| ***Basic service*** | ***Web 1.0*** | | ***Web 2.0*** | ***New characteristics*** |
|---|---|---|---|---|
| Online advertisement | DoubleClick | - | Google AdSense | Dynamic advertisement based on the page content |
| Photo sharing | Ofoto | - | Flickr & MySpace | Personalized templates, tagging, annotating & comment |
| Website | personal websites | - | blogging | |
| File sharing | Akamai | - | BitTorrent | Peer to peer source & each downloading machine becomes server |
| Music sharing | Mp3.com | - | Napster | |
| Online encyclopaedia | Britannica Online | - | Wikipedia | Open content & collaboratively written |
| Online event organizing | Evite | - | upcoming.org & EVDB | Event request & comments from collective users |
| Identity | domain name speculation | - | search engine optimisation | Marketability |
| Visitors volume | Page views | - | cost per click | Navigation behaviour |
| interfacing 2 programs | screen scraping | - | web services | Merging into 1 platform: The Web. |
| Centralized authorship | Publishing | - | participation | Democratisation of authorship |
| Centralized managed content | content management systems | - | wikis | Open content |
| Pre-defined | directories (taxonomy) | - | tagging ("folksonomy") | User-defined |
| Single provider | stickiness | - | syndication | Federated provider |

Summarising O’Reilly’s (2005) observations of the new web-based applications, Table 1 is adapted to show the distinctions between this new breed of characteristics with their counterparts; further annotation on the outer columns are added to clarify the explanations.

The key characteristics of viewing the web as a platform and harnessing collective intelligence have driven the paradigm shift. It is not a mere medium of communication between applications, the web itself has become the application. Participants are no longer just consumers of content; they are producers as well, leading to the trend of user-generated-content. The value of a service can now be measured by the number of people using and contributing to it, rather than the traditional measurement by number of viewers.

The Web 2.0 phenomenon, proliferating on the growing internet-connectedness and improving quality of connection, has redefined the playing field. At its core, it is still just a collection of tools, but these tools have enabled the extension of social interactions and relationships well beyond the physical boundaries (e.g. facebook, friendster), connecting

people with the same interests (e.g. linked-in), creating virtual communities (e.g. myspace) that share each other's thoughts, learn from each other and contributing artefacts such as text (e.g. wikipedia), pictures (e.g. flickr, picasa), audio (e.g. voicethread), video (e.g. youtube, howcast), browsing history (e.g. del.icio.us, stumbleupon), and annotated web pages (e.g. diigo), at a scale that has not been possible before.

## Impact on learning

From an educational view, the proliferation of computer-supported social networks has promoted the constructivist approach to a greater community than before, requiring teachers to start taking the transition seriously.

An often made call for educators to change the way they teach has recently become more apparent. Jonassen, Peck & Wilson (1999) explained there are two implications when teachers made the transition from traditional transmission model to self-regulated learning model:

- Firstly, teachers have to relinquish some of their *intellectual authority*; as learners need some space to construct their own meaning of the world. Teachers thus can't be too instructive in the learning design. The teacher's role has shifted from knowledge transmitter to facilitator who assists students to both discover the larger community of scholars in a particular topic and evaluate their own beliefs and understanding compared with the generally accepted conceptions. Perkins (1992) called this journey a "conflict-faced" path.
- Secondly, teachers must further relinquish the *managerial authority* of the learning process itself; teachers are, *de facto*, no longer in full control of all the learning activities which learners can embark on; there are a significant number of resources available and relatively accessible and this makes it almost impossible to determine what a learner can and cannot know. This also means that learners are required to become gradually more "self-regulated", and be more responsible in managing their own learning tasks (Collins, Brown, & Newman, 1989; Perkins, 1992)

We are particularly interested in handling the effects of loss of managerial authority. Activity theory provides a rich understanding of the learning process and thus offers a framework for understanding how learners utilise Web 2.0 tools to inform learning design decisions.

## Activity Theory

Any design framework that intends to inform use of Web 2.0 tools needs to place social interactions and relationships at its core. Activity theory (eg Engeström, 1987; Jonassen, 2002) focuses on the broader social and cultural context of human activity, allowing a comprehensive explanation of social interactions and relationships.

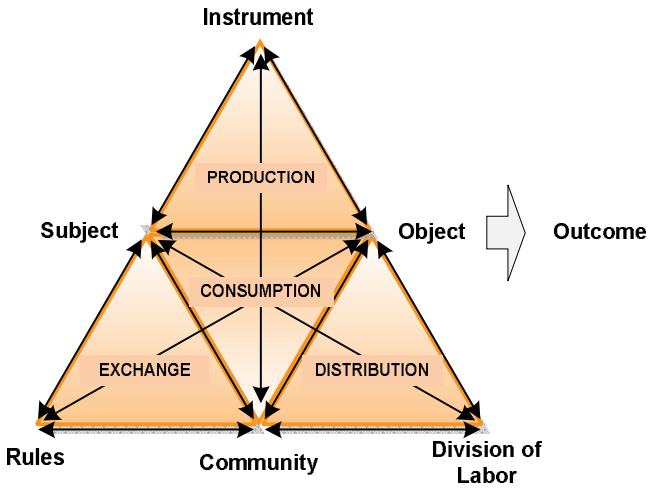

**Figure 1: Development of Human Activity Theory (Engeström, 1987)**

Central to activity theory is the idea that the appropriate unit for analysis of human activity is an activity system which involves a group of people working towards a common motive (Engeström, 1987). Activity systems explain how people interact, with each person contributing to the fulfilment of a common motive.

Engeström (1987) developed a framework to describe activity systems (Figure 1). The framework describes how the efforts of a group or an individual towards an object are mediated by instruments of production, rules and customs, the community and the division of labour. The relationships between these components are represented with four subsystems: production, exchange, consumption and distribution.

Activity systems contain a hierarchy of social activity, individual actions and individual operations (Engeström, 2000). These relate to a collective motive, individual goals and individual conditions, respectively. Bærentsen & Trettvik (2002) describe this hierarchy as explaining why, what and how the activity takes place (Figure 2).

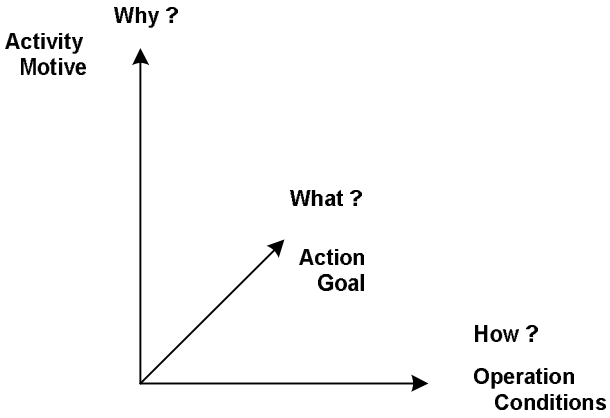


**Figure 2: Constituents of activity as analytical dimensions (Brentsen & Trettvik, 2002)**

## Pilot Case Study

We conducted a pilot case study within two 3rd-year computing project units at Macquarie University. A total of 54 students in 11 groups of 5 and 4 members, participated in the study in Semester 1 2008. The same batch of students, shuffled into new groups, continued their second semester of the units for Semester 2, 2008. The units are compulsory for students enrolled in the Bachelor of Information Technology or Bachelor of Information Systems at Macquarie University. These are capstone units (Clear et al. 2001), which aim to tie together student's previous learning and prepare them to enter the workforce. Students are observed to have high interest and level of engagement with the unit.

The units were built around a single project, which the students have to work on as a team (5 or 4 members per group) for the whole semester. The project is their key activity and it is both the learning vehicle as well as the asssessed outcome for the units. The teams were asked to take the role of a software development team to design and build a computer-based solution for a hypothetical client. The team activity involved gathering user requirements, developed models and chosen a solution from among the range of possible solutions they have identified. At the end of the activity, the group is expected to deliver the final software product and all project documentations, which are marked. The groups were formed by the lecturer at the beginning of the semester based on their grade point average (GPA), gender distribution, time availability, personality type, planned time commitment and grade expectations.

The units were first offered in 2005. In 2008 the units were redesigned due to the observation that an increasing number of groups were experiencing internal conflict with team members. For the redesign, we applied activity theory (Jonassen & Rohrer-Murphy, 1999, pp. 63-66) by reconsidering the:

- Tools – resources used in the transformation process, either physical such as computers, or mental such as heuristics
- Subject – the individual or group of participants engaged in the activity
- Object – the physical or mental product being developed
- Community – the interdependent aggregate who share a set of social meanings
- Rules – social regulations that inherently guide (to some extent) the actions or activities acceptable by the community, so that the signs, symbols, tools, models and methods that the community use will mediate the process
- Division of labour – prescription of task specialization for members within the community.

As a result we redesigned the learning outcomes and the aligned assessment tasks. Two of the five intended learning outcomes (ILO) concerned collaborative learning. To encourage successful teamwork a three hour training session on team skills was provided in week 3. A number of assessed discussion boards and a reflective online personal blog were also established on Blackboard to encourage communication, knowledge sharing and participation. To assist students in managing their group's project resources and resources, an open source tools known as TRAC (http://www.edgewall.com/trac/) was introduced. Based on the findings of Kay et al. (2006), the system was expected to support beyond just a simple project management processes, but also sustain the big five elements of teamwork (Salas, Sims and Burke, 2005): team leadership; mutual performance monitoring; backup behaviour; adaptability; and team orientation. At the core of these collaborative elements is the TRAC wiki's functionality, which binds together the other project management processes support functions in TRAC.

Each group was given its own space within TRAC and encouraged to utilize the tool as it seemed appropriate, while also being allowed to adopt other tools to support their team's activity. Formal training on the use of TRAC was not provided, as the first part of this study did not wish to influence the students' perceived affordances of the tool, but students have access to and make known about the availability of standard documentations that come with the system. The wiki in TRAC was seen by the teacher to provide a communication channel for the internal use of the group. The discussion boards provided a similar function to the wiki but at the class level. The personal blog supported private communication between individual students and the teacher.

## TRAC & Wiki

Trac is a software development project support system, which started at University of Sydney and has been developed as open source software. As stated in the documentation:

> TRAC is an enhanced wiki and issue tracking system for software development projects. TRAC uses a minimalistic approach to web-based software project management. Our mission is to help developers write great software while staying out of the way. TRAC should impose as little as possible on a team's established development process and policies. It provides an interface to Subversion, an integrated Wiki and convenient reporting facilities. TRAC allows wiki markup in issue descriptions and commit messages, creating links and seamless references between bugs, tasks, changesets, files and wiki pages. A timeline shows all current and past project events in order, making the acquisition of an overview of the project and tracking progress very easy. The roadmap shows the road ahead, listing the upcoming milestones. (http://trac.edgewall.org/)

Aspects of TRAC have been previously studied and reported (e.g. Kay et al, 2006), however it has not been evaluated from the perspective of affordances.

## Data Collection

The pilot case study gathered data from the groups' reflective journals, a written report worth 10% which requires the team to look at the processes they have gone through for the entire

semester, considering issues and challenges they faced, what they had done and learnt, what worked and what didn't. Data was also gathered from the TRAC system logs and the groups' wiki pages to describe how each group used their wiki functionality to support collaborations. In the next phase, students' insights will be added to the study through surveys and interviews to provide deeper understanding of the perceived affordances of the system as well as how they arrived at the decision of whether and how to utilize the wiki in TRAC.

## Results

Five categories of utilisation were observed in the TRAC wiki. These are discussed below, ordered by their sophistication in supporting collaboration. Table 2 provides a matrix detailing how each group had used their TRAC wiki.

1. The first category is the complete absence of usage (N=1). Group 4 did not utilize the wiki feature at all. This occurred because of a technical mismatch with the system they were building and they were given permission to use their own version control system. It is unclear whether any product in place of the TRAC wiki was employed. However, the group reported some difficulties in managing collaboration, such as miscommunication of responsibilities and difficulties in sharing resources.
2. The most basic and the second most popular (N=7) use of the wiki was as a communication medium to facilitate the exchange function of the learning activity system. The dominant pattern of this use was a single group member posting an announcement for the others to view. The exception was group 11, which used the wiki as a medium for bidirectional communication amongst team members.

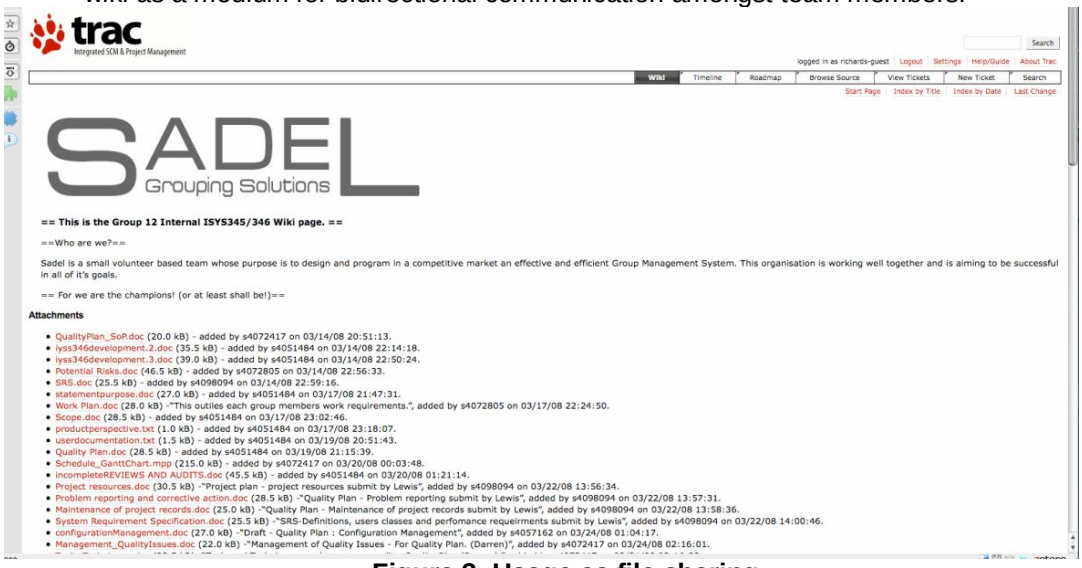


**Figure 3: Usage as file sharing**

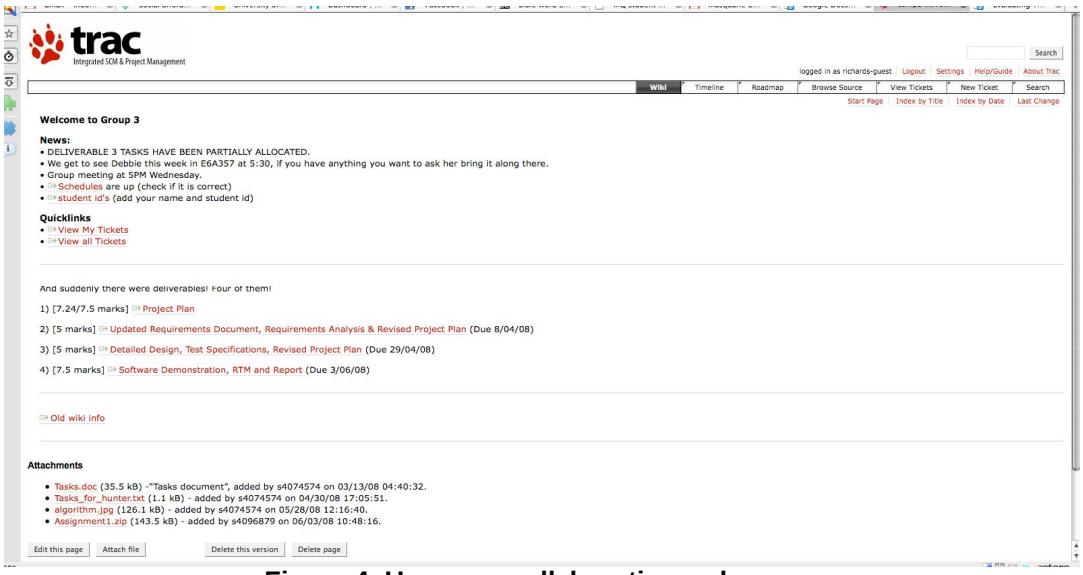


**Figure 4: Usage as collaboration web space**

3. The most popular (N=8) use of the wiki in this case study was as a shared files vault as shown in Figure 3, where each team member or an appointed person uploaded files for later reference, a need that is driven primarily by the nature of the unit which produces numerous deliverables. The feature of uploading, storing and downloading files became the most popular use of the wiki.
4. A more sophisticated use (N=3) of the wiki was as a coordination web space. In this usage, wiki postings were predominantly done by a single group member, with the postings positioning the wiki as a workgroup portal to access other parts of the TRAC system and share resources.
5. The most sophisticated use (N=1) of the wiki was to create a collaboration web space, where the wiki has been personalised and multiple members contributed to wiki (Figure 4).

**Table 2: Utilization of TRAC Wiki**

| *Utilization of TRAC Wiki* | *Group no.* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *11* | *12* | *13* | *14* | *15* |
| Communication (exchange)<br>• Post announcement | | ✓ | ✓ | | ✓ | ✓ | ✓* | | ✓ | ✓ | |
| File sharing<br>• File upload and download | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ |
| Coordination web space<br>• Coordinate workload (distribution)<br>• Tracking progresses<br>• Share bookmarks (consumption) | | | ✓ | | ✓ | | | | | ✓ | |
| Collaboration web space<br>• Multiple contributors<br>• Personalized sections (collaboration) | | | ✓* | | | | | | | | |

* *multiple authors*

The reflective journals also revealed that students had been using other external tools to support their collaboration and communication despite possible redundant functionality available within TRAC; this phenomenon would be interesting to investigate as their decision to utilize a particular affordance in a particular tool rather than the other. Such insight would be included in the second phase of this study.

## Discussion

The results show that although the groups had access to the same software and had the same motive to produce deliverables, each group differed greatly in how they went about the group activity. The most notable result was that only one group used the wiki in a way that can be described as Web 2.0, creating a collaborative web space which supported both personalisation and co-construction of meaning. The other groups that used the wiki utilised the features in a way that supported communication but didn't reach the level of social interaction that characterises Web 2.0. One group didn't use the wiki at all.

Activity theory provided an appropriate framework for the design of collaborative activities, however the collaboration occurred in very different forms. In order to properly use Web 2.0 to support collaborative learning, greater emphasis is needed on understanding how group members relate to each of the available features of the software. The concept of affordances appears to provide the ability to focus on the way specific features of software are perceived.

## An affordances perspective

Affordances describe the possibilities of action between a person and an aspect of the environment (Gibson, 1979) and can be used to describe features of software which may support learning (Bower, 2008). Groups using the TRAC wiki had access to a range of affordances that may be used to support collaboration. However, the groups differed in the way they realised these affordances.

- The group in category 1 did not utilise any affordances.
- Groups in category 2 utilised the communication affordance of the wiki, posting notes for other members.
- Groups in category 3 utilised the file sharing affordance of the wiki (i.e. uploading and downloading files).
- Groups in category 4 combined the affordances displayed by category 2 and 3 and utilised the wiki to provide coordination affordance in dividing the work amongst team member and coordinating tasks.
- One group (category 5) took it one step further by not only utilising the affordances mentioned above, but also utilising the wiki to aggregate resources and personalize access.

Viewing usage of the wiki as the utilisation of affordances provides a framework for exploring the gap between the potential collaboration afforded by the wiki and the way the wiki was used. Future research will use this approach to explore how student perceptions of the affordances drive their decisions on how they collaborate.

## Integrating affordances and Activity Theory

Both activity theory and the concept of affordances are concerned with the way people interact with the world. However, while activity theory emphasises the socially mediated aspect of group work, affordances emphasise how each individual within a group utilises the environment to perform their contribution. A change in the form of activity is reflected by a change in which affordances are utilised. Thus, the form of group collaboration may be influenced if certain affordances of Web 2.0 tools are promoted.

Furthermore, affordances can be aggregated at different levels to provide a fit with different levels within the hierarchy of activity (ie common motives, individual actions and individual operations). Separate affordances which allow individuals to perform actions and operations may be combined to consider the way a group acts together.

This is critical when considering Web 2.0 tools, allowing them to be discussed in terms of both individual action and group activity. For example, a wiki combines writing and editing affordances with affordances that allow distributed, open access. This combination affords groups collaboration in constructing an entry to the wiki. This form of collaboration would not

be possible without each affordance, and allows a very different form of group activity than that allowed by each of affordance separately.

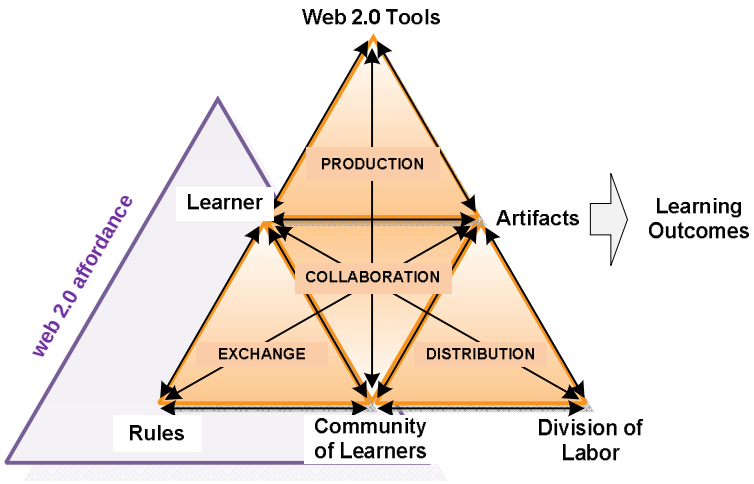


**Figure 5: An affordances perspective to Web 2.0 supported collaborative learning activities**

Figure 5 shows a Web 2.0 supported collaborative learning activity as described from an affordance perspective. The activity is framed at the level at which an individual learner works within a collaborative group to produce a deliverable. The framework may be used to identify affordances to promote to groups of learners in order to align their collaborative activity with the forms of activity that match the learning outcomes.

## Conclusion and Next Steps

While activity theory allows us to describe the functions happening within collaborative learning activities, an affordances perspective allows a deeper understanding of how those activities may be supported by a set of Web 2.0 tools. Combining the theories supports analysis of group collaboration that details how student perceptions of the available affordances contributed to the form of that collaboration.

To further explore this hypothesis, a series of case studies will be conducted in 2009 across a range of study disciplines (computing, education and creative arts), covering undergraduate and postgraduate study levels. These studies will try to discover the utilised and intended affordances as they are perceived from both students' and teachers' perspectives during the learning design, in-learning and post-learning phases within each of the selected units. The outcome of the case studies is expected to provide a practical framework that will assist learning designers to match affordances of Web 2.0 tools with collaborative learning processes.

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## Biographical Details

Andreas Utomo Kuswara is currently a PhD student at the School of Education, Macquarie University. He started to get involved with educational technology as practicing teacher at Bina Nusantara University, Indonesia. The practical experience sparked great interest in investigating how technology, in particular web based tools, can be better used in formal education setting. Educated as engineer, and raised as a consultant, you can now find him in FaceBook as web 2.0 net-citizen.

Andrew Cram is a PhD student at the School of Education, Macquarie University. His interest in using information systems technology to support learning stems from his work with an online mathematics learning system, where he contributed to learning design, usability and accessibility. He is currently applying activity theory and the idea of affordances within research that uses virtual environments to simulate social situations that involve difficult problems such as ethical dilemmas.

Debbie Richards is an Associate Professor in the Computing Department at Macquarie University. She is a strong believer in collaborative learning, team-work and project-based learning and in encouraging students to build computer systems that people can and want to use. Ever since first reading “The Design of Everyday Things” she had stressed to her students the importance of affordances and matching user tasks, mental models and other human factors with the system design and laying the burden on the designer to ensure the user doesn’t feel like a dummy.

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