Commonsense ISD:

An empirical approach to teaching systems analysis and design

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Abstract

In this paper, the authors reflect on their experiences teaching ISD using collaborative teamwork within student groups in consecutive subjects in autumn and spring semesters 2003. The authors took a mentoring role within the class structure. The lectures were informal and of a conversational nature wherein the different student groups openly discussed their progress and difficulties with their projects.

The lecture style of conversational informal delivery coupled with collaborative teamwork enabled the students to take responsibility, individually and collectively, for the group's achievements and therefore was foundational to the students' learning.

It is a requirement that the students participate in team meetings and actively engage each other through discussion of current topics taught within the unit. Understanding and knowledge is transferred within the group and onwards to the class in general during the supporting classroom discussions. The various groups displayed differing levels of social skills when dealing with group and project issues that arose during the learning period.

This paper discusses the unit content, instructional methods, assessment tools and the outcomes achieved in the different learning establishments and the students interaction within the groups and the class as a whole.

Keywords: Collaboration, knowledge sharing, group work, cooperation.

1   Introduction

The purpose of this paper is to relate the results of an initial study of collaborative work among information systems development (ISD) students in the Information Systems degree within the School of Management at University of Western Sydney.

The traditional method of teaching where the lecturer stands in front of the students and delivers the information may not be the best format to convey the many and varied aspects of information technology and/or systems to a class. Whilst these lectures often are supported by tutorials where the students can interact with the tutor/lecturer in a smaller group-oriented environment, the student's learning is still being driven by someone who is seen to be "the source" of the information, as opposed to learning that is being driven by the group itself. By taking a mentoring role rather than one of leadership, the lecturer enables the students to form groups and collaboratively share information and acquire knowledge in student-driven learning environments. This perspective requires the students take much more responsibility for their learning than does the more traditional method where the lecturer is the subject expert and the student expects to have the expert knowledge communicated to all students in the class.

In the authors' experience, information system development (ISD) is usually taught over two teaching periods, and in the first teaching period the emphasis is usually on system analysis; whilst the second concentrates on system design and construction, at least to prototype stage. This paper relates the experiences of the authors using the same student-driven collaborative approach in consecutive ISD units over one academic year.

The learning strategy was slightly different between the two classes with the students being required to keep at least a personal work portfolio or detailed meeting agendas and minutes with the lecturer and amongst the group. In the units under discussion, the individual student actively engages learning through being involved in groups consisting of peers where the tasks themselves become the method of disseminating information that, through the student's experience gained by the task, is transformed into knowledge. (Wells and Brook, 2004)

Collaboration occurs when people work together on tasks to achieve a mutually agreed outcome. This differs from co-operation, wherein different tasks are allocated to different group members in order to achieve that outcome (Lehtinen et al 1999). Panitz (1997) defines collaboration as a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers, whereas cooperation as a

structure of interaction designed to facilitate the accomplishment of a specific product, or goal through people working together in groups.

Whilst the students with the BISD classes are collaborating with each other within their own groups to achieve the project's goal, it would be more descriptive to say that the groups (as a class) worked cooperatively rather than collaboratively.

Collaborative learning is therefore more a social interaction where the students discuss key conceptual issues within a learning framework. The learners identify and carry out the tasks based on the experience that each member brings to the group and the negotiation within the group that is required to arrive at a common goal and shared understanding (Kimber 1996, Arnseth et al 2001, Panitz, 1997, Barros and Verdejo 2000). In this contextual framework, the learners are expected to approach the group's tasks autonomously (Koschmann et al 1994).

Within the different groups under discussion, the focus was on the individual student's engagement of the tasks required to accomplish a successful project rather than the design of the course material. Whilst the authors determined the project goals and set the deadlines for each task as is required for the educational assessment, the individual student within each group retained responsibility for his or her own learning. The framework of the units provided the opportunity for the student to display independence and individuality (Felder and Brent 1996).

The practical inquiry model proposed by Garrison et al (2001) is an appropriate collaborative learning model for the teaching of ISD. Whilst this model reflects the critical thinking process, it also in some way reflects the iterative nature of ISD itself. Garrison et al's model consists of problem identification, exploration of the problem through reflection and discussion with others, integration of the outcome of those discussions in phase two with existing ideas, and implementing those ideas through a proposed solution or action.

The following model (Figure 1) depicts the student's actions within the individual groups and as a class when students face alternatives as to what is accepted by the group as understanding.
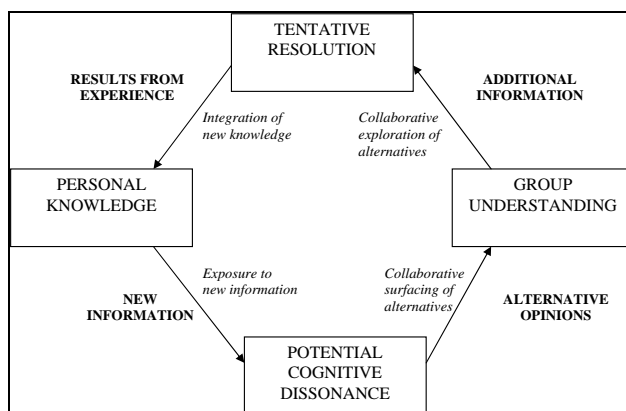

Figure 1: A model of collaborative learning
(Wells and Brook 2004)

The iterative nature of ISD lends itself to the collaborative processes, as depicted in Figure 1. Negotiation within the group is needed to reach a learning resolution that can be assimilated into the individual's knowledge and this experience increases the individual student's understanding of the processes within the ISD framework. (Wells and Brook, 2004)

Within the University curriculum, the units being discussed are the start of a specific four-unit stream that involves theoretical and practical project work and culminates with practical industry based projects. The students need to understand the foundations of the ISD discipline before they can engage their peers in debate to extend their body of knowledge. (Rockwood, cited by Wells and Brook, 2004).

Collaborative student groups operate in a similar way to knowledge professionals, that is, the student groups acquire and share knowledge within a given community (Bruffee, cited by Dobra, S. n.d).

Collaborative learning enables the students build and practice skills that are a necessary requirement for future employment. Lee et al's study in 2002 investigated several authors perceived educational requirement for students of IS and summarised their finding as shown in Table 1 below.

Category	Items
IS core knowledge	*IS management:* visions about IS/IT competitive advantage and knowledge of IS technological trends
	IS technology and development: hardware, software (packaged products, operating systems, networking/communication software, and programming languages), and systems development and maintenance (systems analysis/design/development methodologies/approaches).
Organization and society	Specific function areas, specific organizations, specific industries and general environment.
Interpersonal	Interpersonal behaviour, interpersonal communication, international communication ability, teaching and training skills.
Personal traits	Personal motivation and ability to work independently, creative thinking, critical thinking.

Table 1: Core IS knowledge and skills

Collaborative learning enhances and enables the students to practice the above skills in a learning environment and receive feedback on their individual and group performances in the four skill areas. Supporting the collaborative nature of the students' work, the lectures were interactive and engaged the students in active participation in discussing weekly topics pertaining to systems analysis and design. Active participation by students promotes and supports the transfer, acquisition

and assimilation of knowledge within a community, in this case the class and the groups (Steinert and Snell, 1999).

Lecturer interaction with students during class assists students in understanding how the collaborative processes enable them to gain a higher level of understanding of the discipline being studied. This perspective is founded in constructivist epistemology whereby knowledge is discovered and transformed by contextual meaning into something that can be retained and further transformed by later experience (Johnson, Johnson and Smith 1991 cited by Panitz 1997).

This paper seeks to relate the experiences of the authors using some principles of student-driven collaborative learning in a technology focused course and the subsequent student-driven group work as a means to transfer and acquire knowledge.

2   Research Methodology

The methodology is qualitative action research (Sax and Fisher, 2001), and its iterative nature lends itself to the way educational units are planned and taught. Susman and Evered's (1978) central issues for action research of diagnosis, planning, action and evaluation are mirrored in the tasks of unit development, delivery and reflection over the teaching period. The process of reflection and evaluation enables cyclical changes to be made to the study unit and/or assessment structure to support both teaching and the students' learning process.

In 2002, and following a discussion between the authors regarding their own particular approaches to teaching ISD, provisional theories regarding collaborative learning in ISD units emerged and informed the development of the BISD units and delivery methods for 2003. One author (Jones) presented BISD2 in 2002, and as a result of the aforementioned discussions the assessment procedure for BISD2 was changed in 2003, bringing it into line with the other three units in the ISD stream.

The data collected for this paper consisted of classroom observations and journal entries that recorded events and student/teacher meetings that pertained to the group's learning process. NVivo was used to accomplish the data analysis by creating categories and coding the authors' reflections and meeting notes.

The authors' involvement with the two classes was such that one author (Wells) was the lecturer for the first class, with the other author (Jones) the tutor, and for the second class, the author acting as tutor became the lecturer. Therefore, there was synergy and continuity of approach from one class to the next.

The iterations reported in this paper have enabled the development of a framework enabling the teachers to engage students in a technology-related classroom, and this framework forms the basis of future presentations of these units.

3   Background Information

3.1   Course Structure

The University of Western Sydney teaches information systems development over two semesters in the degree Bachelor of Business (Information Systems) and mainly to second year students. The units under discussion were presented in the academic year 2003: Business Information Systems Development 1 (BISD1) in autumn semester, and Business Information Systems Development 2 (BISD2) in the spring semester. Following the accepted pathway, the first semester unit BISD1 concentrates on systems analysis to the systems proposal stage, whereas the second semester unit, BISD2 concentrates on design and construction to the prototype stage. For BISD1 the assumed knowledge consists of introductory information systems, computer concepts, and software construction. BISD2 assumed knowledge is the same as BISD1, plus BISD1 knowledge. To support the students learning cycle, the teaching strategies place heavy emphasis on interactive workshops where the students were encouraged to engage their peers in conversation on the various aspects of their projects. Apart from the work specified in the unit outline, students were expected to undertake an additional seven hours work per week in relation to the unit.

Course materials were available to all students via WebCT, which also provided collaborative tools such as discussion boards, email and chat rooms.

3.2   Assessment Methods

At the beginning of semester one in 2003, the three separate BISD1 classes (Blacktown day, Parramatta day and Parramatta evening) received a case study based on one author's industry experience. The lecturer instructed the classes to form groups and advised the students to choose their groups carefully as the case study would also apply in the following ISD class (BISD2) and the expectation was that the groups would carry through to that class. The authors had previously observed that self-forming groups performed more cohesively as they were able to draw on collective experience and knowledge derived from prior study units as well as any practical industry based experience held by group members. Knowledge shared within the group would further enhance the student's understanding of the tasks needed to be carried out to satisfy the course requirements. For BISD1, the case study involved the analysis of the requirements needed to develop a subscription information system for a publishing company, and the final group report took the form of a systems proposal. The groups presented their findings at the end of semester to a panel of assessors and submitted the written proposal at the end of the semester. Supporting the group work was an essay where the students individually research current issues involving ISD. In addition, each student was required to submit a separate copy of his or her *own* project research work for assessment as a separate portfolio. The portfolio contained work submitted to the group as a whole for consideration and possible inclusion in the final report. Therefore, a non-assessable peer

assessment was incorporated into the assessment strategy and made explicit, rather than leaving it to the student group to decide on this strategy at group level. The individual student was required to state whether his or her work had been selected for the final group report and the location of the work within the final group report. The student was also required to self assess the value and quality of his or her work submitted to the group for consideration, thereby building into the assessment strategy a measure of explicit self-evaluation. An individual mark was awarded to each member of the group for his or her specific part in the presentation as well as an individual mark for the essay component. As each member of the group was responsible for the content and manner of presentation, each member received the *same* mark.

As previously stated, the second semester group project was a continuation of that used for BISD1 and the students used the group systems proposal from BISD1 as the basis for the design of a working prototype. This enabled the students to participate in the development of a system over an extended period and tie the knowledge and experience gained from doing so back to the learning and teaching strategies of the units. The students then presented these prototypes to their peers and the lecturer for assessment. As part of the BISD2 assessment, the students were required to research testing methods and quality assurance in relation to ISD, apply this research to their own group's prototype and write an assessable report on their research findings.

In the spring of 2003, the BISD2 cohort had the opportunity to assess the other groups during the prototype presentations. The students received assessment forms for each group, and completed them during the presentations and therefore the student feedback was immediate. These forms had a marking scale and a marking guideline to assist the students with their assessments. The guide suggested that the student address items such as: how well the prototype works, have the requirements definition been met, is the application user friendly, how the group respond to questions. Each student was also given the opportunity to make general comments on the works presented. The forms were collected at the end of the presentations and the presenting groups received feedback from the lecturer based on the anonymous peer assessments.

The assessment strategy within both BISD1 and BISD2 comprised both individual and group work. The assessment structure of BISD2 was changed to make the assessment methodology consistent with the prior unit BISD1 and the following two unit Business Information Systems Projects A and B as for the majority of students taking the ISD units would be required to take the following two units as part of their degree. This placed a heavier emphasis on the collaborative nature of the group work rather than students' individual knowledge under exam conditions and encouraged the students to support each other in their academic endeavours in these units. The specific events were:

BISD1		BISD2	
%	Assessment Event	%	Assessment Event
20	Individual Essay	30	Individual research report regarding QA & Testing methods
15	Individual tutorials and software exercises	15	Individual tutorials and software exercises
20	Individual Project Portfolio	15	Individual Project Portfolio
15	Group Presentation - Individual Mark	10	Group Presentation - Individual Mark
30	Group Project Work – a systems proposal report	30	Group Project – a Working Prototype and documentation

Table 2: Assessment events in BISD1 and BISD2

4 Discussion of student group performance in consecutive ISD units at university

This section will follow a cohort of students from their initial exposure to systems analysis in BISD1 through to systems design and construction in BISD2. In the autumn semester of 2003, 81 students completed BISD1 with 50 continuing on to BISD2 in the spring semester. The 31 non-continuing students did not go on with BISD2 for a variety of reasons, such as, they had already completed BISD2 and had taken BISD1 out of sequence; they were continuing with BISD2 at a later stage; or they had taken BISD1 as an elective and did not intend to continue with BISD2. As stated elsewhere in this paper, BISD1 is not a pre-requisite for BISD2 and in fact, there are no formal pre-requisites for either subject.

4.1 BISD1 and BISD2 group formation

There is a requirement for the students to form into groups to complete group assignments in BISD1 and BISD2 and these groups generally form by the second week of semester. The groups in both units are student actualised and the formation is based on the collaborative learning principles of students working together to achieve a common goal. Often the students form themselves into groups based on previous social acquaintanceship or they may have previously worked together on a group assignment in another unit. The authors chose not to assign students to specific groups as the feeling of familiarity with known work patterns engendered by established social contact far outweighed, in the authors' opinion, any possible placement of students with specific skills into certain groups.

However, several of the students formed groups at the beginning of BISD1 based on whoever the student happened to be sitting near when the need to form a group arose. Other reasons the authors have observed for student groups forming include work obligations and the need to get the assignment done "without any mucking around"; and the proximity of the students home

addresses. As an example of this, one of the authors, while undertaking postgraduate studies, once formed a group that lasted for several semesters, because all the members lived north of the Sydney Harbour Bridge and therefore it was assumed that group meetings would be easier to arrange. In general, the most successful groups across the two units were those that had been together from BISD1 and had remained mostly unchanged through to BISD2 and beyond as these groups had been through the Forming-Storming-Norming-Performing development as outlined by Tuckman (cited by Atherton, 2003a).

Of the 50 continuing students, 11 did not make the transition from BISD1 to BISD2 as a member of his or her original group. There were various reasons for this: three students chose to change campus, two changed study mode; four students split from their groups due to dissension and two changed groups for other reasons. In addition to these changes, 15 students joined BISD2 in 2003 who had not taken BISD1 in the autumn session. Of these 15 students, six were repeating from 2002 and the remaining nine were intending to take BISD1 at the same time as BISD2 or in a later session.

There is however a danger that if new members are accepted into a stable group environment, group forming problems may re-emerge as the new members "jockey for position" within the group. A problem may also occur if a vital member leaves a group and no other member has the leadership skills or confidence to fill that void. Whilst the roles and individuals within the groups may change, the task that the group needs to carry out will remain the same (Atherton, 2003b).

4.2 Member commitment and group performance

Student groups that form for a specific assessment requirement are like any other group that is formed in a business environment, that is, it is generally the luck of the draw and what looks good on paper might not be so good in practice.

The authors observed that members who did not perform well in one group suddenly performed well in another group. This may be due to the different mixture of personalities and knowledge skills in the new group, or it may be due to the student realising that he or she will have to prove themselves to the new group. This may cause them to make an extra effort to deliver their part of the assessment on time and as complete as possible.

In general, the newly formed groups in BISD2 performed very well. There were however some spectacular failures. One group had accepted a new member and had an unfortunate experience on the evening of the presentation of their software. Three out of four group members had been meeting regularly and worked well together. However, the fourth member had not carried out his responsibilities and always had an excuse why his portion of the assigned work was not complete. On the presentation night, he once again turned up without his portion of the work complete. He was very surprised when the group fired him and completed the presentation without him.

Another example of a group member being fired for non-compliance happened in the first tutorial of BISD2. One group informed one of their members that he was not welcome to continue in the group for the BISD2 semester, and that he had been replaced by a new group member. The "fired student" did not attempt to join any other group and did not continue in BISD2 for that semester.

There are two examples of students performing much better in their new groups than in the previous group. In their previous group, the other members were very high achievers with very good technical skills. These high achieving students tended to dominate the group and the other students did not have strong enough personalities or the confidence to exert influence. When these two students moved to new groups, the two transferring students became active and much more vocal and contributed more to their new groups than to their previous groups. Due to the newfound acceptance of their skills and knowledge, these two new members also increased their commitment to their new group's performance and quality of work. The new members integrated well as the original members had similar levels of skills and knowledge, which helped the acceptance of the new members' opinions and ideas, which lead to discussion and facilitated understanding.

Grade	BISD1 2003	BISD2 2003		BISD2 2002
High Distinction (HD)	1	6		1
Distinction (D)	22	24		9
Credit (C)	34	28		34
Pass (P)	23	6		28
Fail (F)	1	1		15
Total	81	65		87

Table 3: Grade comparison 2002 and 2003

Table 3, above, shows the grade distribution for BISD1 and BISD2 in 2003. The grades for BISD2 in 2002 are also shown for comparison purposes. As stated previously in this paper, the assessment structure of BISD2 changed in 2003 by removing the examination component thereby making the assessment and teaching strategy consistent with the other units in the ISD stream. More collaborative components in the form of class interaction and group assessment replaced the examination as well as a shift to more emphasis on the individual assessment.

The following chart, Figure 2, compares the grades distribution between BISD2 in 2002 and 2003, gives a graphical indication of the improvement in the grades, brought about by the higher collaborative and class interaction components within the cohort. To give a further comparison Figure 3 shows the grade distribution in BISD2 in both 2002 and 2003 with the 50% examination component removed.
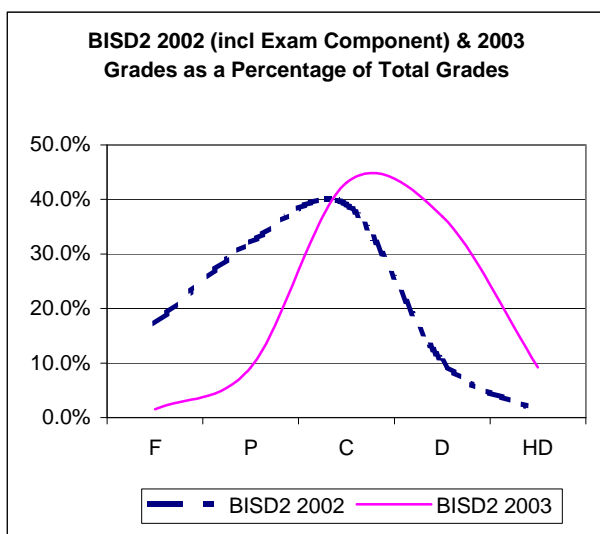
**BISD2 2002 (incl Exam Component) & 2003
Grades as a Percentage of Total Grades**

Figure 2: BISD2 grades for 2002 and 2003

**BISD2 2002 (excl Exam Component) & 2003
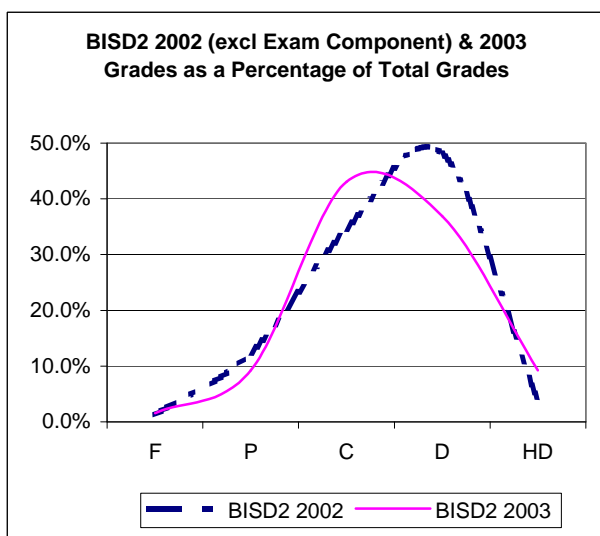Grades as a Percentage of Total Grades**

Figure 3: BISD2 grades 20022 and 2003
excluding exam component

The grades improved substantially after the removal of the examination component, due to the heavier emphasis on collaboration in the group projects and to a degree with the individual portfolios. There was a marked consistency of quality in the presentation of the individual portfolios among groups members who socialised the group processes, as opposed to the groups where the students had joined forces only for necessity and remained with that perspective. There is substantial evidence to suggest that helping others is a very effective way to learn. In this way, less able students can make an important contribution to the learning of their more able peers as well as helping themselves (Atherton, 2003c).

The following graph (Figure 4) shows the comparison between the grades attained in BISD1 and BISD2 in 2003. It can be seen from this graph that there is a significant correlation between the grades for the two units. The improvement in the number of students achieving higher grades can be attributed to their familiarity with the work styles of their group members.

By this stage, the groups had recognised other group members' strengths and weakness and could work towards their goals as a unit. Most groups had realised that members do not always contribute equally; some will always do more than others will, and despite their best efforts, there will never be equal participation (Atherton, 2003d). Some of the groups had also remained together for other subject streams, which would also help them work together as a unit.
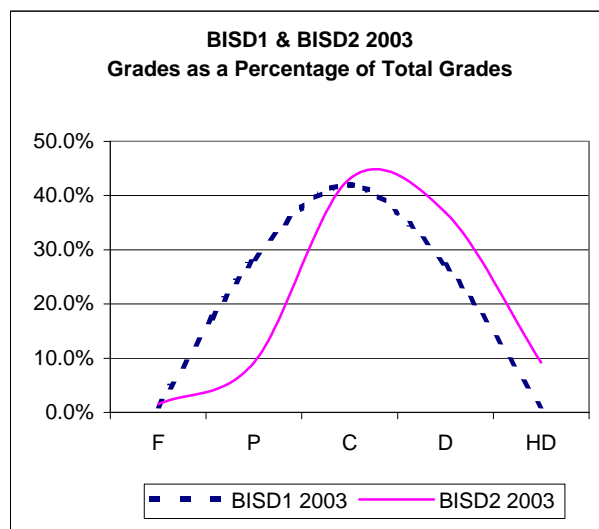
**BISD1 & BISD2 2003
Grades as a Percentage of Total Grades**

Figure 4: Grade comparison BISD1 and BISD2

5   Conclusion and Further Research

Collaborative and interaction methods for group learning help to develop the students' awareness of the need to foster social and academic relationships that survive the current unit being taught. Whilst undertaking units that use these methods the student performs as one component of a group whose task it is to deliver a project that meets a certain criteria, to a certain timeframe and to a certain standard.

The members of groups that participated in BISD1 and BISD2 during 2003 have developed a wide range of skills that will stand them in good stead for future employment in the areas of systems analysis and design. The skills include the ability to interact with peers on several different levels, to take responsibility for their own learning and to develop a responsibility for the learning of others in their group. The students can carry these skills forward into the practical subjects units of BIS Project A and Project B, which follow the units BISD1 and BISD2. The authors are not involved in the delivery of the units BISD1 and BISD2 in the current university year (2004).

However, one of the authors is responsible for the practical units that follow these units. The practical units are a continuation of BISD1 and BISD2 in that they use the same framework but are a practical demonstration of the student's skill evidenced by developing a project for an organisation.

As the practical projects are a continuation of the units under discussion, it is most likely that several groups will continue in their entirety to these projects in 2004. A

more formal research project is being undertaken involving these units in 2004.

The authors will report the initial findings from the 2004 research ACE2005 conference in January 2005.

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