# Knowledge Building in Student Centered Learning Using Distributed Cognition in Teams.

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## Abstract

*The purpose of the paper is to report on the provisional results of student knowledge building when involved in collaboration within teams. Distributed cognition, and human relationships with artefacts has been the subject of much recent debate in the health sciences and in computing, when collaborative teamwork is discussed. ( [1] [2] [3] [4] [5] [6] [7] [8]. This is known as Distributed Cognition in Teamwork (DiCoT). An observation of, and investigation into, the usage of DiCoT artefacts by lecturers revealed clear evidence of DiCoT linked to knowledge building [1].This knowledge building was evidenced through a greater reliance of the artefact by inexperienced lecturers and a lesser reliance on DiCoT artefacts in more experienced lecturers [9]. This lesser reliance on an artefact, because of experience with the contents, shows a higher level of internalization of the knowledge [9]. The higher the internalization of the content of the artefact, the better the lecturer can discuss and talk about the subject content (externalization). This shift from high artefact use to low artefact use reflected the building of knowledge within the lecturer.*
*Equally important to the creation and usage of the artefact was the conduct of the meetings at which the artefact was created.*
*To evaluate if DiCoT could assist in student-centered learning, a case study involving third year students in a financial subject was conducted at the University of Johannesburg. A mixed-method approach was used in the comparative case study which involved investigating the outcomes various assessments, and two learning tasks, where individual effort is required for one assignment, and collaborative teamwork is required in the second. The construction of the second learning task dictated the conduct of meetings to comply with the principles of DiCoT. The teams were randomly populated into 11 groups by the learning system.*
*The aim is to investigate if DiCoT revealed more enhanced knowledge building in students than that achieved through individual learning. The students were required to create a blog of the team interactions and participate in interviews. Preliminary analysis reveals enhanced knowledge building in students.*
*Keywords: DiCoT, Knowledge building, Student Centered Learning, Case Study*

## 1. Introduction

Cognition is defined as the internal workings of the human brain [4]. Salomon [10] in his foreword to "Distributed Cognition: Psychological and Educational considerations" notes the likeness between the Social and Cultural distribution of cognition and the human behavior in, among other, social, technological and cultural situations. To this can be added, the educational environment which, while forming a part of the social environment comes with its own stresses, social interactions and distributed cognition environments. Distributed Cognition in Teamwork (DiCoT) is the sharing of information between individuals usually through an artefact equally created by the individuals in a team [2] [8]. In the educational context, lecturing teams on large enrolled courses are required to get together, discuss the division of the work, and individuals are tasked to complete certain sections of the work [11]. The lecturers meet as a team where each section of work is presented, discussed and amended to the satisfaction of the team creating an artefact available to all members of the team [1] [8]. Rhodes in discussing artefacts commented that "in a workplace scenario, this artefact would be used by the individuals to ensure consistency in the application of those tasks' [1, p. 191]. Should a new member be appointed to the team, that person has the artefact available to use to ensure that the task is applied consistently [8]. As the new members of the team use and apply the information contained in the artefact, they build knowledge of the artefact, and the more they use the artefact the better their knowledge of the content of the artefact is (internalization), until they no longer need to refer to the artefact; this process is termed "Knowledge building through DiCoT" [11].

This concept was enforced on students, during a group learning task, to evaluate the effectiveness of knowledge building.

Students were given two assignments covering a general topic. The first was an individual case study, and the second, a more complex case study to be completed as teamwork.

## 1.2 Setting
Within the College of Business and Economics (CBE), of the University of Johannesburg (SA), resides the School of Tourism and Hospitality. The degree, Hospitality Management, has, as a major subject, Hospitality Financial Management which spans six semesters of the degree.

As part of the overall concept of graduateness and employability of the students [9], a holistic approach to studies are undertaken where the students are encouraged to learn through class participation (lecturer centered learning) and through self-study (student centered learning).

## 2. Student centered learning
### 2.1 Individual assignments
Individual assignments are given where the students' individual analysis and cognitive ability is to be tested. These tasks would normally be undertaken as individual financial assignments in business environments, such as analysing trends and researching companies' performances. The advantages of individual tasks is that, theoretically at least, the students are encouraged to perform and to individually hand in the task. The disadvantage is that students could copy (plagiarise) the work of other willing participants and then change it just sufficiently that it does not look the same.

2.1.1 Assignment topic
The assignment was structured as a finance case-study, where elements of Cost-Volume-Profit had to be used to reach a decision of which product to manufacture and which not to. The question included quantities and rand values so the students had to isolate the correct values, insert them into the correct formula and calculate the values.

2.1.2 Hypothetical outcomes
The hypothesised outcomes was that the students would critically analyse the question, research and prepare the calculations, evaluate the results and prepare an answer as prescribed. This would build knowledge of the subject and strengthen the student' soft skills.

2.1.3 Soft Skills
The soft skills developed through this assignment was a) Written communication-, b) Critical thinking-, c) Independent problem solving-, and d) Time management skills.

### 2.2 Group collaborative assignments
Collaborative assignments used for student-centered learning can be assigned as self-enrolment of participants or random selection of participants. Self-enrolment is more popular with the students as they can work with their friends. Random selection is more true-to-life as in a company setting where individuals cannot always choose the members of teams to work with. However, often within group settings, there is one or more participants who are natural leaders who tend to dominate the groups and the artefact is then created with their bias. This could cause feelings of resentment and "being left out" or "ignored" amongst the other participants.

The advantage of group work therefore is a multi-focussed approach to a problem, but the disadvantage is that "dominant" personalities can prevail.

2.2.1 DiCoT
One of the features of distributed cognition in team work is that all team members are person-solo with only their own knowledge, however the synergies created by working in a team means that the team members, with the artefact, are enhanced with the combined knowledge of the team and become person plus [8]. There was no group "leader" role assigned, as all the participants were seen as equal in their input and the artefact was created by the team by consensus,

2.2.2 Collaborative assignment
The teams were randomly selected in five-person groups and they were tasked to get together and agree on who would be the convener of meetings, the scribe, a speaker/interviewee and the blogger. The blogger could also be the interviewee for the purposes of this study. The teams were to discuss the strengths needed for these positions and to reach a consensus as to who would be best suited to fulfil these roles. In the meetings, all participants were equal and all work entered into the artefact

needed to be approved by all members. The scribe was tasked with compiling the artefact and the blogger had to report on the team interaction and dynamics in the meetings. Some meetings had to be conducted as face-to-face meetings and some over the internet via Skype, Zoom, and WhatsApp or similar.

2.2.3 Assignment topic
The assignment was structured as a finance case-study, where elements of Cost-Volume-Profit had to be used to reach a decision of which course of action to take and which not to. The question was based on rand values only so the students had to isolate the correct values using percentages rather than units, plug them into the correct formula and calculate the values. The assignments were marked with a rubric reflecting the criteria of a) overall presentation of the artefact as measured against the instructions for layout, fonts and headings etc. (Maximum 15 marks); b) accuracy of calculations (Maximum 20 marks); and, c) accuracy of the report and recommendations (maximum 15 marks) (Total 50 marks).

2.2.4 Hypothetical outcomes
The hypothesised outcomes was that the students, in interacting as a team, would discuss the assignment and critically evaluate their own work as well as that of the other team members. This would build measurable knowledge of the subject and strengthen the student soft skills.

2.2.5 Soft skills
The soft skills developed through this assignment was a) Communication-, b) teamwork-, c) empathy-, d) interpersonal-, e) listening-, f) social-, and g) critical thinking skills.

## 3. Outputs from the assignment
The students were tasked with the following outputs from the assignment:
a) A collaborative answer to the case study was required to be submitted for marking;
b) A blog had to be updated on the website explaining the team dynamics and interactions;
c) One team member, normally the blogger, was interviewed on the team dynamics and team performance.

## 4. Provisional results
### 4.1 Assignments
Due to time constraints, full results and statistical analyses of the results are not available.
However, the results from the collaborative assignment were significantly higher at 73% than the individual assignments' results of 64%.

### 4.2 Blog feedback
The blogs were mainly directed at what happened in the meetings and what was planned for the following meetings. Occasional complaints against team members were recorded.

### 4.3 Interviews
A member of each team was interviewed to inquire as to the conduct and dynamics of the team as well as their experiences in teamwork.

## References

[1]  R. J. Rhodes, "Knowledge Building in Accounting Education," Florence, Italy, 2019.

[2]  R. Heersmink, "Distributed Cognition and Distributed Morality: Agency, Artifacts and Systems," *Science and Engineering Ethics,* vol. 23, no. 2, pp. 431-448, 2017.

[3]  S. J. Durning and A. R. Artino, "Situativity theory: A perspective on how participants and the environment can interact: AMEE Guide no. 52," *Medical Teacher,* vol. 33, no. 3, pp. 188-199, 2011.

[4]  J. Hollan, E. Hutchins and D. Kirsh, "Distributed cognition: toward a new foundation for human-computer interaction research," *ACM Transactions on Computer-Human Interaction (TOCHI),,* vol. 7, no. 2, pp. 174-196, 2000.

[5]  P. C. Wright, R. E. Fields and M. Harrison, "Analyzing human-computer interaction as distributed cognition: the resources model.," *Human-Computer Interaction,,* vol. 15, no. 1, pp. 1-41, 2000.

[6]  B. Nardi, "Studying context: A comparison of activity theory, situated action models, and distributed cognition," in *Context and consciousness: Activity theory and human-computer interaction*, B. A. Nardi, Ed., Cambridge, Massachusetts, MIT Press, 1996, pp. 69-102.

[7]  Y. Rogers and J. Ellis, "Distributed cognition: an alternative framework for analysing and explaining collaborative working.," *Journal of information technology,* vol. 9, no. 2, pp. 119-128, 1994.

[8]  D. N. Perkins, "Person-plus: a distributed view of thinking and learning," in *Distributed cogniyions:Psycological and educational considerations*, First paperback ed., G. Salomon, Ed., Cambridge, Cambridge University Press, 1993, pp. 88-110.

[9]  R. J. Rhodes, *Evaluating the impact of ICT in accounting education (PhD Thesis),* Johannesburg: University of Johannesburg, 2019.

[10] G. Salomon, Distributed cognitions: Psychological and educational considerations, First paperback edition ed., S. Gavriel, Ed., Cambridge: Cambridge University Press, 1993.

[11] R. J. Rhodes, *Evaluating the impact of integrating information and communication technologies in accounting education: a case study at the University of Johannesburg,* Johannesburg: University of Johannesburg, 2019.