# A STUDENT-CENTERED INSTRUCTION IN CALCULUS USING TASK-BASED LEARNING

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## Abstract

According to Bakhtin's dialogism that views emergent of knowledge from dialogic interaction among people, the teaching paradigm shifted from a teacher-centered to the student-centered instruction. In this study, a student-centered instruction in calculus using Task-based Learning is developed. The data is collected to explain students' group discussion behavior, students' attitude towards Task-based Learning, and the number of accomplishment students in each learning environment. The results from this study reveal that Task-based Learning could enhance classroom activity in terms of student-centered learning.

**Introduction**

Present situation of the teaching and learning in higher education institutions, it is believed that knowledge consists of facts that are fixed and static. When knowledge is seen as something which are set and fixed objectives which exist apart from the knower and prior to class, students are considered as empty vessels to be filled by teachers. The epistemic role of students under the terms of such circumstances is limited to remembering what others, particularly, teachers and textbooks, have said, not figuring things out and not producing any new knowledge (Nystrand [2]; Wells [7]).

In accordance with Bakhtin [1], truth is born collectively and knowledge emerges from the process of their dialogic interactions. Truth is born collectively when people are co-building it in their process of social interaction. It is born between people collectively searching for truth, as a result. Classroom interaction should be used as a way of instructing and rehearing students in the process of interpretation rather than to check whether students can correctly recall the right answers (Nystrand [2]).

By this reason, challenges and rationales for education reform that higher education institutions need to redesign the teaching-learning approaches which will enable students to learn all time and cultivate them with the attitudes and behaviors of lifelong learning and based on a dialogical perspective, student-centered instruction is one crucial approach that educators endeavor to introduce classroom.

This study was preliminary developed as a student-centered instruction (SCI) in calculus using Task-based Learning. Facilitative learning tools, including Calculus Self-practice Hand Book for students, Calculus Problem Catalog for teachers, and a set of instructional activities were developed. Data was collected to explain students' group discussion behaviors, students' attitude towards Task-based Learning, and the number of accomplishment students in each learning environment during performing classroom activities in this course.

**Teaching Method**

In Task-based Learning (modified from Salter et al. [5]; Richards [4]), there is learning environment. Each learning environment contains five steps. Learners have to take responsibilities of four tasks and the last part is learning in classroom.

| Task 1 Individual | Task 2 Feedback to Peer | Task 3 Feedback from Peer | Task 4 Team Task | Instructor 1 hr |
|---|---|---|---|---|

Due
Midnight Mon

**Task 1**

**Task 1. Individual work**

Steps of working

1. Read through the work until understand.

2. Study supplement materials for this work.

3. Finish the work and submit the work on time (before due), because the system will deny the delay submission.

Work on task 2

4. After that, the learners can get through the second task.

**Task 2. Evaluate friends' work including giving suggestions to improve the work**

Steps of working

1. Read through the work until understand.

2. There are no supplement materials for the learners on this work.

3. Finish the work and submit the work on time.

Task 2 consists of two important parts:

**Part 1.** Read 3 pieces of work results in task 1 from 3 friends including giving suggestions to improve the work (as a blind reviewer).

**Part 2.** Before submission suggestions to improve the work to friends, the reviewer needs to assess friends' work by putting numbers 0-5 into evaluation form (it is evaluation for effort, not for the correction of the work).

| Task 1 | Task 2 | Task 3 | Task 4 | Instructor |
|--------|--------|--------|--------|------------|
| Individual | Feedback to Peer | Feedback from Peer | Team Task | 1 hr |

Due
Midnight Mon

Due
Midnight Wed

**Task 2**

Assessment Guide:

Poor $= 0 - 1$ means friends pay no or less attention to the work.

Good $= 2 - 3$ means friends pay good effort to the work.

Excellent $= 4 - 5$ means friends pay great effort to the work.

| Task 1 | Task 2 | Task 3 | Task 4 | Instructor |
|--------|--------|--------|--------|------------|
| Individual | Feedback to Peer | Feedback from Peer | Team Task | 1 hr |

Due
Midnight Mon

Due
Midnight Wed

Due
Midnight Wed

**Task 3**

## Task 3. Evaluate suggestions from friends

For task 3, it is the task 2' result. The learner evaluated 3 pieces of task 1' results from 3 friends while the learner was evaluated from 3 friends and received suggestions to improve the work. Thus, in task 3, the learners have to evaluate friends' suggestions in terms of the usefulness to improve the work and give feedback to the suggestions in return. Steps of working on task 3 are as followings:

1. Read through suggestions from 3 friends.

2. Evaluate suggestions by putting numbers 0-5 into evaluation form (it is evaluation for effort, not for the correction of the work).

3. Finish the work and submit the work on time.

**Note.** If the suggestions are from only 1 or 2 friends, then calculation the suggestions as 100%.

Assessment Guide:

Poor $= 0 - 1$ means friends pay no or less attention to giving feedback.

Good $= 2 - 3$ means friends pay good effort on giving feedback.

Excellent $= 4 - 5$ means friends pay great effort on giving feedback.

| Task 1 Individual | Task 2 Feedback to Peer | Task 3 Feedback from Peer | Task 4 Team Task | Instructor 1 hr |
|---|---|---|---|---|
| Due Midnight Mon | Due Midnight Wed | Due Midnight Wed | Due Midnight Thur | |

**Task 4**

**Task 4. Group work**

Steps of working:

1. The learners have to make appointments to each other in groups to discuss and finish the work.

2. Each group needs to assign a member which will submit the file into the system on time.

3. After submission of the work, members need to evaluate effort of 3 members.

**Note.** The learners have to evaluate every member in group. Working in group, a member needs to submit task 1 into system first.

Assessment Guide:

Poor $= 0 - 1$ means friends pay no or less attention on working in group.

Good $= 2 - 3$ means friends pay good attention on working in group.

Excellent $= 4 - 5$ means friends pay great attention and give useful suggestions.

**Teaching hour**

Before teaching hour, learners will be engaged with assignment.

- Effort on self inquiry.

- Read and critique works from 3 friends in order to give suggestions as well as evaluation of the works.

- Read and critique friends' suggestion for improvement of owns work as well as be able to evaluate and select suggestions from 3 friends.

- Participate group work as raising and sharing ideas to better improve group work.

- Receiving suggestions from instructor as individual and as group.

| Task 1 Individual | Task 2 Feedback to Peer | Task 3 Feedback from Peer | Task 4 Team Task 3rd floor Library | Instructor 1 hr |
|---|---|---|---|---|
| Due Midnight Mon | Due Midnight Wed | Due Midnight Thurs | Due Midnight Thurs | Date 10:00-11:00 Fri |

**Teaching hour**

Teaching hour provides chances for instructor to add some missed body of knowledge, suggests learners as individual and as group in order to enhance learners' understanding, and provides chances for the learners to exchange ideas, challenge in working, and results of work.

**Methodology**

**Participants**

This study was undertaken with undergraduate students in Calculus I, the course served by the Department of Mathematics, Statistics and Computer, Faculty of Science, Ubon Rajathanee University. There were 267 students enrolled in this course, 34 students from Faculty of Agriculture, 111 students from Faculty of Science, and 122 students from Faculty of Engineering. They were separated into 67 teams, 3-4 students in each team, to solve problems in seven learning environments relied on Task-based Learning.

**Data collection instruments**

To evaluate the effectiveness of the instructional processes from collaborative work through discussion, data collection instruments were constructed.

Rating scale questionnaire composed of 11 items to survey group discussion behavior of learners (modified from Seebut [6])). Reliability of questionnaire (tried out with 40 students) had Cronbach Alpha coefficient of 0.85 and Pearson's product moment correlation coefficient indicated significance for item analysis.

Rating scale questionnaire composed of 25 items to survey students' attitude towards Task-based Learning. Reliability of questionnaire (tried out with 40 students) had Cronbach Alpha coefficient of 0.80 and Pearson's product moment correlation coefficient indicated significance for item analysis.

The students' achievement scores from individual task and team task were calculated to view the percentage of the number of accomplishment students in each learning environment.

**Procedure**

The learning environment sequence relied on Task-based Learning was developed and posed in the classroom as listed below (see Figure 1). (Ln denoted the nth learning environment)

L1: Limits of functions of one variable

L2: Limits and continuity of functions of one variable

L3: Derivative of functions

L4: Antiderivatives and indefinite integrals

L5: Basic concept of integration techniques

L6: Advance concept of integration techniques

L7: Integration

After completion of each learning environment, three teaching assistants gathered students' achievement scores in individual task and team task in order to calculate the percentage of the number of accomplishment students for the instructor to do lesson plan in the instructional sequence.

Finally, students' group discussion behavior and attitude towards Task-based Learning were surveyed at the end of this course.

**Methods of analysis**

Data from rating scale questionnaire was analyzed using descriptive statistics,

mean and standard deviation for each item were computed. Descriptive statistics was used to find out the percentage of accomplishment between Task 1 and Task 4 to view the effective of this teaching method to the construction of shared knowledge in collaborative problem solving.



**Figure 1.** Learning environment based on Task-based Learning on D4L+P.

## Results and Discussion

### Group discussion behavior of student

The support of instructional activities on individual discussion behavior in each group was concerned. Rating scale questionnaire was employed to survey group discussion behavior of students and the results from rating scale questionnaires are presented in Table 1.

**Table 1.** Students' evaluation of group discussion behavior ($n = 120$)

| As a result of the instructional processes I believe I: | Score (Mean) | S.D. |
|---|---|---|
| Gave explanation to group. | | |
| Disagree  1  2  3  4  5  Agree | 4.14 | 0.60 |
| | □ | □ |
| Clarified member's speech. | 4.31 | 0.58 |
| Disagree  1  2  3  4  5  Agree | | |
| Gave examples while I talked. | 4.30 | 0.60 |
| Disagree  1  2  3  4  5  Agree | | |
| Provided conclusion. | 4.29 | 0.54 |
| Disagree  1  2  3  4  5  Agree | | |
| Provided suggestions for applications to solve problem. | 4.20 | 0.66 |
| Disagree  1  2  3  4  5  Agree | | |
| Asked to repeat statements. | 3.91 | 0.64 |
| Disagree  1  2  3  4  5  Agree | | |
| Asked for examples. | 4.33 | 0.80 |
| Disagree  1  2  3  4  5  Agree | | |
| Asked for explanations. | 4.23 | 0.63 |
| Disagree  1  2  3  4  5  Agree | | |
| Asked for conclusion. | 3.95 | 0.85 |
| Disagree  1  2  3  4  5  Agree | | |
| Encouraged colleagues to participate. | 3.95 | 1.01 |
| Disagree  1  2  3  4  5  Agree | | |
| Expressed compromise in case of contradiction. | 4.15 | 0.60 |
| Disagree  1  2  3  4  5  Agree | | |

Students' evaluation of group discussion behavior revealed that most of the students indicated a degree of agreement with each item. Overall mean scores of students' evaluation were higher than 3.5 (see Table 1).

The result from group discussion behavior of students illustrated that all students participated in this aspect of the instructional activities.

**Students' attitude towards Task-based Learning**

The effective of Task-based Learning to students' attitude towards this course

was surveyed. Rating scale questionnaire was separated into two types, positive and negative questions. The results from rating scale questionnaires are presented in Table 2.

**Table 2.** Students' attitude towards Task-based Learning $(n = 120)$

| As a result of T5 Task-based Learning: | Score (Mean) | S.D. |
|---|---|---|
| (+) 1. I like learning using this approach. | 3.85 | 0.80 |
| (+) 2. Giving suggestions on friends' works made me to realize the sameness and the difference, and to originate of new ideas. | 4.03 | 0.75 |
| (+) 3. Learning using this approach provided me chances to express my thoughts. | 4.09 | 0.73 |
| (–) 4. I feel that learning using this approach is boring. | 2.11 | 0.89 |
| (+) 5. Working in group made me to express my thoughts and acquire more variety of ideas. | 3.83 | 0.76 |
| (–) 6. I felt nervous when the instructor asked me to do activity in front of class. | 2.67 | 1.08 |
| (+) 7. Suggestions on my work given by my friends made me to realize the errors and the faults of my own work. | 4.18 | 0.85 |
| (+) 8. Learning using this approach made me becomes more enthusiastic. | 4.16 | 0.82 |
| (–) 9. Learning using this approach is difficult for me. | 2.56 | 1.11 |
| (+) 10. I am happy to learning using this approach. | 3.74 | 0.79 |
| (+) 11. Submission of work via D4L+P system made Knowledge Sharing occurred to me. | 4.09 | 0.71 |
| (–) 12. Friends blamed me on working in group. | 2.53 | 1.00 |
| (–) 13. I wanted that the time would up quickly when I was studying in this class. | 1.70 | 0.97 |
| (+) 14. I found interesting things in learning Mathematics by using this approach. | 3.81 | 0.79 |
| (+) 15. Learning using Task-based Learning approach allowed me to use my full capability. | 3.72 | 0.85 |
| (–) 16. I was not enjoying working in group. | 2.06 | 0.98 |
| (+) 17. I can relate and apply knowledge gained from learning using this approach to use with other subjects. | 3.88 | 0.82 |
| (+) 18. After learning using this approach, I can relate the surroundings and things I have learned more. | 3.84 | 0.71 |

| | | |
|---|---|---|
| (+) 19. Learning using this approach trained me to think systematically, circumspectly, steps of causes and effects. | 3.91 | 0.75 |
| (–) 20. Friends were rarely co-operated on working in group. | 2.37 | 1.08 |
| (+) 21. I like learning using this approach more than Self-access Learning. | 3.64 | 1.00 |
| (+) 22. Learning using this approach made me to like doing more. | 3.75 | 0.88 |
| (+) 23. Learning using this approach benefits to me to learn other subjects. | 3.93 | 0.75 |
| (–) 24. I think learning using this approach is a waste of time. | 1.93 | 0.95 |
| (+) 25. Learning using this approach activates me to pay more attention to what I am learning. | 4.28 | 0.72 |

Students' attitude towards Task-based Learning revealed in positive questions that most of the students indicated a degree of agreement with each item. Overall mean scores of students' evaluation were higher than 3.5 (see Table 2), where as in negative questions, most of the students indicated a degree of disagreement with each item. Overall mean scores of student evaluation were lower than 2.5 (see Table 2), except items 6, 9 and 12, which mean scores were 2.67, 2.56 and 2.53, respectively, which were not significantly higher than 2.5.

The result from students' evaluation revealed that the students have positive attitude towards Task-based Learning in this course.

**The percentage of accomplishment students in learning environment**

The achievement of students would be indicated by the percentage of the number of accomplishment students in each learning environment, both individual and team task.

Table 3 shows the total 34.57 percentage of accomplishment students from individual task and 33.84 percentages of accomplishment students from team task.

These results indicated that 93 students (from 267 students) were investigational accomplishment for problem solving and 23 teams or 92 students (from 67 teams or 267 students) were accomplishment in the construction of shared knowledge in collaborative problem solving.

**Table 3.** The percentage of accomplishment students in learning environment

| Learning environment | The percentage of accomplishment students | |
|---|---|---|
| | Individual task (267 students) | Team task (67 teams) |
| L1: Limits of functions of one variable | 51.61% | 29.70% |
| L2: Limits and continuity of functions of one variable | 35.48% | 39.26% |
| L3: Derivative of functions | 47.57% | 44.78% |
| L4: Antiderivatives and indefinite integrals | 38.75% | 39.75% |
| L5: Basic concept of integration techniques | 29.08% | 38.22% |
| L6: Advance concept of integration techniques | 18.44% | 17.33% |
| L7: Integration | 21.09% | 27.84% |
| **Overall** | **34.57%** | **33.84%** |

**Conclusions**

According to Bakhtin's dialogism that views the emergent of knowledge from dialogic interaction between people, the teaching paradigm and instruction shifted from a teacher-centered to the student-centered. In this study, a student-centered instruction in calculus using Task-based Learning was developed. The results from study revealed that Task-based Learning could enhance classroom activity to more student-centered learning. Task-based Learning could motivate 34.57% of the students to complete problem solving in all learning environment by their own investigation. It could promote 33.84% of students to construction of shared knowledge in collaborative problem. Moreover, the result from group discussion behavior of students illustrated that all students participated in this aspect of the instructional activities and students have positive attitude towards Task-based Learning in this course. Finally, it was found that all of the students who enrolled in this course became curious, inquiring, and endeavor students. Thus, it is indicated that Task-based Learning provides the students to be active learners.

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