

平成 30 年 6 月 21 日現在

機関番号：13401

研究種目：若手研究(B)

研究期間：2015～2017

課題番号：15K16793

研究課題名(和文) The Longitudinal Learning Effects on Engineering Students in an English Project-Based Learning Curriculum: An Inter-Faculty and Business Community-Designed Program at a Japanese National University

研究課題名(英文) The Longitudinal Learning Effects on Engineering Students in an English Project-Based Learning Curriculum: An Inter-Faculty and Business Community-Designed Program at a Japanese National University

研究代表者

ヘネシー クリストファー (Hennessy, Christopher)

福井大学・学術研究院教育・人文社会系部門(総合グローバル)・助教

研究者番号：50727732

交付決定額(研究期間全体)：(直接経費) 2,800,000円

研究成果の概要(和文)：当研究から、研究目的の範囲内外の様々な結果が得られた。

(1)参加者は、先行研究が示すとおりPBLコースの終了後すぐ、特にSTEM分野のスキルの改善が認識できた。(2)参加者より、PBLコースへの参加により得られたSTEM分野のスキルについて、学術的及び非学術的な他分野への縦断的な効果が認識できたと報告があった。この結果は、研究提案書の主な研究目的であった英語による工学部PBLコースの縦断的な効果を示す。(3)研究者は、他教育機関におけるSTEM PBLコースのモデルを開発した。(4)研究者は、日本の国立大学における英語教員と工学系教員による学部を越えたチームティーチングの手法を開発した。

研究成果の概要(英文)：The research produced a number of results, both from within the stated research goals and outside of the research goals.

(1) Participants in the research recognized and reported the improvement of certain skills, particularly those associated with STEM subjects, through the work they conducted in the PBL immediately after the PBL course, which matches the existing literature. (2) Participants in the research also recognized and reported about the longitudinal transfer of certain STEM skills gained from the course to other settings, both academic and non-academic. This result addresses the main issue of the longitudinal effect of a PBL engineering course in English, the main research goal of the proposal. (3) The researcher was able to develop a model for STEM PBL course implementation for other institutions. (4) The researcher developed cross-departmental team-teaching methods between English instructors and engineering instructors at a national Japanese university.

研究分野：外国語教育

キーワード：project-based learning 課題探究プロジェクト STEM EFL ESP SLA PBL active learning

### 1. 研究開始当初の背景

(1) There has been an emphasis on globalization and English curriculum development within Japanese universities. As a result, reform of university English curricula within Japan into interactive and collaborative university language-learning environments has been a task of immediate importance. In the engineering field, Ravesteijn et al. (2006) wrote of the need for “Imagineers” – engineers who can create and implement highly innovative ideas in English – through content-driven English courses with a focus on communication. In response, the investigator and colleagues successfully developed and implemented a pilot Project-Based Learning (PBL) English curriculum for second-year Japanese architect and mechanical engineering students at a national university in Japan from April to August 2014. The course was developed and implemented by English instructors in close collaboration with engineering professors and the local business community. The framework of this pilot course was based largely on previous research in the PBL field (Gülbahar et al. 2006, Beckett et al. 2005) and featured 24 mechanical engineering and architecture students collaborating in teams of four to design, build, and present various engineering projects in English.

(2) However, major issues were apparent in the PBL literature. Thomas (2000) in his extensive review of PBL literature suggested an overall lack of research into the effectiveness of the PBL curriculum on students following their PBL experience. International and domestic research into PBL since then also revealed research trends towards implementation or theory. However, exhaustive literature review showed scant research domestically and virtually no research internationally on the longitudinal effectiveness of PBL curriculums on students.

(3) The applicant and collaborators’ initial analysis of data collected from a number of sources during and after the pilot course in FY2014 – including audio/video recordings of class proceedings, student reflection journals, instructor reflection journals, and semi-structured interviews with engineering professors and community businesses representatives – appears to validate a positive effect on student learning and achievement in a multitude of areas including English ability. However, PBL literature suggests that initial reactions tend to show positive learning results in multiple areas immediately after implementation of a PBL curriculum, but

follow-up research is lacking to verify this result over a long period. Against this background, the investigator attempted to fill in this research gap by monitoring and analyzing a collection of data from a science, technology, engineering and math (STEM) PBL in English course at a Japanese national university over three years.

### 2. 研究の目的

Throughout the three-year research period, the investigators set out to research as the primary objective:

- (1) Longitudinal effects of the Project-Based Learning (PBL) curriculum on student learning.

Secondary objectives directly connected to the primary objective include investigating:

- (2) Effectiveness of an engineering-based PBL in English curriculum at the University of Fukui.
- (3) Potential to expand a PBL curriculum in English to other Japanese national universities.

### 3. 研究の方法

#### Data Collection Methods

- (1) Semi-structured Interview (Japanese or English) Target: PBL students, participating engineering professors; Goal: Conducted in the last year of the research period with different PBL course iteration participants as well as throughout the research period with engineering professors associated with content formulation of the PBL class to determine emerging themes in the learning of PBL students.
- (2) Weekly Reflective Journals Target: PBL students, PBL class instructors; Goal: Conducted during the PBL to determine how PBL students perceive their own learning and their peers’ learning and how instructors perceive the students’ learning.
- (3) Questionnaires (Japanese) Target: PBL students; Goal: Conducted immediately after completion of the course then yearly afterwards over three years to determine emerging themes in the learning of PBL students through open-ended questions with students

#### Data Analysis Methods

- (1) Theoretical Coding The investigator’s primary research interest had to do with the longitudinal effects of a project-based course on university students’ learning in

Japan, and so utilized a grounded theory method of theoretical coding on the data described above for analysis. Particularly, the investigator, in analyzing the interview text and weekly reflective journals, utilized the Constant Comparative Analysis research method developed in the grounded theory approach in order to develop and support any core categories revealed in the data. There was a risk of investigator bias with determining codes, so the investigator created codes independently and compared them against another investigator's interpretation to avoid bias.

### **Respondent Participation**

- (1) Respondent participation varied due to a number of factors. Weekly Reflective Journals were obtained from all 72 participants (24 from each year). Interviews were conducted with six participants from different iterations of the PBL course. Interviews were also conducted with a number of the engineering instructors and organization members involved with the project. Yearly questionnaires started with a 100% participation rate immediately after the course then fell to around 25% by the third year of the research period.

### **4 . 研究成果**

The research produced a number of results, both from within the stated research goals and outside of the research goals.

- (1) Participants in the research recognized and reported the improvement of certain skills, particularly those associated with STEM subjects, through the work they conducted in the PBL immediately after the PBL course. Particularly, these skills include increased presentation ability, increased research ability, increased group work ability, increased design ability, increased communication ability, and increased engineering knowledge among others. This result falls in line with other research in the field. These skills seemed to be expressed more strongly year-on-year, most likely due to yearly revisions to the course by the instructors based on student feedback through the collected data.
- (2) Participants in the research also recognized and reported about the transfer of skills gained from the course to other settings, both academic and non-academic, and, again, particularly those associated

with STEM. Some reported use of skills acquired in the course years after the class was conducted. Particularly, these skills do not seem to change much from (1) and include presentation ability, increased research ability, increased group work ability, increased design ability, increased communication ability, and increased engineering knowledge as well as increased decision-making ability among others. This result addresses the main issue of the longitudinal effect of a PBL engineering course in English, which was the main research goal of the proposal.

- (3) The investigator and colleague were able to develop a model for STEM PBL course implementation in other institutions, both domestic and international. The model allows for large-scale projects that encompass the whole semester, such as the case with the course being reported on here, or smaller-scale projects that can be done in a single day. The current name for this developing model is "Scaffolded PBL." Particularly, the investigator and colleague presented the model in a workshop to over 800 teachers of STEM and English at the National Institute of Education in Cambodia, which is the premier education institute for teacher training in Cambodia. Many participants reported the potential use of the model described by the investigator in their own teaching context once they return to school instruction at multiple levels throughout Cambodia. This experience addresses and suggests positive results for the secondary research goals of potential for expanding this model to other institutions.
- (4) The model developed by the investigator and colleague was based on cross-departmental team-teaching methods with multiple English instructors and multiple engineering instructors working together outside of the class to identify and develop potential projects suitable for the students and also in-class team-teaching to ensure high-level English education and engineering education. This team-teaching and cross-departmental approach was also reported by a number of sources as difficult if not impossible to implement, particularly at a Japanese institution, which means the approach may be a barrier to entry into other institutions.
- (5) In developing the model described in (3),

during the research period, the investigator was able to use the data collected and analyzed to pinpoint issues with the course and then address these issues for improvement. These improvements led to higher student satisfaction in the course year-on-year according to interviews, questionnaires, and course evaluations. In effect showing the research methods can contribute to course curriculum improvement. This result was a side effect of the research outside of the initial research scope.

- (6) Though the course was conducted as an English course, participants rarely mentioned English skills as one of the skills acquired in the course within the data, though responses to overt questioning about English skills during interviews suggested participants felt their English ability did improve due to the course. This suggests students in this type of course may be able to experience more natural acquisition of English compared to a more traditional second-language classroom structure.

#### 5. 主な発表論文等

(研究代表者、研究分担者及び連携研究者には下線)

[雑誌論文](計4件)

Hennessy, C. R., & Malcolm, W. (2018). Using Student Voices to Guide Class Content in a PBL English Classroom: Implementing a Critical Thinking Class Activity. *JALT2017 Conference Publication* (23) (forthcoming). Peer-reviewed.

Hennessy, C. R., & Malcolm, W. (2017). Development of a STEM Project-Based Learning Class in English: Narratives from Instructors at a Japanese National University. *Proceedings from The 2<sup>nd</sup> International Conference on Teaching*. Not peer-reviewed.

Hennessy, C. R., & Malcolm, W. (2017). Student Voices through Journals in a Japanese University STEM Project-Based Learning Class for EFL Learners. *The 8<sup>th</sup> International Conference on Language, Literature, Culture and Education*, 39-48. Peer-reviewed.

Hennessy, C. R., Malcolm, W., Akashi, Y., Kawai, M., Sakai, Y., Suzuki, K. (2016). Project-Based Learning at a National University: A Collaboration between English and Engineering Departments. University of Fukui Engineering

Department Bulletin (65), 1-10. Peer-reviewed.

[学会発表](計11件)

Hennessy, C. R. & Malcolm, W. (2018, February). *STEM PBL in English: Scaffolded Project-Based Learning*. Workshop presented at the Cambodian National Institute of Education, Phnom Penh, Cambodia.

Hennessy, C. R. & Malcolm, W. (2018, February). *Towards better STEM project-based learning in an ESL class: Learning longitudinally and implementing effectively using student voices*. Paper presented at the 14th Annual CamTESOL Conference on English Language Teaching, Phnom Penh, Cambodia.

Hennessy, C. R. & Malcolm, W. (2017, November). *Student Voices on a PBL Class for STEM English*. Paper presented at the JALT International Conference 2017, Tsukuba, Japan.

Hennessy, C. R. & Malcolm, W. (2017, September). *Development of a STEM Project-Based Learning Class in English: Narratives from Instructors at a Japanese National University*. Paper presented at the The 2<sup>nd</sup> International Conference on Teaching, Pekanbaru, Indonesia.

Hennessy, C. R. & Malcolm, W. (2017, September). *Student Voices through Journals in a Japanese University STEM Project-Based Learning Class for EFL Learners*. Paper presented at the The 8<sup>th</sup> International Conference on Language, Literature, Culture and Education, Bali, Indonesia.

Hennessy, C. R. & Malcolm, W. (2017, February). *Towards better STEM project-based learning in an ESL class: Learning longitudinally and implementing effectively using student voices* presented at the 13<sup>th</sup> Annual CamTESOL Conference on English Language Teaching, Phnom Penh, Cambodia.

Hennessy, C. R. & Malcolm, W. (2016, November). *A Longitudinal Comparison of Two PBL Experiences*. Paper presented at the JALT International Conference 2016, Nagoya, Japan.

Hennessy, C. R. & Malcolm, W. (2016, November). *Changes to a PBL Course Induced by Students' Critical Feedback*. Paper presented at the JALT Debate and Critical Thinking Conference, Nagoya, Japan.

Hennessy, C. R. & Malcolm, W. (2016, February). *A Longitudinal Study on*

*Perceived Acquired Skills in an English engineering PBL Course at a Japanese University* presented at the 12<sup>th</sup> Annual CamTESOL Conference on English Language Teaching, Phnom Penh, Cambodia.

Hennessy, C. R. & Malcolm, W. (2015, December). *Critical Thinking: Inherent to Project-Based Learning?* presented at the English Teacher in Japan Tohoku Expo, Sendai, Japan.

Hennessy, C. R. (2015, November). *Cross-Departmental PBL Course Collaboration at a Japanese University.* Paper presented at the 42nd International MexTESOL Convention, Cancun, Mexico.

## 6. 研究組織

### (1) 研究代表者

ヘネシー クリストファー

(Hennessy, Christopher)

福井大学・学術研究院教育・人文社会系

部門(総合グローバル)・助教

研究者番号：50727732

### (2) 研究分担者

( )

研究者番号：

### (3) 連携研究者

( )

研究者番号：

### (4) 研究協力者

マルコム ウェイン

(Malcolm, Wayne)

福井大学・語学センター・講師