Fostering Self-Directed Learning Ability of Educational Technology Learners: Insights from Project-Based Learning Implementation

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Abstract

Because of the constant change in technological advancement, self-directed learning is an important ability for educational technology learners to possess. This study investigated the effects of project-based learning on self-directed learning ability by using a quasi-experimental research. Utilizing the learner-directed and real-world approach, a project-based learning was implemented in a course, enrolled by 32 undergraduate learners, studying in the second year of the Computer Education major at a College of Education in the central part of Thailand. Four aspects of self-directed learning ability were measured after implementing the project-based learning (learning motivation, planning and implementing, self-monitoring, and interpersonal communication). It is evident that learners reported having higher level of self-directed learning ability in all aspects after implementing project-based learning. Future research should conduct a longitudinal research study to study conceptual retention in project-based learning.

Key words: self-directed learning ability, project-based learning, educational technology

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Introduction

In today's twenty-first-century society where information technology is rapidly changing, it is obvious that individuals have to possess a set of necessary skills in order to survive and become successful at work. These necessary skills are referred to as twenty-first-century skills (Häkkinen et al., 2017). Among the twenty-first-century skills, self-directed learning receives a tremendous interest from many educational provisions around the world since prior research has provided compelling evidence that self-directed learning is the best ways to learn (Bagheri et al., 2013). Self-directed learning individuals, who take initiative responsibility for their learning, likely learn better, are highly motivated, and tend to retain more information than those who do not (Knowles, 1975). Specifically, in the context of education, Brockett and Hiemstra (1991) pointed out that learners who displayed more self-directed learning behaviors tend to perform better academically than those who did not.

Apart from individuals in general, who unavoidably receive the effects from changes in the twenty-first century, it is observed that the high speed of information technology also affects educational technologists. With this high speed of change, educational technologists have to possess self-directed learning ability in order to keep up the pace with technological changes. As a teacher educator specializing in educational technology, it is my job to prepare educational technologists, who are ready to perform self-directed learning and to cope with this technological change. Therefore, it is crucial to foster self-directed learning ability of educational technology learners. This study takes on the stance of argument that self-directed learning should be treated that an important ability for graduates in the field of educational technology and it should receive a priority by researchers and educational technologists (Bagheri et al., 2013).

To foster self-directed learning ability, Knowles (1975) theorized that adult learners will be able to direct their learning when they are provided with appropriate environment and a freedom to formulate their learning questions. Based on this theory, a project-based learning approach might be able to foster self-directed learning ability since it is a learner-centered approach in which teachers provide opportunities for learners to pursue knowledge, based on their curiosity (Bell, 2010; Morgan, 1983). This study attempts to use project-based learning to foster self-directed learning ability of educational technology learners. In so doing, I review theoretical underpinning in this study: self-directed learning and project-based learning.

Theoretical Underpinning

In this study, two interrelated theoretical frameworks were used to guide the pursue of knowledge: *self-directed learning* and *project-based learning*. The frameworks influenced the conceptualization and the design of this study. Each is discussed respectively.

Self-directed Learning

Self-directed learning is originated in the field of adult learning as a theory to describe how adults learn (Levett-Jones, 2005). Prabjandee and Inthachot (2013) summarized that self-directed learning has been referred to as self-direction in learning, self-instructed learning, autonomous learning, self-planned learning, self-regulated learning, self-managed learning, self-education, and independent learning. The most commonly cited definition is by Knowles (1975), who defined self-directed learning as *a learning process* in which learners take responsibility for their learning by identifying their needs, formulating learning goals, indicating resources, selecting appropriate strategies, and evaluating learning outcomes (Prabjandee & Inthachot, 2013). Based on Knowles' definition, it is evident that the construct of self-directed learning consists of multidimensional dimensions.

The concept of self-directed learning has been misinterpreted simply as learning by oneself in an out of class context (Silén & Uhlin, 2008). It should be noted that self-directed learning involves interaction with others, and it may be conducted not only outside of class, but also in class as well (Wilcox, 1996). Even though self-directed learning was used to describe the process of adult learning, Knowles (1975) emphasized that it does not confine to only adults or learning without teachers. Self-directed learning is appropriate for all learners (Wilcox, 1996).

Self-directed learning is a natural mode of learning of adult learners. To foster self-directed learning, it is theorized that when presented with appropriate opportunities, adult learners tend to take initiative responsibility for their learning and thrive in such conditions (Levett-Jones, 2005). Also, adult learners will rarely learn, memorize, or utilize knowledge if they do not formulate a question (Knox, 1979). The theory has significant implications for developing self-directed learning: the importance of appropriate learning conditions, the emphasis of independence, and the full of choices. These principles should be taken into considerations when fostering self-directed learning.

Measuring self-directed learning is a complicated since it is a multidimensional construct; it is psychological (inherently internal) and social (involves others). Prior research has not been able to develop an instrument to measure observable behaviors of self-directed learning directly. Existing instruments have been developed to measure *readiness* for self-

directed learning (e.g., Fisher, King, & Tague, 2001; Guglielmino, 1977;) or self-directed learning *ability* (e.g., Cheng, Kuo, Lin, & Lee-Hsieh, 2010). This study takes the stance of measuring self-directed learning in terms of learner's ability to take initiative responsibility for their learning since it matches with the theoretical consideration in this study. Specifically, the measurement of self-directed learning is derived from Cheng et al. (2010), conceptualizing self-directed learning as four interrelated components: learning motivation, planning and implementing, self-monitoring, and interpersonal communication. Learning motivation is an internal drive and an external stimulus to drive learners to take responsibility for their own learning. Planning and implementing is the capability to formulate learning goals independently and to employ appropriate learning strategies and resources to carry out learning. Self-monitoring is an ability to assess one's learning progress and outcome. Interpersonal communication is the ability to interact with others to promote one's learning outcomes (Cheng et al., 2010).

Project-Based Learning

Defining project-based learning is problematic since it includes a multiple range of learning experience centered around a project (Morgan, 1983). Generally speaking, project-based learning in an instructional, learner-driven, and teacher-facilitated approach, in which learners drive their own learning to pursue knowledge, stimulated by their curiosity (Bell, 2010). The pursue of knowledge involves a wide range of activities, such as communicating, doing research, or presenting outcomes to the audience (Bell, 2010). Theoretically speaking, it is obvious that these activities emphasize a collective attempt to work collaboratively among learners, to learn from experience (Dewey, 1916), and to be active in one's learning (Bruner, 1961).

The theory of project-based learning was formulated by Morgan (1983), and it becomes the classic. Morgan theorized that in the project-learning environment, learners are actively engaged in simulated or real-life problems and they have some degree of responsibility to design their own learning activities. A sense of responsibility in project-based learning can be understood as a type of self-directed learning (Knowles, 1975). Morgan (1983) emphasized that, "the key feature of project-based learning is that students develop autonomy and responsibility for their learning. The *process* of learning as well as the *products* become important aspects of educational activity" [emphasis original] (p. 67). From this perspective, implementing project-based learning should focus on both process (how learner learn) and product (what learners learn). These two aspects are of high importance when designing project-based learning.

Since project-based learning consists of multiple aspects, thinking about project-based learning theoretically should be conducted accordingly. Morgan (1983) presents the dimensions of project-based learning in Figure 1.
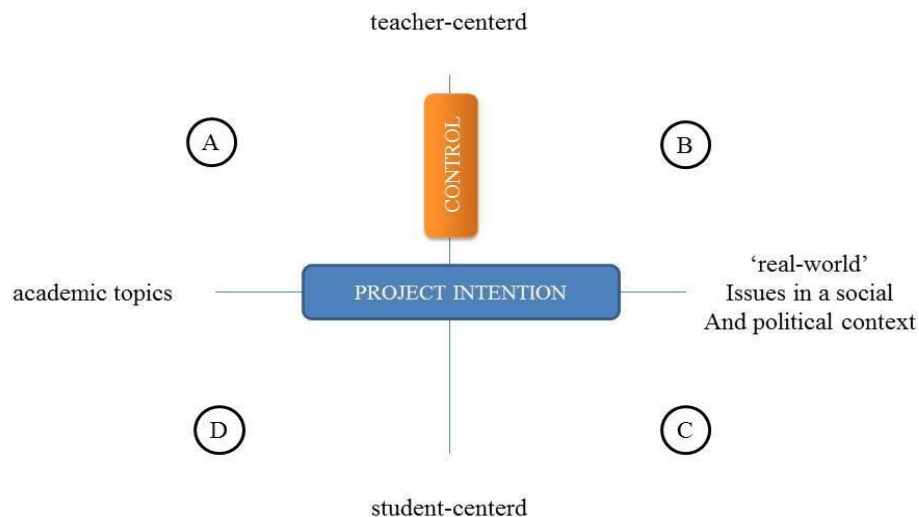

Figure 1 *Dimensions in project-based learning* (Morgan, 1983)

As shown in Figure 1, the focuses of project-based learning are a *project intention* (a continuum of academic topics to real-world issues) and *control* (a continuum of teacher-centered or learner-centered activity). The project intention is a topic of investigation, designed to focus on either academics or real-world problems. The control aspect is about who have the power to design what topics to be studied; teacher or learners (Morgan, 1983). Based on this conceptualization, project-based learning could be described in terms of four dimensions: teacher-centered/academic (A), teacher-centered/real-world (B), learner-centered/real-world (C), and learner-centered/academic (D). These theoretical aspects are useful for designing project-based learning in practice.

Related Research

Implementing project-based learning into the classrooms is a global phenomenon. Prior research has implemented project-based learning in different contexts, such as Malaysia (e.g., Bagheri et al., 2013), Canada (e.g., Wilcox, 1996), China (e.g., Xu & Liu, 2010), Greece (e.g., Kaldi, Filippatou, & Govaris, 2011), Turkey (e.g., Baser, Ozden, & Karaarslan, 2017; İlhan, 2014;

Karaman & Celik, 2008), USA (e.g., Ellis, 2007), and Thailand (e.g., Rampai, 2013; Wichadee, 2011). These studies consistently yielded positive effects of project-based learning in terms of it increases learning outcomes, enhances conceptual understanding, and provides learning experience to exercise self-directed learning.

The most relevant research is by Begheri et al. (2012). In Malaysia, Bagheri et al. (2013) applied a project-based learning to foster self-directed learning skills of educational technology learners in a true-experimental research design. The data revealed that learners in the experimental group performed significantly better in terms of self-directed learning than learners in the control group. Based on this research, it could be hypothesized that project-based learning could be used to foster self-directed learning.

Research Questions

This study attempts to answer the following research question: What are the effects of project-based learning on self-directed learning ability of educational technology learners?

Methods

Research Design

This study employed a quasi-experimental research, with a one-group pre-test posttest design, to examine the effects of project-based learning on self-directed learning ability because it is the most practical approach. Prior to implementing project-based learning, the learners completed a questionnaire to measure their self-directed learning ability level. After that the project-based learning was implemented in an alternative course, *Multimedia and Animation on Technology*, for learners majoring in the Computer Education. It took 16 weeks to finish the course. At the end of the course, the learners completed the questionnaire to measure self-directed learning ability. The comparison between before and after of self-directed learning ability levels was made with attempts to establish causal relationships between project-based learning and self-directed learning ability.

Participants

The participants in this study were 32 undergraduate learners, studying in the second year of the Computer Education major at a College of Education in the central part of Thailand. Out of 32 students, there are 15 males and 17 females. Their ages range from 20 – 21 years old. The participants were purposefully selected since they never had any experiences learning in the project-based learning classroom.

Project-Based Learning as an Instructional Framework

Project-based learning was implemented as an instructional approach in a course, called *Multimedia and Animation*, provided for learners in the Computer Education major. The objectives of the course are to equip learners with fundamental understanding about multimedia and animation in order to produce a project. In this course, the learners completed one small-group project, based on their interest. As a lecturer of this course, I facilitate group work and provided supports throughout the semester. The framework of project-based learning in this study were adapted from Moursund (2003) since it matches with the field of educational technology. The steps of project-based learning are as follows:

1. *Introduction*. In this stage, the learners learn related concepts, theories, principles, and literature about creating multimedia and animation.

2*. Selection*. After learners were introduced to the literature of multimedia and animation, they selected a topic of interest to produce multimedia or animation project, by working in a small group (4 – 5 people) of their choice. As a lecturer of the course, I observed and facilitated group discussions.

3. *Plan*. After choosing a topic, the learners designed a plan of action by brainstorming, discussing, and negotiating with group members. The product of this plan is in the story board form. At the end of this stage, the story board is presented to the whole class. Feedback was provided for learners to revise their plans.

4. *Creation*. The learners carried out the project, by researching, sharing, and working collaboratively. The learners report their progress weekly in class.

5. *Presentation*. At the end of the course, the learners present their project to the whole class. The project is then illustrated in the website of the department.

6. *Evaluation*. The learners evaluated their learning outcomes.

Based on Morgan's dimension of project-based learning (1983),it is clear that project-based learning in this study was learner-centered/ real-world problems. The learners were allowed to exercise their responsibility freely.

Measuring Self-Directed Learning Ability

Self-directed learning ability is a multidimensional construct (Cheng et al., 2010). To measure self-directed learning ability, a self-reported questionnaire developed by Cheng et al. (2010) was adapted. Self-directed learning ability was measured from four dimensions: *learning motivation, planning and implementing, self-monitoring*, and *interpersonal communication* (Cheng et al., 2010). Originally, the questionnaire was developed to measure self-directed learning ability of nursing learners in China, so it is crucial to adapt the questionnaire to match

in the Thai context. To adapt the questionnaire, it was translated to the Thai language, by using the collaborative and iterative approach (Douglas & Craig, 2007), checking conceptual equivalence rather than using back translation method that emphasizes literal meaning (Prabjandee & Inthachot, 2013). The translation was negotiated several times. Meetings were scheduled to discuss the discrepancies until arriving at the conclusion. After that, the translation was checked by three experts. The questionnaire was later modified and tried out to examine the reliability of the questionnaire. The revised questionnaire was a four-pointed Likert's scale, ranging from strongly agree to strongly disagree. The questionnaire consists of 20 items. The Cronbach's alpha reliability of the questionnaire was at .916.

Ethical Considerations

This study was conducted with ethical considerations. Participation in this study was voluntary. The participants were informed the purpose of the study, potential risks, and benefits, prior to collecting the data. Confidentiality was protected, since no identification was employed. The data were analyzed and reported aggregately to understand the effects of project-based learning on self-directed learning ability. The participants were informed that they could withdraw from the study at any time without any negative consequences.

Findings

This section presents the effects of project-based learning on self-directed learning ability. It begins by exploring increased levels of self-directed learning ability after implementing project-based learning, followed by the detailed description of aspects of self-directed learning ability, and the comparison of before and after project-based learning.

Effects of Project-based Learning on Self-directed Learning Ability

To report the effects of project-based learning on self-directed learning ability, descriptive statistics (mean and standard deviation) were presented. As shown in Table 1, this section begins by presenting the overall self-directed learning ability.

Table 1 *Self-directed learning ability before and after implementing project-based learning*

Self-directed Learning Ability	Pre-test	Post-test
	M (SD)	*M* (SD)
1. Learning motivation	3.27 (0.32)	3.51 (0.44)
2. Planning and implementing	3.11 (0.24)	3.42 (0.39)
3. Self-monitoring	3.25 (0.39)	3.49 (0.41)
4. Interpersonal communication	3.29 (0.42)	3.36 (0.34)
Overall	**3.22 (0.25)**	**3.44 (0.35)**

As presented in Table 1, the overall self-directed learning ability prior to attending the course was relatively high; out the 4.0 scale, the mean scores range from 3.11 – 3.29. After implementing the project-based learning, it was found that there was an increased mean score of self-directed learning ability, M = 3.44, SD = 0.35. Two major aspects increased the most: learning motivation (M = 3.51, SD = 0.44) and planning and implementing (M = 3.42, SD = 0.39). The aspect that gain the least is interpersonal communication, M = 3.42, SD = 0.39. To gain a more in-depth understanding, Table 2 – 5 presents the details of each aspect.

Table 2 *Learning motivation before and after implementing project-based learning*

Learning Motivation	Pretest	Posttest
	M (SD)	M (SD)
1. I know what I need to learn	3.06 (0.67)	3.59 (0.50)
2. Regardless of the results or effectiveness of my learning, I still like learning.	3.15 (0.57)	3.22 (0.66)
3. I strongly hope to constantly improve and excel in my learning.	3.50 (0.51)	3.66 (0.48)
4. My successes and failures inspire me to continue learning.	3.53 (0.51)	3.78 (0.42)
5. I enjoy finding answers to questions.	3.25 (0.57)	3.34 (0.48)
6. I will not give up learning because I face some difficulties.	3.09 (0.30)	3.47 (0.51)

As shown in Table 2, learners enter the course with a relatively high level of learning motivation; the mean scores range from 3.06 – 3.53, out of the 4.00 scale. It is evident that the majority of learners enter the course with a strong motivation to learn as shown in the statement "My success and failures inspire me to continue to continue learning," M = 3.53, SD = 0.51. After implementing the project-based learning, the learning motivation increased; the mean scores range from 3.22 – 3.78. The learners reported gaining the most in "I know what I need to learn," M = 3.59 (SD = 0.50), and "I will not give up learning because I face some difficulties," M = 3.47, SD = 0.51. These increased scores indicate that the project-based learning might contribute to the self-directed learning ability.

Table 3 *Planning and implementing before and after implementing project-based learning*

Planning and Implementing	Pretest	Posttest
	M (SD)	*M* (SD)
7. I can pro-actively establish my learning goals.	3.18 (0.39)	3.47 (0.51)
8. I know what learning strategies are appropriate for me in reaching my learning goals.	3.12 (0.49)	3.41 (0.61)
9. I set the priorities of my learning.	3.12 (0.34)	3.41 (0.50)
10. Whether in the clinical practicum, classroom or on my own, I am able to follow my own plan of learning.	3.06 (0.43)	3.53 (0.51)
11. I am good at arranging and controlling my learning time.	3.00 (0.35)	3.28 (0.68)
12. I know how to find resources for my learning.	3.19 (0.53)	3.41 (0.61)

Table 3 presents a comparison of self-directed learning scores before and after implementing the project-based learning. It is apparent that the learners had planning and implementing ability prior to entering the courses; out of the 4.0 scale, the learners reported having planning and implementing ability from 3.00 – 3.19. After implementing the project-based learning, the planning and implementing ability increased; the mean scores range from 3.28 – 3.53. The learners reported gaining the most in "Whether in the clinical practicum, classroom or on my own, I am able to follow my own plan of learning," *M* = 3.53 (*SD* = 0.51), and "I can pro-actively establish my learning goals," *M* = 3.47, *SD* = 0.51. These increased scores indicate that certain aspects of project-based learning might contribute to the increased level of planning and implementing ability. However, it is interesting to see that the learners reported a small increased score on, "I am good at arranging and controlling my learning time," *M* = 3.28, *SD* = 0.68.

Table 4 *Self-monitoring before and after implementing project-based learning*

Self-monitoring	Pretest	Posttest

	M (SD)	*M* (SD)
13. I can connect new knowledge with my own personal experiences.	3.12 (0.60)	3.47 (0.51)
14. I understand the strengths and weakness of my learning.	3.37 (0.49)	3.56 (0.50)
15. I can monitor my learning progress.	3.18 (0.39)	3.41 (0.50)
16. I can evaluate on my own my learning outcomes.	3.31 (0.47)	3.53 (0.51)

As illustrated in Table 4, learners enter the course with a relatively high level of self-monitoring ability; out of the 4.00 scale, the mean scores range from 3.12 – 3.37. Prior to participating in the course, the learners seemed to know their strengths and weaknesses in learning as shown in the statement, "I understand the strengths and weakness of my learning," *M* = 3.37, *SD* = 0.49. However, after implementing project-based learning, the self-monitoring ability increased; the mean scores range from 3.41 – 3.56. After the course, the learners reported gaining the most on self-perception of their ability "I understand the strengths and weakness of my learning," *M* = 3.56, *SD* = 0.50, and evaluating one's own learning, "I can evaluate on my own my learning outcomes," *M* = 3.53, *SD* = 0.51. The increased mean scores indicated that the project-based learning might be able to foster self-monitoring ability. Next section presents the last aspect of self-directed learning ability: interpersonal communication.

Table 5 *Interpersonal communication before and after implementing project-based learning*

Interpersonal Communication	Pretest	Posttest
	M (SD)	*M* (SD)
17. My interaction with others helps me plan for further learning.	3.44 (0.50)	3.47 (0.51)
18. I would like to learn the language and culture of those whom I frequently interact with.	3.37 (0.49)	3.47 (0.51)
19. I am able to express messages effectively in oral presentations.	3.18 (0.53)	3.34 (0.48)
20. I am able to communicate messages effectively in writing.	3.15 (0.51)	3.16 (0.63)

Table 5 presents the interpersonal communication ability before and after implementing project-based learning. It is apparent that the learners participated in the course with the belief that they possessed interpersonal communication ability; the mean scores

range from 3.15 – 3.44, out of the 4.00 scale. However, after the course, learners reported the increased scores in all statements, but the scores increased very little. For example, the statement of "I am able to communicate messages effectively in writing," the mean score of before the course was $M = 3.15$, $SD = 0.51$, and the mean score of after the course was $M = 3.16$, $SD = 0.63$. It is likely to conclude that the increased scores of interpersonal communications ability are minimal.

Comparison of Self-Directed Learning Ability

A paired-samples t-test was conducted to compare self-directed learning ability before and after implementing project-based learning as shown in Table 6.

Table 6 *Comparisons of self-directed learning ability before and after project-based learning*

	t	df	Sig
Pre - Post	- 2.913	31	.007

$p < .05$

As shown in Table 6, there was a significant difference in the mean scores for self-directed learning before implementing project-based learning ($M = 3.22$, $SD = 0.25$) and after project-based learning (M = 3.44, SD = 0.35) conditions; t (31) = - 2.913, p = 0.007. These results suggest that there was an increased mean score of self-directed learning ability after implementing project-based learning.

Discussion

The purpose of this study was to investigate the effects of project-based learning on self-directed learning ability of educational technology learners. Similar to previous studies (Inthachot, 2017; Prabjandee & Inthachot, 2013), it is apparent that the learners possessed a relatively high level of self-directed learning ability prior to attending the project-based learning even though they never have had learning experience in the project-based learning classroom before. This empirical data provide evidence to support Knowles (1975) that adult learners are inherently self-directed regardless of their sociocultural differences. From this data, self-directed learning might be a global characteristic of human beings.

After implementing project-based learning, it is evident that learners reported having higher level of self-directed learning ability in all aspects: learning motivation, planning and implementing, self-monitoring, and interpersonal communication (Cheng et al., 2010). The findings of this study are consistent with previous studies, reporting positive effects of project-

based learning on self-directed learning ability (Bagheri et al., 2013; Ellis, 2007; Kaldi et al., 2011; Karaman & Celik, 2008; Rampai, 2013; Wichadee, 2011; Xu & Liu, 2010). The increased scores of self-directed learning might be because project-based learning in this study provides a space for learners to exercise those abilities: learning motivation, planning and implementing, self-monitoring, and interpersonal communication.

However, it should be noted that out of the four abilities of self-directed learning, the aspect of interpersonal communication increased the least. By examining the questionnaire items carefully, it was found that learners were struggle with the statement that asks about their presentational skills. This might be because this study did not teach presentational skills explicitly. Future research should spend more time on raising awareness of the importance of presentation since it is a missing piece of this research. By addressing presentational skills explicitly, learners might receive more benefits.

The interpretation of the findings should be conducted cautiously because of inherent limitations in the research design. The quasi-experimental research design does not allow a strong causal effect of project-based learning on self-directed learning ability. There might be other factors, contributing to the increased levels of self-directed learning ability, such as the learners' learning habits of independence or they are simply responsible learners. Secondly, self-directed learning ability in this study is mainly self-reported. Thus, the increased scores of self-directed learning ability might not be learners' real learning behaviors. The reliance of the participants' self-report is the limitation of any survey research.

Even though the study has some limitations, implications for educational research on learning and instruction are prevalent. First and foremost, the findings contribute to the theory of adult learning that self-directed learning is changeable, ongoing, and it is a natural mode of learning across contexts (Knowles, 1975). By having learners exposed to a learning environment where they have opportunities to excise their readiness for self-directed learning, their ability to perform self-directed learning and to learn independently increased significantly. Secondly, it is manifested that integrating technology into a class has a power to help learners take control over their learning since technology provides a space for learners to revisit their learning anytime and anywhere. This points out the need to use technology in learning and instruction in order to foster learners' self-directed learning ability. Future research should conduct a longitudinal research study to study conceptual retention in project-based learning.

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