

Twitter-based Course Support System considering Relatedness Needs

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Abstract—In this paper, we propose a new course support system based on the principles of self-determination theory. Specifically, this system is developed to maintain and enhance student motivation based on their intrinsic motivation. Moreover, we expect that the proposed system will provide support to students by enabling them to exchange opinions and ask questions freely via Twitter. Thereby, we expect that students can easily find other students who are using the same system. Indeed, it is known that motivation increases when people feel connected and related to others. Thus, we expect that student motivation will develop as students interact with other students and exchange opinions via the proposed system. We developed the proposed support system and utilized it in two courses for evaluation. We then evaluated the same by using questionnaires and analyzing the tweets of students who took the courses that utilized the proposed system. As a result, we show that our proposed system fosters relatedness among the students and increases student motivation.

Keywords-component; *Learning Management System(LMS); e-learning system; Self-Determination Theory(SDT)*

I. INTRODUCTION

With the rapid growth of the large progression of information communication technology, a variety of web-based course support systems [1–3] have been proposed in recent years. Course support systems allow students to check course information and study from any location with access to the Internet. Moodle, WebCT, and Prometheus are the most common course support systems. These systems are equipped with features that promote self-study and the delivery of course information, including practice problems, the distribution of course materials, and assignment submissions.

Course support systems assist teachers in a variety of ways. Specifically, these systems reduce teachers' efforts for the distribution of course materials and grading of assignments. Moreover, students can access course materials and submit assignments to the teacher remotely. However, existing course support systems focus exclusively only on teacher and/or student time and spatial convenience. To the best of our knowledge, course support systems that focus solely on student motivation are yet to be implemented.

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In this paper, we propose a new course support system that aims to maintain and enhance student motivation based on intrinsic motivation in self-determination theory [4]. The proposed system supports students by enabling them to exchange opinions and ask questions freely via Twitter [5]. Thereby, students can easily discover other students who are taking the same course. It is known that motivation increases if relatedness needs are satisfied [4].

Therefore, it is expected that motivation for a course will develop in students when they discover other students and exchange opinions by using the proposed system. Moreover, the system is expected to aid the process of establishing real-world friendships between students, and not just virtual friendships.

In the proposed system, we utilize Twitter. Twitter is a web service referred to as a microblog, and has attracted considerable attention in recent years. Unlike other communication tools, such as blogs, bulletin board systems, mailing lists, and chat, microblogs are limited to extremely short character sequences (140 characters per tweet in the case of Twitter). Therefore, as compared to other Web services for opinion exchange, Twitter is easier to use. Users can “follow” other users to receive a feed of their tweets. One of the reasons why Twitter became popular could be the fact that various Twitter clients were created by software developers for personal digital devices (for instance, iPhone, iPad, Android-based devices, and PSP), which has enabled users to respond to tweets immediately even if they are not in front of a computer, unlike in the case of chat. We utilize these twitter characteristics in the proposed system for satisfying the relatedness needs.

Moreover, Twitter can be thought of as a type of social network service (SNS). One SNS feature of Twitter is the ability to create lists of friends with similar interests to follow. Adding a friend generally requires mutual consent in most SNSs, but there is no such restriction on who users can follow on Twitter. Therefore, lists of friends can be created unilaterally on Twitter even in cases where a user might hesitate to create a list of friends in another SNS. Hence, Twitter provides users with a means for easier communication as compared to other SNSs. Due to all the features described above, Twitter is suitable for the purpose of promoting opinion

exchange between students, supporting the establishment of friendships, and strengthening the motivation for taking a course. Therefore, we adopt Twitter as the platform for the proposed system.

The proposed system consists of a course management feature and a communication support feature, where the former contains three sub features: problem exercise, course material distribution, and report registration. Furthermore, the communication support feature also contains two sub features: Twitter client and bot. By utilizing the Twitter client, students can easily see when tweets are created by other students taking the same course, regardless of whether those other students are followed by them on Twitter, which can improve the connectivity of students. The bot is an automated program that creates tweets on Twitter. By displaying tweets from other students who are taking the same course, students can discover other students, which can satisfy their relatedness needs as described by self-determination theory.

In this paper, we implement a proposed system and then evaluate it by utilizing the system in two actual courses at the University. Specifically, we evaluate the proposed system by (1) the questionnaires for the participants of the courses and (2) the analysis of the tweets on Twitter and the user relationships in Twitter. As a result of evaluation, by having the courses use a proposed system, the relatedness between students can be supported. Further, we show that it leads to the improvement in volition for a course of a student. Note that this paper is an expanded and revised version of work published in [6, 7]. We extend our previous work by the course design, the feature the system and the performance evaluation.

The structure of this paper is as follows. In Section 2 we describe the current studies on the course support system. Next, in Section 3, we explain the motivation in the self-determination theory, after which we illustrate the course model in Section 4. Furthermore, in Section 5, we present the features of the proposed system. We then show performance evaluation of our proposed system in Section 6. Finally, in Section 7, we conclude the paper and discuss the possible direction of future studies.

II. RELATED WORKS

There is existing research on the course support system [8–10]. For instance, the authors utilized the web-based e-learning system in the actual course, and then evaluated the system [8]. From the interviews of students and teachers and the questionnaire, it is seen that the rise in motivation was obtained throughout the course using the e-learning system. However, the system in [8] is a system that attaches great importance to the contents. For instance, the system enables many selections to students in one class in order to raise the desire in a student for autonomy. Moreover, the course materials in this system utilized by a teacher in class, includes video, animation, and music. Therefore, a teacher needs to make very large and elaborate contents for every course. This implies that the system requires a great investment by the teacher in terms of time.

In [9], the authors evaluated the degree of course comprehension, the degree of satisfaction of the course, the degree of mutual exchange between the teacher and the students, and the degree of mutual exchange among the students in the e-learning system based Web. Specifically, the authors employed Prometheus [3] in the course and then provided the questionnaire to students. From the questionnaire, it is found that the course with an e-learning system based on Web, obtained the highest degree of comprehension and satisfaction of the course. Furthermore, the results of the questionnaire showed that mutual exchange between the teacher and students and among students can be realized. However, the motivation, which is our research objective, is not examined in this research.

Moreover, in [10], the practical use of Twitter in higher education is considered. In [10], students living in different countries tackled a problem in collaboration using Twitter. It is reported that very many mutual exchanges occurred on Twitter and the students' community was formed. However, in [10], the authors focused on Twitter as just an information sharing tool between students. Twitter is not considered as an e-learning tool for motivation.

III. MOTIVATION IN SELF-DETERMINATION THEORY

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads—the template will do that for you. Self-determination theory [4] is one of the most promising theories to have emerged in recent motivational research. According to the theory, motivation can be divided into two kinds: intrinsic and extrinsic. Intrinsic motivation refers to feelings of pleasure and interest that are evoked simply by partaking in a certain activity. In an academic context, intrinsic motivation prompts students to study independently without the imposition of others. Moreover, individuals who are intrinsically motivated are eager to make decisions autonomously, and to establish relationships with others. In contrast, extrinsic motivation is triggered by external forces. Extrinsic motivation produces actions wherein a return is expected, such as to avoid punishment or to achieve a passing test score. In some cases, extrinsic motivation may indeed be rooted in fear. Past research has demonstrated that extrinsic motivation decreases intrinsic motivation [11, 12], particularly when it is based on an expectation of returns. As such, this paper focuses on intrinsic rather than extrinsic motivation.

According to self-determination theory, intrinsic motivation can be divided into needs based on autonomy, competence, and relatedness. Autonomy entails the ability to make a decision or perform a task freely and spontaneously. Individuals who possess autonomy regulate their actions independently, and work toward the fulfillment of a target goal. When autonomy has been achieved, people perform tasks based on an inherent desire to do so, and therefore harbor genuine interest in

achieving an eventual goal. Therefore, in promoting autonomy, it is important for individuals to be given an opportunity to make decisions independently, and to participate in the decision-making process. Likewise, competence encompasses the ability to effectively interact with individuals in one's surrounding environment. This, in turn, produces motivation. Similarly, relatedness concerns an individual's connection to his or her environment, and is achieved by establishing relationships with others. Hence, a desire to be connected and live with others in a community is a form of intrinsic motivation.

It is possible to satisfy autonomous needs by preparing diverse content for students, and by using it as a basis to create various activities for a course support system. However, such an undertaking is a costly endeavor for instructors, not only from a financial standpoint, but with respect to time as well. Likewise, a sense of competence can be achieved by assessing a student's ability in a particular subject in order to create appropriate content. Unfortunately, this too necessitates a painstaking process of content creation. Accordingly, this paper does not focus on autonomy or competence, but instead emphasizes relatedness. By promoting interactions between students, the support system implemented in this research aims to increase relatedness, and by extension student motivation as well.

IV. COURSE MODEL

This section describes a course model based on the support system used in this study—although the model could also be applied in conjunction with similar systems. The adoption of this model assumes that the system to be implemented will feature computer-based practice exercises. Using this model in a traditional, lecture-based classroom would force students to shift their attention away from the teacher, and instead focus on their computer screens. In such cases, this model may be less than optimal.

A course that implements our support system begins with a lecture during the first half of the class. In the second half, students are allotted time to solve exercises using their computers. Hence, the system is used solely during the second half of the class, and not during lectures. During the session's second half, the instructor encourages students to tweet about problems as they attempt to solve them, and also to tweet questions that they might have concerning a given exercise. By following students' tweets, the teacher is able to monitor learner progress, and is therefore aware of particular issues that they might be encountering. Moreover, by tweeting questions, thoughts, and updates about the problem solving process, students can become acquainted with classmates, thereby increasing relatedness.

Students who use the system start tweeting after they begin to work on problems, upon successfully completing them, or if they are struggling to understand a particular concept. As such, the system's impact on student concentration is minimal. When a teacher or teaching assistant notices a tweet wherein a student requires assistance in answering a problem, they consequently provide the class with an appropriate explanation,

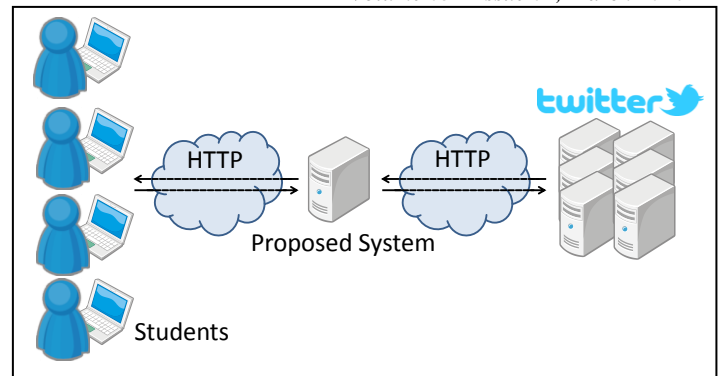


Figure 1. Relationship between students, the proposed system, and Twitter

either verbally or by using the Twitter client. Likewise, feedback concerning student-submitted solutions can also be provided.

V. PROPOSED SYSTEM

Our proposed system operates as a Web application. Fig. 1 shows the relations among students, the proposed system, and Twitter. Using HTTP, students can access the proposed system and utilize the communication support feature and the course management feature. The proposed system allows students to create and read tweets on Twitter. We developed the proposed system using Ruby on Rails version 3.0.0 and Ruby version 1.8.7. We used MySQL 5.1.49 as a database server and Passenger 3.0.0 as a web server.

A. System Accounts

The proposed system has five kinds of accounts — a student, a TA, a teacher, an administrator, and a bot account. The student account can utilize course support features such as a practice problem, a report submission, a check of course information, and a communication support feature that is described subsequently. A TA account can perform all the features that are possible in the student account. In addition, TA accounts can create exercise problems, confirm the report that the student submitted and give feedback to the student. In addition to all the features that the TA account can perform, the teacher account can create and manage courses, and create and manage practice problems. The administrator account can perform all features that are possible in a teacher account, as well as manage the system itself.

The bot account tweets the contents configured in the system beforehand. These tweets are simple such as “the course start” and, “I’m solving the problem No.3.” Most people do not talk in the places where nobody is talking. The purpose of the bot account tweets is to ease the mental resistance to tweet so that students might feel comfortable with tweeting. Throughout the tweets of the bot account, we can expect that students to respond with frequent tweets. The relatedness needs of students are satisfied by seeing the tweet by other students and the bot, which in turn is expected to increase their intrinsic motivation. Note that students do not know there are bot accounts in the proposed system. Students regard tweets by bot accounts as tweets by other students.

B. Features

The proposed system consists of a course management feature and a communication support feature. The communication support feature consists of two subfeatures: a Twitter client and a bot tweeting feature. Students can communicate with other students by tweeting questions and opinions regarding the course, using the Twitter client in the proposed system. Furthermore, the bot automatically tweets content prepared in advance, which encourages students to tweet as well.

Using the Twitter client in the proposed system, students can create and read tweets on Twitter, and the Twitter client saves tweets upon transmitting them to Twitter. Furthermore, the proposed system allows students to read tweets created by other students taking the same course, rather than reading tweets created by anonymous users on the Internet, thus satisfying the relatedness needs of the students.

In tweets created by students, the proposed system inserts “hash tags,” which are used for linking keywords or topics on Twitter. Hash tags are configured in advance for every course, and their usage enables Twitter clients other than those using the proposed system to identify tweets related to the course. The proposed system summarizes the content of all tweets related to the course on a Web page, where students can find explanations about points that might have been difficult to understand during class. Students can also use such Web-based summaries to review parts of the course or to catch up on coursework if they were absent.

Moreover, the course management feature in the proposed system consists of three subfeatures, namely, a practice problem, a course material distribution, and a report registration feature. In the practice problem feature, students solve problems created in advance for the course. Furthermore, course materials are distributed to students through the course material distribution feature, and the teacher can receive reports from students through the report registration feature. In addition, when the report submission deadline approaches, the proposed system creates tweets that remind students to submit their reports.

C. Privacy

A student needs a Twitter account to use the proposed system. If a student already has a Twitter account, this account can be used in the proposed system. The teacher explains that if a student utilizes the already existing account, other students have access to his/her past tweets and friend relationships on Twitter. The teacher also says that those who know of neither the tweets that are unrelated to the course, nor have friend relationships on Twitter to other students, may create a new account for the course.

The open range of the tweet using the proposed system changes with the configurations of a student’s Twitter account. Twitter has a configuration called “Protect my Tweets.” When this is not chosen, the contents that the student tweets, are exhibited to all Twitter users. That is, it is open to the public on the Internet, and users who do not use Twitter can also see the

TABLE 1. OVERVIEW OF TWITTER PRIVACY CONTROLS IN RELATION TO THE SUPPORT SYSTEM

	Public	Followers	Classmates
Protect my tweets disable	✓	✓	✓
Protect my tweets enabled and without hash-tag		✓	
Protect my tweets enabled and with hash-tag		✓	✓

tweets. Note that in Twitter, unless a user chooses it, a configuration is not set by default for “Protect my Tweets.”

Furthermore, the open range of a tweet using the proposed system changes also with different types of tweets. The proposed system automatically attaches a different hash tag for every course to students’ tweets. The open range of the tweet changes with the existence of this hash tag. A tweet without the hash tag is displayed only for the followers of a student’s Twitter account, and is not open to other Twitter users. On the other hand, in addition to the follower of a student’s Twitter account, the tweet with the hash tag is displayed for other students studying the same course on the proposed system. We summarize the open range of the tweet by the proposed system in Tab. 1.

VI. PERFORMANCE EVALUATION

We implemented the system in actual courses, and then we evaluated the system via questionnaires to the students, and by analysis of the tweets on Twitter by students. The proposed system was used in two programming seminars at Osaka Electro-Communication University. The courses implemented the proposed system 12 and 13 times, and 44 and 32 persons completed the course, respectively. The average attendance in each course was 38.5 and 10.1 persons respectively.

A. Questionnaire Results

The questionnaire was administered on the final day of each course. Questionnaires were distributed to 41 persons and 35 questionnaires were completed. The contents and results of the questionnaire are shown in Tab. 2. As indicated in Question 1, the proposed system resulted in many students creating Twitter accounts. Indeed, half of the students had not used Twitter prior to the course. Moreover, if students used previously created Twitter accounts the teacher explained that his/her previous tweets would be known accessible by other students. Thus, some students created new accounts especially for the course.

The results from Question 2 indicated that all the students used the proposed system. Moreover, all the students confirmed that they accessed the course time-line, which summarized the tweets of the students in the course, at least once per week. Furthermore, approximately half of the students confirmed that they reviewed the course time-line on days besides a course day, and this means that the proposed system was actively used.

TABLE 2. SURVEY QUESTIONS AND RESULTS

Q1. Did you already have a Twitter account?	Yes 24 %	Yes, but I created a new account for this course 24 %	No 51 %
Q2. How frequently did you review the course timeline?	Daily 6 %	Two or more days each week 40 %	Only on class days 54 % Never 0
Q3. Did you tweet using the support system?	Yes 80 %	No 20 %	
Q4. Did you become acquainted with other students?	Yes 83 %	No 17 %	
Q5. Did you gain more followers on Twitter?	Yes 46 %	No 54 %	
Q6. Were tweets made by classmates helpful in completing assignments?	Yes 20 %	Somewhat 49 %	Not really 23 % Not at all 9 %
Q7. Did other students' tweets encourage you to tweet as well?	Yes 51 %	No 49 %	
Q8. Did feedback from peers, your teacher, or the teaching assistant increase your motivation?	Yes 14 %	Somewhat 46 %	Not really 17 % Not at all 23
Q9. Did viewing other students' tweets increase your motivation?	Yes 29 %	Somewhat 43 %	Not really 20 % Not at all 9 %

The results of Question 3 revealed that many students tweeted via the proposed system. Since many students tweeted, it is likely that the proposed system provided an environment that was conducive to student tweeting.

According to the findings from Question 4, students appear to have connected with other students. All the students confirm the time line of the course on the course day and this may be understood from Question 2. Therefore, a student discovers other students through the course's time-line. Thus, relatedness was fostered when students connected with one another.

The results of Question 5 indicate that approximately half of the students' followers on Twitter increased. The average increase in followers was 4, as reported by 14 students. Therefore, it appears that student relatedness occurred via the proposed system.

As indicated by the results of Question 6, many students completed assignments by reviewing other students' tweets. When a student asked a question using the proposed system, the entire exchange was displayed to all the students. Therefore, a student could review other students' questions and subsequent replies. The effectiveness of sharing questions and responses via the proposed system is demonstrated by this result.

The results of Question 7 show that approximately half of the students tweeted because the other students tweeted.

Therefore, it can be assumed that the use of a bot encourages student tweets.

In addition, the findings from Question 8 indicate that students reported an increase in motivation because of the feedback they received. This may be due to the fact that students communicated with others through the proposed system, which fostered student relatedness.

Finally, as demonstrated by the response to Question 9, student motivation increased because of the relatedness between students. Indeed, through the proposed system, students discovered one another in the environment by viewing other students' tweets.

In summary, these results indicated that our proposed system fosters relatedness among the students and thereby increases student motivation. The effectiveness of the proposed system was seen through the results.

B. Analysis of tweets

Next, we analyze the tweets by the students using the proposed system. We investigate the tweets of each student before, during and after the course. We show the frequency of the tweets of the students.

Figure 2 shows the distribution of tweets according to the number of days when classes were held and days between them. It should be noted that the number of tweets is

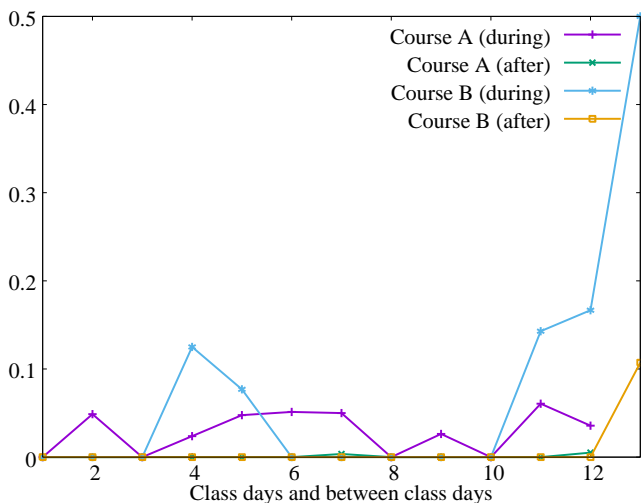
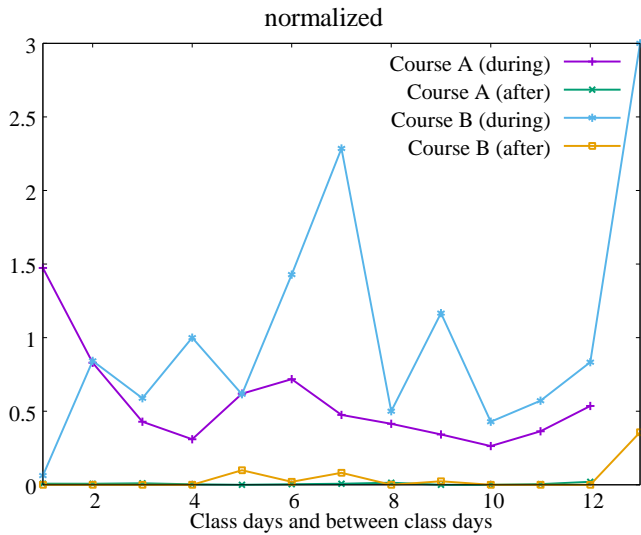


Figure 2. Distribution of tweets in general

Figure 3. Distribution of tweets posting questions

according to each day’s attendance. “During” refers to the number of tweets that occurred during a class session, while “after” indicates the number of tweets made in between the sessions. The average number of tweets in Course A and Course B were 1.025 and 0.5644 respectively. As shown in Figure 2, roughly half of the students tweeted during class sessions, although virtually no tweets occurred between sessions. Nevertheless, approximately half of the participants reviewed the timeline at some point between sessions, even if they did not actually tweet.

Figure 3 shows the distribution of tweets that posed questions concerning the course between and during class sessions. As in Figure 2, the number of tweets is normalized according to each day’s attendance. The frequency with which questions were asked during many, although not all classes was low. This is because questions and their answers were displayed directly on the timeline, and therefore students could often find solutions to their problems without asking questions directly.

Table 3 shows the number of tweets made daily by students before the course began, a week after it ended, and throughout TABLE 3. NUMBER OF TWEETS BEFORE, DURING, AND AFTER THE COURSE, CATEGORIZED ACCORDING TO PAST TWITTER EXPERIENCE

	Had a Twitter account	Created a Twitter account
Before	0.1746	N/A
During	1.8841	0.7271
After	2.3810	0.6108

its 114-day duration categorized according to whether they possessed a Twitter account prior to enrollment or not. Nine students used Twitter before enrolling in the course, while 20 created accounts specifically for it.

From Table 3, it is seen that the number of tweets by students who had previously used Twitter increased progressively. This could be attributable to the enhanced sense of relatedness that was acquired by students while using the support system. In contrast, the number of tweets from students with newly created accounts decreased following the course’s completion. This is likely because students with newly created accounts considered them to be merely an extension of the support system, and therefore the class itself. Consequently, they no longer deemed their accounts to be useful after completing the course.

In summation, almost half of the students tweeted using the support system, a percentage that is substantially larger than in a normal class. The system provided students with an environment wherein tweeting could be performed easily. Moreover, the number of tweets made by prior members of Twitter increased due to the formation of new relationships, which was made possible through the course’s support system.

VII. CONCLUSION AND FUTURE WORKS

In this paper, we proposed and evaluated the course support system that is based on the relatedness needs in the self-determination theory. The proposed system uses Twitter and provides an environment in which students can easily exchange information with other by creating and reading tweets. By confirming the tweets of the other students who take the same course using a proposed system, connection between students can be established and the relatedness can be seen in students.

We developed the proposed system as a Web application and implemented the proposed system in the two actual courses. We then evaluated the proposed system using the questionnaires given to the students, and the analysis of the tweets posted by students on Twitter. As a result, we show that the proposed system increases relatedness among the students as well as student motivation. We show the effectiveness of the proposed system.

As future work, it would be important to utilize the proposed system in more courses, and for more students to evaluate the proposed system. Moreover, in this paper, we assumed that the proposed system is used in a course that has a practice problem. Therefore, it is difficult to utilize the

proposed system in a course that does not have a practice problem. We are going to extend the course model in this paper for the lecture style courses, and develop a new course support system.

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