

1-Day-N-Questions: Online Crowd-Powered Platform for Study Groups

Sunggeun Ahn
20165192
topmaze@kaist.ac.kr

Young-Min Baek
20165161
ymbaek@se.kaist.ac.kr

Sungjae Hong
20163703
yain@kaist.ac.kr

ABSTRACT

Recently, online learning platforms have evolved in various ways to satisfy individual learners. However, many of the platforms are still providing unfair education environment or using ineffective and monotonous set of learning materials. The unfair learning environment can lead to the unfair accessibility, and the ineffective materials can cause tediousness or boredom. Therefore, a good way to get "good and diverse" learning materials "for free" is needed to motivate learners. In other words, we need to enable learners to study anytime and anywhere with diverse problems while effectively motivating the learners. To achieve this goal, we bring the idea of a solution from study groups in real-life. Already in many study groups, they have facilitated group-based crowdsourcing to effectively make test sheets for free. Based on study groups' learning process, we developed a prototype system, called 1-Day-N-Questions (1DNQ). 1DNQ applies online crowdsourcing approach to the traditional study group processes, and this platform supports online crowd-powered study groups, especially for learning English words. The experimental results showed that our 1DNQ platform and application can motivate learners and workers more effectively than traditional platforms. Also, our quality control and motivation mechanisms worked quite well for voluntary crowds. This study introduces the overall design of 1DNQ platform and discusses the results of user study with limitations and possible improvements.

Author Keywords

Crowdsourcing; Study Group; Crowd-powered Learning System; Mobile Application; 1-Day-N-Questions; 1DNQ

INTRODUCTION

In recent years, a number of online learning platforms have evolved in various ways to satisfy individual learners and enhance learning experience. However, many of the online platforms still have limitations to provide learning materials with the fairness. According to the survey of Statistical Office of Korea, the cost of private education increases as household income increases despite of various education platforms [7]. The unfair learning environment can lead to the unfair accessibility and disparities of educational levels. Furthermore, the ineffective materials can be tedious or boring to motivate learners who are unwilling to study something by themselves.

Therefore, a good way to get "good and diverse" learning materials "for free" is essentially required to motivate learners. In order to achieve the goal, we have to address following three major issues. First, we have to make a platform that is accessible anytime and anywhere. Since an effective learning method

should be a part of daily lives, the mobility and portability must be considered. Second, our learning platform should be able to motivate learners effectively. To provide proper stimulation for learning, a mechanism for the motivation should be carefully designed. Third, the learning platform should be able to provide newer and more diverse problems to users.

To address these issues, we bring the idea of a solution from study groups in real-life. Previous studies show that online social support has been widely used for shaping an individual's behavior [6] and mutual support in a group can stem from altruism and group dynamics [9, 1]. Also in many study groups, they have facilitated group-based crowdsourcing to effectively make learning materials and to motivate learners for free. Based on study groups' learning process and group dynamics, we developed a prototype system, called *1-Day-N-Questions (1DNQ)*. 1DNQ applies online crowdsourcing approach to the traditional study group processes, and this platform supports online crowd-powered study groups, especially for learning English words. This paper introduces overall methodology and development to combine traditional study group management with a crowd-powered approach.

Our experimental results showed that our 1DNQ platform and application can motivate learners and workers more effectively than traditional platforms. Also, our quality control and motivation mechanisms worked quite well for voluntary crowds. This study introduces the overall design of 1DNQ platform and discusses the results of user study with limitations and possible improvements.

RELATED WORK

To get inspired, some of literature on group-based learning and crowdsourced education have reviewed. In detail, we analyzed impressive elements and limitations of each idea, to make advancement of them.

Group-based Learning Platform

Group-based learning, which is more commonly called as team-based learning(TBL), has been studied since late 1970s. Larry Michaelsen, who was a faculty member at the University of Oklahoma, found that making a group of students and taking them responsibilities to peers' learning improved the effectiveness of the learning [4]. However, TBL is less likely to be realized in the application or platform style, and more likely to be considered of facilitation on real-world classroom. Moreover, idea of TBL became too formalized, thus it is hard to use the idea literally. Rather, use of the basic concept is more favorable.

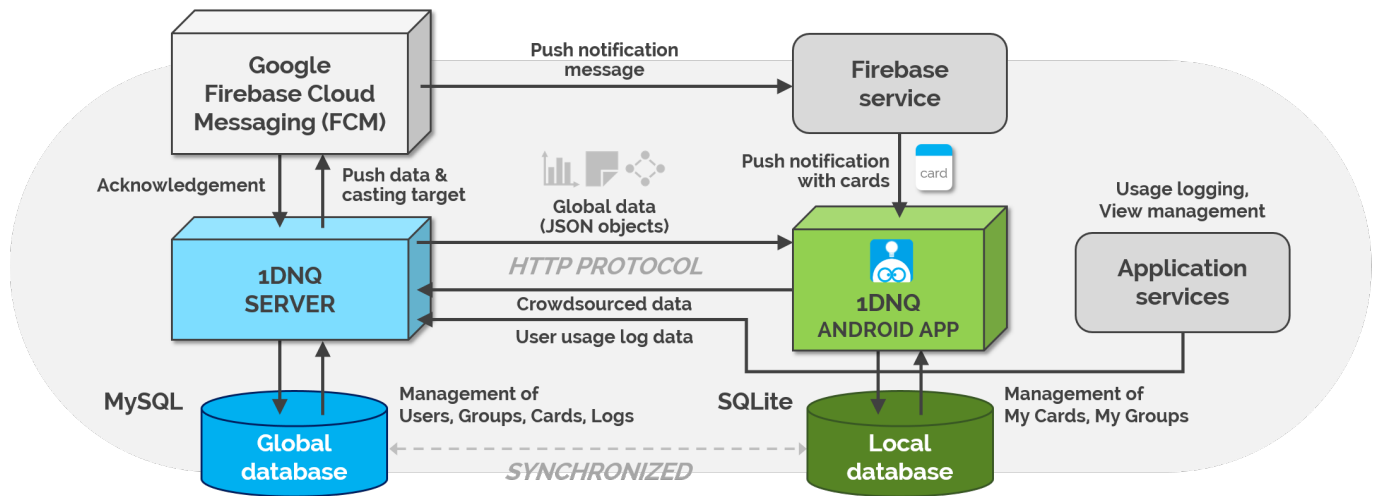


Figure 1: System Architecture of 1-Day-N-Question Platform

Crowdsourced Education Support

There are number of crowdsourced education platforms including Coursmos and iTunes U [3, 5]. These platforms let the users to create the lectures. Thus crowds make the problems and answers in the system. However, they lack the element of motivation on learning process. To be specific, there is no installation of letting the users keep on learning. As distractions on English learning process is one important problem to solve, those systems cannot solve the whole problem in English learning.

SYSTEM: 1-DAY-N-QUESTIONS

Task Design and Requirement Elicitation

We designed following four major tasks to support effective learning based on characteristics and advantages of the actual study groups.

- **Make a new card.** Users should be able to make a word card easily in a brief time through a specific submission format. Also, a simple and convenient interface should be accessible anywhere and at anytime.
- **Solve a given card.** The decision of card solving should be made of user's free will, but a given card should be able to give a user some sense of duty. At the same time, the notifications should not be annoying to give an increased incentive for learning.
- **Check my achievements.** Since a learner certainly hopes to see their current achievement as both a requester and a worker, 1DNQ app should be handy for checking such achievement information.
- **Check group information.** For the effective motivation of group activity and also for the group finding, the functionality for comparing the relative contribution is essential. Leaderboard-type dashboard can gamify the activities performed in 1DNQ app by motivating the card making/solving tasks.

System Design & Implementation

Our prototype consists of two subsystems and a communication layer. Two subsystems are (1) *1DNQ Android app* and

(2) *1DNQ remote server*, and they are connected via the *communication layer*. First, our *1DNQ Android app* provides user interface that is used to manipulate app settings and to manage several data from study groups. Specifically, our app performs or provides functionalities of card creation, card solving, group management, study review, account management, checking achievements/records, card evaluation, and analysis of my achievements. Meanwhile, *1DNQ remote server* performs the management of database (user DB, card DB, group DB, card-group relation), push message request, card-distribution algorithm, and supports global settings. Overall system architecture is illustrated in Figure 1 and more details are described below.

1DNQ Remote Server

1DNQ server is a backbone of 1DNQ platform. Every crowdsourced data is collected, managed or manipulated, and redistributed by the server. Also, the server determines the timing for proper notification alarm to the learners in a study group. In other words, the functions of our server are designed to support general crowdsourcing techniques. *1DNQ server* is implemented with PHP and Apache web server, and *1DNQ Android app* can request to the server to return some information.

Our *1DNQ server* reliably collects and stores crowd-made data such as account information, cards, and groups. If the data does not violate the integrity, MySQL global database stores it and uses it when the server receives client requests. As another function of *1DNQ server*, effective generation of push notifications is required. Our server can make push data both automatically and manually by administrators. An instance of push message with card information is made by the server and it is sent to Google Firebase Cloud Messaging (FCM) server to make actual push notification messages.

1DNQ Android Application

1DNQ Android app provides several useful interfaces to end-users for the effective card making, card solving, and managing their achievements.

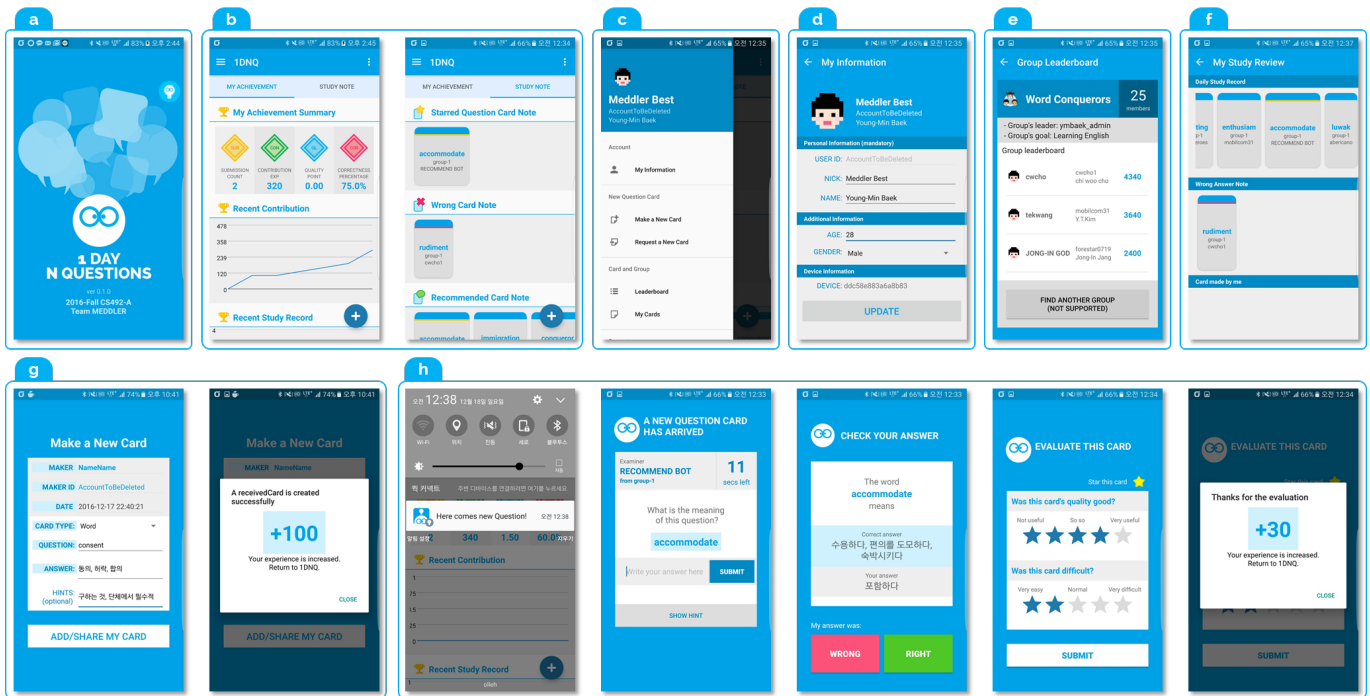


Figure 2: Screenshots of IDNQ Android app

Each box of this figure shows (a) Splash screen with IDNQ logo, (b) Two main screens showing a dashboard and a study note, (c) Navigation drawer menu, (d) Account management, (e) Group leaderboard, (f) Study review, (g) Card making and earning points, (h) Push notification message and card solving & evaluation

First, a user can make cards in the same format, which contains card's timestamp, maker's id, target group, and concrete card information. The concrete card information should include the type of card (word, idiom, sentence), an English question (i.e., English word), a Korean answer corresponding to the question, and some optional hints. Once a user (here, we can call this user "a worker") finishes making a new card with the information, the data is sent to the *IDNQ server* by calling PHP via an HTTP post request. When a new card is made, the server not just stores the card, but the maker's contribution point is also increased. Also, the new card information is stored into the local SQLite database, which is synchronized with the global database on the server.

Second, users can receive new cards in two ways, which are performed by server's automated alarm and by user's card request, respectively. Server's automated push messages are broadcasted to multiple users in the same group at the same time, but user's card request generates a single push message to the user who sends the request. Both ways produce a new push message on server-side, and Google FCM sends push notification messages to Android apps. When a push message is received at client side, Firebase service of IDNQ app automatically builds an instance of new card with received card information. Then, a user who got a push message can open the card on the status bar of his/her smartphone.

Third, users can check their current status of contribution, hourly achievement and studying activities on the dashboard of IDNQ app. Also, they can compare their own achievement

(i.e., contribution points) with other members in Leaderboard page. Both the dashboard and leaderboard are synchronized with the data stored in IDNQ server, thus users can check their real-time achievements and positions. Detailed purpose is described in next sections.

Crowdsourcing Techniques

Motivating Users

Our system is targeting unspecified online learners who want to study English word anytime and anywhere. To effectively motivate them, we designed some UI components with motivating data. First, every user's current achievement is visually illustrated. There is a main dashboard in the MainActivity of IDNQ app, and hourly contribution and card-solving activities are depicted as graphs below the dashboard. Furthermore, <Leaderboard> page shows the leaderboard of a study group to gamify the participation. By comparing other user's contribution points in the same group, users can be motivated to make more word cards and solve other members' cards. Figure 2-(b) and Figure 2-(e) show the dashboard of IDNQ app and leaderboard of a group, respectively.

Quality Control

In order to control the quality of group members' tasks, we facilitated several mechanisms explicitly.

- **Fixed simple format for creating cards.** IDNQ app provides a simple and fixed format for card making tasks. Users cannot sabotage the card making, since it only requires basic elements to make a card.

- **Quality evaluation of cards & User's quality points.** After solving a question of a certain card, a learner can evaluate two types of features of the card. One of the two features is a quality point, which indicates the completeness and kindness of the given card. If a card does not have enough information to understand question and answer, it will be evaluated in disrepute. The evaluated cards' quality points are averaged and reflected to card maker's quality points. Group leader can use the points to assess group members' commitment, and some members can be expelled from the group if the quality points are under the threshold (This function is not supported now).
- **Real-name based exam.** 1DNQ app does not only support quality evaluation, but it also pairs a card with a card maker's real name. This mechanism provides appropriate pressure to both a card maker and a card solver. Also, it makes learners think that cards are from other people (or crowds) not from a machine.

Demonstration

This section introduces the interfaces of 1DNQ app that implement the functionalities introduced in the previous sections. Figure 2 shows the overall use case scenarios from worker's and learner's point of view.

Users of 1DNQ platform can make and solve cards with the convenient and intuitive user interface. The prototype consists of the minimum number of buttons and menus. A user can make a card with a floating button both inside an app and outside of the app while using other apps. In addition, a dashboard panel to show user's achievement is located in the first screen of the app. We tried to reduce the depth of accessing to the functions as much as possible.

PHP files of 1DNQ server and Android project file (with an apk file) of 1DNQ app are uploaded on Github¹. Demo video is uploaded on Youtube².

PRELIMINARY STUDY

The purpose of preliminary study is observing how learners provide problems for peer learners in group study environment. We recruited 9 participants (mean age: 31.11 ($\sigma = 8.43$), 1 female and 8 male). Participants were asked to make problems utilizing 1DNQ application while they study with a given reading material in 40 minutes. Also we provide problems with push alarm at 7 minutes interval. Provided problems were from participants generated problem set. At the end of the study, we interviewed about what make them motivate to make a problem for peer learners in group.

Findings

As a result of interview, most of participants feel mandatory when they get problems which were generated by peer learners. Four of them mentioned that if provided problems are relative to their study context, they feel presence of peer learners. Also, 2 participants mentioned that restricted form filling area makes them careful to enter an answer because they feel more

¹<https://github.com/KAIST-CS492A-Meddler/1DNQ>

²<https://youtu.be/Ec8CpRMIzTY>

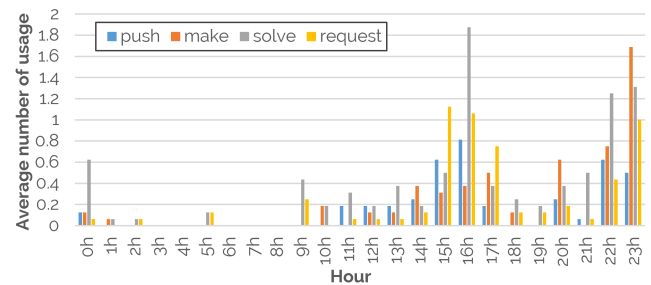


Figure 3: 1DNQ users' usage pattern in daily life

consider about their groups study context. One interesting finding is that when users faced impressed hint, they shared that problem to colleague and took more time to consider about hint when they make problems.

USER STUDY

To make system work well, there are need voluntary work from learners who use our system. System should be motivate learners to make more problems in both of implicit and explicit way. Implicit way is from the sense of duty and explicit way is group polish and push alarm for requesting to make a new problem. Also our system should encourage to learn, to make learners using our system over time. So we conducted user study to observe usage pattern of our system in daily life and how the methods, for 1) motivate to solve problems and 2) motivate to make problems, are work.

Participants

We recruited eight participants (mean age: 31.36 ($\sigma = 8.08$), 1 female and 7 male) from our lab members (three different lab) who share almost time with each of our team members in daily life. Six of them have experience of off-line group study. All of them had been participated in preliminary study too.

Method and Procedure

At the start of the user study, participants learned how-to-use of 1DNQ application. After that, they asked to use it for four days except weekends. There was only one group for the test due to small amount of participants, so there was no exact group polish aspect, but we demanded the participants to assume that there is group polish. In detail, group polish is 1) banish from the group if contribution point is too low and 2) a certain amount of contribution point is needed to be joined in a certain group. Also the system has sent 16 push alarms per day except 1 to 8 am, the expected sleeping time. All the events the users engaged were stored as log messages in the DB server. At the end of the user study, we surveyed and interviewed about the experience of 1DNQ application. First we survey with Pairwise Wiki surveys method [8]. We explained the five methods to motivate problem making applied in the system, and asked which method is more likely to spend the time to make a new problem. Second, participants were asked to assess usability of our system with the System Usability Scale (SUS) [2]. Lastly, interviewed about the usage experiment of our system.

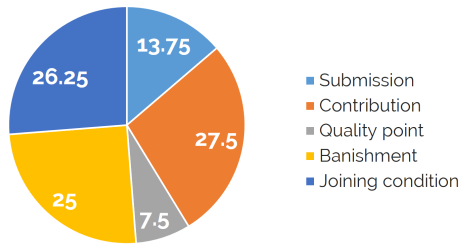


Figure 4: Results of pairwise voting about the methods to motivate problem making

Results and Discussion

Usage Pattern

Figure 3 show that the usage pattern of 1DNQ from the participant's daily life. X-axis is represent hour of day and Y-axis represent the average number of usage events per participants and day. The list of usage events were following: 1) problem making (make), 2) getting push alarm of new problem (push), 3) problem solving from self-request new question (request), and 4) problem solving from push, self-request, and card list (solve). The result show that learners are not study regular but tend to study intensively in specific time (pm 3:00 to pm 5:00 and pm 11:00 to pm 12:00). Also there are two interesting point. First one is that the number of problem solving is increased with the number of push alarm. When learners explicitly get a push alarm, they not only solve a problem from the push alarm but also solve more problems they selves. Second is that there are no relationship of the number of problem solving and the number of problem making. Figure 3 is looked like that our participants tend to make problems all together at the end of the day. Two participants mentioned that they made most of problems before sleep all together because they feel annoying to make problems while they study.

Usability of system

The results of SUS is that 4 of 8 participants were scored above the 68 point which is criteria of above average. Unfortunately, others were scored below the 68 point, but 2 of them were getting marginal point (65.25 point). A lots of participants mensioned that process of making a problem is too cumbersome. Four participants point out absense of the dictionary makes the task too complicated.

Methods for motivating problem making

Figure 4 show that visualization of contribution point and group polish is effective way to motivate problem making. It means that system should be have group polish for enforcement to make problem.

LIMITATIONS

Limitation 1: Need of level classification. Number of users gave complaints on the level of the questions. While some of them had complaints about low quality of card questions, some others complained about too hard questions. There was a shared view on the need of level classification.

Limitation 2: Need of more motivations on card making. In the user study, there was discontent on the question card making process. Some users found it tiresome and time-consuming to creating a card question.

Limitation 3: Need of fun components to let users stick on. While most of users enjoyed 1DNQ app in the early stage, some of them felt boring in the long term usage. Thus, letting users to stick on long term is necessary.

POSSIBLE IMPROVEMENTS

Possible Improvement 1: Proper user-question match system. For a level classification problem, difficulty of a card question and user learning status, including user experience, quality and correctness rate, can be used for user-question matching.

Possible Improvement 2: Attractable reputation system. For more motivations on card making, provision of attractable system can be considered. Proper rating system with visualization of ranking is necessary.

Possible Improvement 3: More gamification components. To let users stick on the 1DNQ app long time, more gamification is necessary. To be specific, blend with solving problem with adventure game can be one possible approach.

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