AC 2012-4059: GETTING STUDENTS INVOLVED IN A CLASSROOM WITH AN IPHONE APP

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Getting Students Involved in a Classroom with an iPhone App

A common approach to assess comprehension during lecturing is to regularly interrupt the lectures with questions addressed to the audience. In its basic form, the questions are open for anyone to respond and are often answered by the selected few who are inherently able to respond - a situation that naturally leads to a false generalization of learning in progress. A better approach involves randomly selecting a student to answer the questions or using a classroom response system to gain feedback from the whole class. The later typically requiring more preparation from instructors while questions are limited to true/false and multiple choice formats. For random selection, instructors often rely on 'picking-out-of-a-hat' method which like the classroom response system has the added benefit of keeping the class attentive. To automate this activity an Apple iOS App, called Pikme, was developed that can be operated on an iPhone or an iPod Touch devices for instructional use. Pikme was designed to allow instructors to randomly select a student from the class and be able to quickly assess their response for latter evaluation. The app enables instructors to generate a photo-roster that can be shuffled through by shaking the device. This approach was utilized in two different courses on regular basis to gauge understanding and simultaneously improve class participation. The paper highlights the features of Pikme, presents the key outcomes of this implementation from the instructor's perspective, and discusses a survey of student responses to the use of such a technology in classrooms. Overall the students felt the app provided an opportunity for everyone to contribute and as a result improved their comfort towards voluntary class participation.

Introduction

Student engagement is an essential component of effective teaching practice in classrooms. While there are several methods to engage students in and out of class[1], the most basic strategy involves student engagement during lectures via in-class participation[2]. An extensive review by Dr. Kelly A. Rocca, titled *Student Participation in the College Classroom: An Extended Multidisciplinary Literature Review,* discusses numerous approaches to improving participation and its benefits.[3] Dr. Rocca documents "students are more motivated, learn better, become better critical thinkers, and have self-reported gains in character when they are prepared for class and participate in discussions."[3] In other words, participation leads to engagement which in turn leads to higher level of thinking. Apart from learning outcomes, instructors requesting student input are indirectly acknowledging that the students have something to contribute and thus develop a mutually respectful platform for learning.[4] Effective teachers regularly solicit student participation to avoid creating a passive learning environment. That said, it is often the case that only a selected few students volunteer leading to biases in feedback and more importantly an unequal distribution in student engagement. To counter this phenomenon, teachers rely on one of many approaches to randomly select a student to respond. This is especially useful as class sizes increase because students become increasingly detached from the class.[5-8] With larger classes, it becomes challenging to learn student names and as a result connect with students - a key catalyst for engagement.[3,8] Therefore, any tool that facilitates class participation and allows instructors to connect with individual students has the potential to better engage students.

A common approach to improve class participation is to make it count toward students' grade. While effective, this approach is highly dependent on the implementation and the method of assessment to avoid it becoming a subjective grading scheme.[3] A more systematic strategy involves randomly selecting students for questioning and immediately evaluating their responses. There are, of course, more traditional methods of conducting a random selection by 'picking-out-of-a-hat' or using shuffled flash cards. The use of technological solutions can dramatically enhance the information gathered during the random selection event. For instance, software-based random selection can allow photos of students to be displayed and instructors can rate student responses for an accurate later assessment of participation. While there are several PC-based solutions[9,10] and mobile-based apps that can perform selected tasks, there are none that are designed to effectively address three critical features. These three features include the ability to: 1. Generate a photo roster for each class, 2. Randomly select a student, and 3. Rate the student response. In addition, it is just as important to have an app with a functional yet simple design from user's standpoint.

A new mobile-based app, called Pikme, was designed by senior engineering students at Rowan University for Apple's iOS platform to address the specific requirements outlined. The app was published on iTunes App Store in May 2011 and has been recently updated to add new usability features. The app is available as a free download for Apple's iPod Touch, iPhone nd iPad. The app was also covered in *Courier Post* (a Southern New Jersey newspaper)[11] and *The Chronicle for Higher Education* blog[12] as a useful teaching tool. Since its launch, Pikme has been downloaded over 1000 times around the world. Further development continues to add new features for taking attendance and grouping students like other apps, at the same time making the app available on the Android platform.

While the app sufficiently addressed the design objectives, the app's impact on lectures had not been explored. Specifically, how do the students react when they are randomly picked for class participation? This paper documents a study on the use of the app for two very distinct classes over the course of a term. This work includes a usability study from the instructor's perspective and student surveys conducted to gauge student comfort with the use of such technology in classroom and its impact.

The Pikme App

Pikme was designed as a simple app to boost class participation. The app facilitates the whole class to get involved without relying on the selected few to raise their hands. The app randomly picks students and allows responses to be rated and stored for subsequent grading. With its ability to take and store photos of the students alongside their names, Pikme is a powerful tool for rapidly learning student names, especially when dealing with large class sizes.

There are three key features that the app provides: 1. Managing student lists. You can organize student lists by courses and manage multiple courses. Student profiles include their names and

the ability to assign a photo to the profile. A student list displays the student profile photo with their respective names. 2. Random selection. While teaching, the instructor can use 'shake-to-randomize' function to pick students for questioning. 3. Rate student response. Tap on the 'ask' button to evaluate responses using three tiered rating system. Pikme stores the rating for each student and the totals can be viewed for later assessment. Figure 1 provides screenshots of these key features. The app provides a clean and simple interface for immediate integration into a lecture.

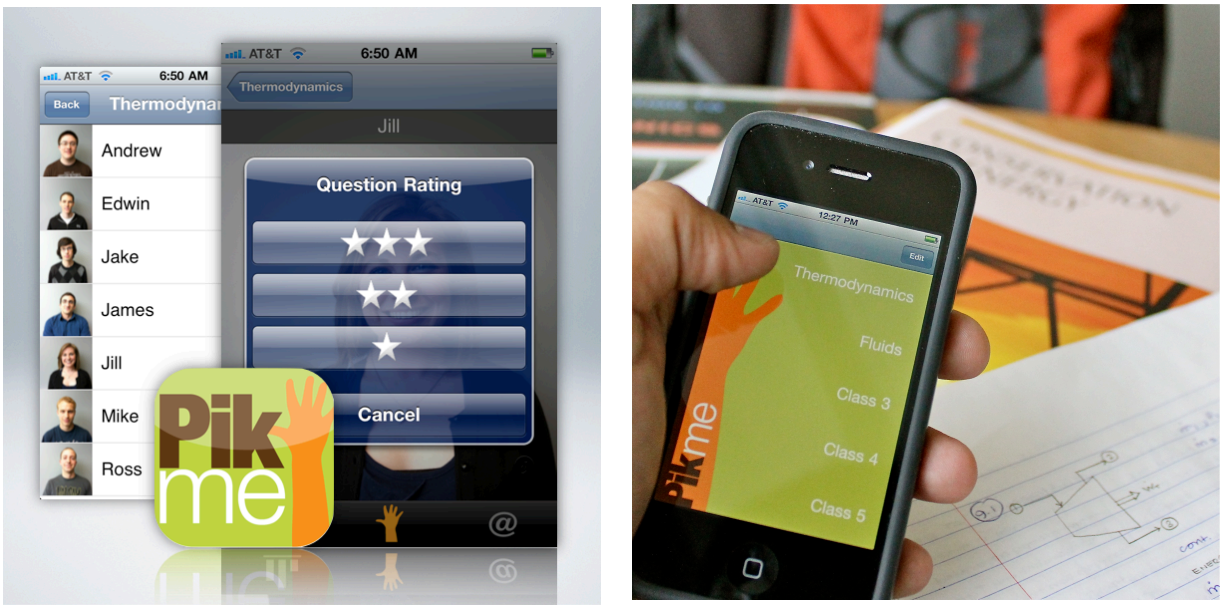

Figure 1. Screenshots of Pikme app that allows instructors to randomly select a student by shake-to-randomize function on an iPhone or an iPod Touch. Pikme also allows rating student responses and grouping students by class to assign class participation grades.

Study Methodology

Even though the functionality of the app was thoroughly tested before submission to the app store, its usability and impact on a class had yet to be explored. Usability referred to the ease of use during lectures without disturbing the flow of instruction and more importantly studying the impact of incorporating such a technology in a traditional lecture-based classroom on students.

As a result, during the Fall 2011 term two separate classes were selected to conduct the study. Class 1 was a *Freshmen Engineering Clinic I* which is first in a series of courses that engineering students take to familiarize with and apply their engineering/technical skills. There were 24 students enrolled in Class 1. Class 2 which was a senior elective *Introduction to Nanotechnology* course with 15 students composed of mostly seniors and few graduate students.

For both the courses, the instructor would typically assign a reading, problem solving or a video viewing homework before the next class period. Factual questions accompany the assignments and are provided beforehand to students to respond regarding the content. These were 'suggested' assignments, as opposed to, 'required' homework. In other words, the completion of the homework did not contribute directly to their grade in the class. However, the students were aware that they will be randomly picked to respond to the questions during class using the Pikme app and consequently assessed on the quality of their responses using the rating feature. The instructor often used the app while lecturing to test the understanding of the topic being discussed by randomly selecting a student, however this was less often carried out then the previous approach.

The usability of the app was evaluated based on the instructor's personal experience with the app. The impact of the app in the classroom was qualitatively evaluated using student feedback that was solicited in two forms:

1. *Open Feedback.* After the first 2 weeks of classes the instructor asked students to comment on 'what is working' and 'what is not working' with their respective courses. These are open ended responses where students can comment on anything related to the courses.
2. *Pikme Feedback.* At the end of the course a specific survey targeted to understand the impact of the Pikme app in the courses was administered. The students were asked about their attitude towards the use of Pikme and the outcomes in their respective courses.

Study Rationale

Previous studies have shown such cold-calling practices have mixed perceptions depending on the methodology used.[3] As a result, the assignments were designed to remove any ambiguity or surprises during the random selection event by providing the questions beforehand. The homework was tailored simply to get students prepared for the lecture topic. The random selection then acted as an event for students to share their answers to the homework questions. The aim of the study, which was to gain an insight on what the students felt about Pikme's usage, was fittingly addressed by conducting the student surveys. In other words, a qualitative measure of impact was sufficient for the purpose of the study.

It is also understood that these were relatively smaller class sizes considering the app was designed to help remember names while teaching larger classes. Nonetheless, the implementation suited the purpose of this study and in addition, the selection of classes offers a range of students with distinct backgrounds. Class 1 included students who had limited familiarity with college lectures while Class 2 involved students who had considerable experience with college-level courses, because it included all senior-level engineering students (or higher).

Instructor Evaluation

Usability

Overall, Pikme excels at what it was designed to do: help memorize student names with a photo-roster and get everyone involved in class by randomly picking students while being able to rate their responses. During the lectures one can quickly access the class list and shake-to-randomize to pick a student for responses. The response rating feature required an additional step which at times disturbed the flow of lectures. Considering the app is operated on a phone, no additional gadget or gear is necessary to employ it. The app resides in your pocket until the next time you need it, making it a a very convenient tool for classroom use.

While extremely useful, there were certain features that required minor changes. After the first few lectures, the instructor noticed that the phone would 'go-to-sleep' if the app was not in use while lecturing. The next time someone had to be picked the phone had to be unlocked for use - taking away some precious few seconds. Note, the instructor used an iPhone for this study but the app can run on an iPod Touch or an iPad. These issues were quickly addressed by a software update during the term. Several other minor changes that would make Pikme a stronger candidate for use in classrooms were identified and are being incorporated into the next version of the app. Features such as importing a prepared class list into the app when dealing with a large number students or functionality for taking attendance can greatly enhance the utility of Pikme. Nevertheless, the current version of the app is incredibly effective at getting the whole class involved.

Impact in Classroom

From the instructor's perspective, beyond the app's clear ability to facilitate learning student names, the following are the key observations made regarding the use of Pikme and its impact on students over the course of the term for both classes.

1. *Motivated students to complete ungraded assignments.* With the looming fear of being picked and having to find an excuse, the students completed all the 'suggested' assignments before the lectures. On the few occasions, a student would respond, "I could not answer that question," which yielded further discussion. If random selection or mass-collection of assignment was not carried out then such instances would go unnoticed because the students who answered the question confidently would naturally raise their hands, ultimately leading to a biased view of the class's comprehension.
2. *Provided a more balanced feedback.* For both the classes there were a couple of students (in each) that regularly volunteered to answer questions. More often then not, these volunteering individuals had the correct responses to the questions. Nevertheless, Pikme helped to quickly pick an alternative student when the instructor was aware that the answer was not obvious and wanted to gauge someone else's understanding. This was especially helpful when the alternative student did not know the answer, prompting a necessary explanation.

3. *Improved student engagement.* When the app was in use most students seemed engaged and ready to respond compared to when the iPhone was not out. During the 'non-app-lecturing' sessions, it was easy to notice a number of students disengaged or distracted - this was especially true for Class 1 which was an 8 am class.
4. *Increased overall participation.* Apart from participation mandated by the app, students were eventually more comfortable at sharing their thoughts during class - even without the use of the app. Of course, it is difficult to make such a statement without an effective comparison but the level of volunteered participation was noticeably higher compared to previous offerings of the same courses. This can be attributed to the frequent use of Pikme leading to students feeling at ease with contributing their ideas. This observation was also reflected in the student survey.

Student Survey Results

As explained earlier, two forms of feedback were requested: Open Feedback and Pikme Feedback. This section summarizes the student responses from the two feedback events and provides key conclusions on Pikme's impact from students' perspective.

Open Feedback

Open feedback asked students to comment on 'what is working' and 'what is not working' with regards to the course in general within the first two weeks of each class. This meant, no specific feedback with respect to the use of Pikme was requested. The following are combined comments from both classes directly related to the app's usage.

1. Everything is working for me, topics are explained well, everyone is involved and contributing, I like the app.
2. ... The instructor is enthusiastic about the course, and encourages class discussion and interaction. The assignments give a good addition to the lecture material, without being overburdening. Also, the use of the PikMe app gives a more fair chance for students to obtain their participation grades.
3. ... The lectures are well done and everything is presented in an organized fashion. The randomized student selections with the iPhone is good. Does the app remember who has already been picked so you don't have to shake it multiple times?
4. So far I like the use of the "pick me" app, as it forces each of the class members to pay attention.
5. The presentations. I like that the presentations are available after the lecture. Good pace. I like the use of the iPhone app. Good assignments and workload.

It is important to emphasize the above comments were completely voluntary with respect to Pikme's usage. In addition, while these are a selection of comments related to the app's benefit specifically, there were several general comments related to students observing higher class participation and "... how the class isn't a lecture, its a discussion. ..." that suggested the positive

influence of Pikme in the class dynamics. On the other hand, there were no negative comments related to how the class was overall conducted or anything distinctly related to the random selection method. In fact, the comments seen above inspired the follow-up Pikme specific survey to gain a general consensus on Pikme's impact.

Pikme Feedback

The Pikme survey was designed to gain feedback on the students' attitude towards the use of Pikme in their courses and its influence from their perspective. The survey was administered on the last day of classes with majority of the students participating and providing comments (participation was 87.5% for Class 1 and 100% for Class 2). The survey included three multiple choice rating questions with a final open-ended question. Table 1 summarizes the outcomes for the first three questions. The table also provides the selection of rated responses, the percent rating selections from both classes and finally an overall evaluation of the responses is presented.

Table 1. Pikme feedback survey questions and the responses.

Questions	Response Alternatives	Class 1 Responses (21 students)	Class 2 Responses (15 students)	Overall
How would you rate your attitude towards Pikme app for randomly selecting students to respond in class?	1. very negative 2. somewhat negative 3. neutral 4. positive 5. very positive	1. 0% 2. 0% 3. 9% 4. 59% 5. 32%	1. 0% 2. 7% 3. 7% 4. 57% 5. 29%	Majority felt positively towards being randomly picked.
Do you think Pikme helps students stay engaged during class?	1. does not 2. somewhat 3. absolutely	1. 0% 2. 32% 3. 68%	1. 0% 2. 36% 3. 64%	Majority of the class felt the app engaged students.
Do you think it is fair to randomly select students to respond?	1. No 2. Yes	1. 5% 2. 95%	1. 0% 2. 100%	Students thought it was fair to randomly select.

For the final comments question, the following description was provided to the students on the same sheet as the previous three questions, "Your instructor used Pikme at several instances during the course of the term. Please comment on what you liked the most and/or least about the use of Pikme app." To document the overwhelmingly positive and unique responses, all the comments are provided below for completeness (numbered here to simplify referencing).

Student Comments from Class 1

1. It seems that the app does not continue to remain random. In other words, the app should remember who it called already even if it was turned off. This way, everyone is sure to be picked at least once per cycle.
2. I liked how it can randomly select students, I did notice however that it would take the attention away from class momentarily if the shake-to-select did not respond.
3. I felt it encouraged volunteering more, since you felt as though you were going to be picked anyways so why not volunteer. It also kept us alert, since we needed to be ready if we were picked. It was sort the "negative" encouragement we needed.
4. I think it was a good idea. Students should be involved and if they are picked they have to be paying attention or else everyone will know.
5. + Keeps students on their toes, prevents favoritism, fair choosing. - random, and may choose some person each time, some students do not pay attention anyways.
6. It's good because everyone has to pay close attention because everyone has a chance being picked.
7. Most: Kept everyone attentive and in class, Not the same person is always answering, creates more of a discussion, Gets everyone involved. Least: If you didn't know the answer and still got picked.
8. I liked the idea of the Pikme App. I have been in several classes in the past where the participation by the students was lacking. This app strives to keep all the students engaged and even if they aren't picked they still know they can be picked so they recognize that they need to pay attention. I disliked when the Pikme app was used instead of asking students for their input first. Give them a chance before starting to use the app. This was not usually the case but did happen a few times.
9. It's just an app ... teachers usually pick students at random anyway. So on app is a great idea.
10. It kept me active.
11. The randomness is nice cause it makes things fair. It did seem that it pick some people alot and some like me never got picked.
12. I liked when it wasn't me. I disliked vice versa.
13. I liked that it's completely random. It also prevented long awkward pauses in the classroom when a question came up. I didn't like how it picked me sometimes.
14. I was rarely picked.
15. It only picked me twice the whole semester. Can have a very unequal distribution for some students.
16. That it rarely picked me (liked most). It did get good conversations going though.
17. I found myself paying attention more often when the phone was out.
18. The only time I was picked, I had no idea of the answer.
19. This seems to be a great app other than the idea of taking pictures of the students which could make some uncomfortable, it seems like a great approach to keeping a flow to the class and making sure everybody participates.
20. I thought that the Pikme app helped move the class along well when it stalled.
21. It kept me thinking, because I was more worried to be called on.

Student Comments from Class 2

1. Pikme ensured that all students were picked at least once over the course of the several lectures, where the Prof. may not remember who has answered. Prevents one person from answering all questions, and individuals getting away without answering any. Keeps students on toes - don't know when will be called on.
2. The use of the Pikme app actually helped in my understanding of the course material. Using the app made me feel more comfortable as I realized that most of the class was in the same boat as I was in terms of understanding key concepts brought up during the lectures. Bottom line, the app encourages free flow of ideas as responses from the students aren't limited to those coming from the smartest students.
3. It definitely kept me more engaged when I knew I could be randomly selected for a question. It seemed that the same names would come up even if that student already answered a question, which required multiple shaking. This was the only downside that I could see.
4. It kept me attentive knowing I could be picked on at any time.
5. It keeps the student alert to the material being discussed.
6. Most: engages students. Least: may pick the same students multiple times while not picking others at all.
7. It allows for a better distribution of student participation, and is a more fair system if participation is part of a grade.
8. Like: how it gives people a chance to participate who normally would not. Dislike: the fear of your name being picked if you are unprepared or simply not ready.
9. Good tool to test student whether they are actively participating in the class and to test students whether they know what's going on in the class; are students gaining knowledge.
10. I like the Pikme app because it allows everyone to answer so that several students don't answer all the questions, as it happens in most of my other classes. People who are shy or "out-of-the-loop" are forced to be involved.
11. I liked Pikme because it forced me to be prepared for class and I did not have to worry as much about my participation grade because I would get called-on anyway. I didn't like it because sometimes you don't know the answer to the question being asked when you're picked.
12. The app required me to always be prepared and to be ready to answer any question in class. Keeps one person or small group of students from answering all questions.
13. The app made me do homework since there is a real chance of getting chosen to answer questions.

Survey Conclusions

The surveys clearly established the highly favorable attitude of students towards the use of Pikme and at the same time providing corroborating evidence for the observations made by the instructor. The overall conclusions from students' perspective can be grouped into three basic ideas.

1. *Randomly picking students is a fair approach and the students had a positive attitude towards the app.* It is important to establish this considering there are several ways one can use the app that would generate a negative sentiment towards the app. For instance, randomly selecting (cold-calling) a student to answer a question without giving enough resources or time to prepare. Such an approach would typically raise the anxiety level and generate a negative attitude towards random selection, in turn having a detrimental effect on engagement and participation.
2. *The app engaged the students.* Beyond the majority of students saying the app 'absolutely' engaged them during class, several comments clarify and justify their selections. Comments like, "It kept me attentive..." and "It kept me thinking..." suggest the students were paying attention during lectures and making an attempt to understand the material to be prepared to respond if called upon.
3. *The benefits of full participation.* Students noted the several different benefits of having the whole class participate. For instance, the app encouraged those who did not participate regularly to share their responses (Class 2, Comments 8 and 10). Full participation inherently provides an unbiased feedback for students to gauge their understanding of material - by comparing themselves to the class and not necessarily to the "smartest students" who would normally raise their hands (Class 2, Comment 2). On the other hand, when classes have students who are overzealous responders to instructor questions, the class participation is dominated by these few (Class 1, Comment 7) and it is often difficult for instructors to break the cycle without explicit intervention. As the students noticed, Pikme facilitated an even distribution of students who participated (Class 1, Comment 6 & Class 2, Comments 1, 2, and 7). In addition, the knowledge that everyone will be participating at one point or another encouraged students to volunteer without prompting from the app (Class 1, Comment 3 & Class 2, Comment 2) - an important observation that was also made by the instructor. The students also noted a higher level of participation for these classes compared to other classes they were concurrently taking or previous classes they had taken (Class 1, Comment 8).

While most comments were overwhelmingly positive, the negative comments were limited to the technical aspects of the app. Issues such as the truly random nature of the selection resulted in some students being picked more than twice during a lecture. When the instructor made an attempt to select someone else, there was a break in the flow of lecture that was noticeable. A student (Class 1 Comment 19) commented on an idea that might be of equal concern for other instructors: the idea of taking students pictures can seem discomforting to some from the privacy standpoint. This is a valid concern however schools already provide student photo IDs to instructors so taking your own photos is simply optional, considering one can download the photo IDs from the school's database. There was a comment (Class 1 Comment 8) suggesting the instructor to wait for volunteered student responses before using Pikme however, it is exactly this circumstance that leads to biases in participation when 'those who know' respond while 'those who do not know' remain silent.

Conclusions and Recommendations

Apart from the more direct influence of the app on class participation the most promising outcome relates to the fact that students spontaneously volunteered to respond as a result of the comfort developed with app-assisted random selection. It would be interesting to observe if the class of freshmen engineers continued to demonstrate this behavior in other classes. As an anecdotal comment, the same freshmen class when combined with three other sections of *Freshmen Engineering Clinic I* for a discussion on sustainability, the students involved in the study were noticeably more vocal about their ideas and frequently shared their opinions with an audience of over 100 students. In fact, the discussions were dominated by the section involved in the described study. Of course, such a correlation is challenging to make without a rigorous study. Alternatively, one can study if higher class participation leads to better learning. While this was beyond the scope of this study, there is relevant research suggesting class participation and engagement in general leads to student learning. From a broader perspective, the study raises several important pedagogical research questions on the effective use of technology in classrooms. For instance, educational research has demonstrated random-calling on students can hinder engagement by raising the students' anxiety level. This study showed no such discomfort with random selection when students were allowed to prepare for questions beforehand. In fact, the student attitude towards app's use was overwhelmingly positive. An iPhone app, while similar in principal to picking names-of-out-a-hat or using randomized flash cards, provides a more systematic approach to enhance class participation. More importantly, an iPhone-based app that is always accessible with the added benefit of recording student responses and using it to quickly learn student names can become a handy assistive technology. With several new features being incorporated, Pikme with added functionalities has the potential to become an essential tool in classrooms.

Acknowledgements

Majority of the Pikme app development efforts were headed by Ryan Sikorski as part of his senior year student project at Rowan University Mechanical Engineering Department. Michael Goldberg assisted in the initial stages of the app development, while Robert Sheridan, Alexander Redfield and Justin Litowitz were involved in the latest update. Pikme was developed using funding from the Rowan University's Mechanical Engineering Department.

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