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Supporting and Amplifying Teaching Experience of New College Teachers
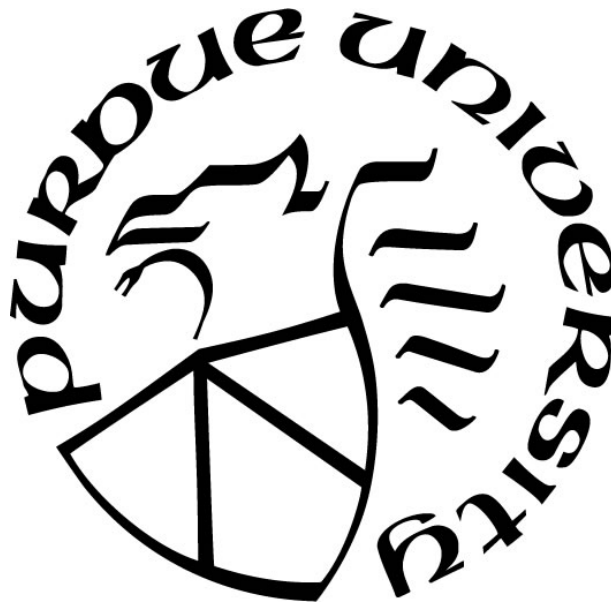
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SUPPORTING AND AMPLIFYING THE TEACHING EXPERIENCE OF NEW COLLEGE TEACHERS

by

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This thesis is dedicated to the parents Juming Liu and Aijun Wang. Thank you all for helping to give me the life I love today

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ABSTRACT

Author: Siyan, Liu. MFA
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Title: Supporting and Amplifying Teaching Experience of New College Teachers
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This thesis investigates how to amplify and support novice college teacher's teaching experience. It has been found that a majority of percent novice teachers (55%) could not prepare there are lessons effectively (Fantilli & McDougall, 2009), many of them will spend a lot of time adapting to the educating and academic environment. The main issue is that these beginning teachers cannot recognize what kinds of methods are more effective to enhance their teaching efforts in the short period term. At the meanwhile, how to enhance their class quality as a crucial problem as well. There are several factors affecting the overall situation. First, beginning teachers have different cultural backgrounds, characteristics, and experiences, and they are being confronted with new and different situations. Second, due to the courses having been designed by others, they are unfamiliar with the structure of the classes they are teaching. Third, novice college teachers generally lack of any teaching experience, so it is difficult for them to deal with particular situations. Additionally, the process of preparation is quite difficult for them to master.

Two main design approaches have been taken in existing research and projects that aim to help novice teachers. One design approach, which is somewhat limited, is to provide interactive functions between teachers and college students during class time. The other kind of design work concentrates on helping teachers to manage their classes.

Based on the results of the literature review, peer-product review, and user studies research, I propose a mobile-based campus application with an external technology device to explore and provide useful educational information to novice teacher corresponding to the following four dimensions: teaching experience cognition, augmented reality, communication, and resources collaboration. The application aims to help novice teachers figure out an effective method for improving the quality of their

classes. Additionally, both qualitative and quantitative data were collected via online questionnaires, interviews, and frameworks.

As a result, I aim to design a system with an external device to support novice college teachers. The app design will concentrate on how to enhance teaching experience for new teachers. The objective is that design solution will help the beginning teachers adapting to the education environment and explore the most appropriate method to enhance the quality of their classes.

KEYWORDS: Teaching Experience, Resources Collaboration, Augmented Reality

CHAPTER 1. INTRODUCTION

As new college teachers who have no previous teaching experience, it is quite

difficult for them to understand how to fulfill their new class role. First, they are not

familiar with the content of the class, and therefore have to spend a lot of time preparing

class materials and re-organizing the class content. For instance, new college teachers

need to make outlines of class for each section and prepare the latest resources for

different lessons. Usually, the vast workload that comes with the process of collection.

What's more, new college teachers are expected to become more confident and unhurried

during the class. So, they need reminders and tips to help them to be well-prepared the

class. Additionally, they would like to be able to exchange ideas and resources about the

classes they are teaching with other, more experienced college teachers. Through the

method of resources collaboration, key information could be integrated more

comprehensively and in a more diversified fashion. Finally, another significant request of

new college teachers is that they would like to improve the overall experience of teaching

with the use of more innovative educational approaches. Not only do are they concerned

about the quality of their class instruction; they also prefer to use creative methods during

the class to improve outcomes. Based on the situation I have just described, I intend to

create a design solution to support and amplify the teaching experience among new

college teachers.

The in fact quite a lot of consensus concerning the number and types of challenges

confronting new college teachers. "Historically, school have not been set up to support

the learning of teachers, and novice"(Sarason, 1990). This suggests that when new

college teachers approach their classes, they have little support and are generally isolated; it is often difficult for them to find a group or community to ask for help or exchange ideas with. In addition, "The disturbing reality is that many teachers continue to respond in ways that inadequately address the complexities of teaching and learning in a multicultural nation"(Lisi & Roxas, 2018). This shows that one of the challenges among new college teachers is knowing how to apply teaching methods to satisfactorily address the growing diversity of the student body at colleges. Furthermore, novice college teachers who are working through these challenging situations often feel like failures and disappointments to their students and peers. The result is that "Without sufficient supports, only the strongest and most determined teachers succeed"(Colbert & Wolfe, 1992). This illustrates that novice college teachers need adequate supports to improve teaching experience for them and their students. Thus, the main concentration in this thesis is on following three aspects: supporting a platform for new college teachers to communicate with other, more experienced teachers; amplifying the educational methods for new college teachers to enhance the quality of their classes; and improving the teaching experience of beginning college teachers.

Through the exploration of educational technologies and methods, I have found that the existing research is focused in two different directions: (a) improved e-management of the class and (b) advanced interaction through the technology of augmented reality. For instance, the mobile application *Remind* (Brett and David Kopf, 2011) supports a platform for college teachers to manage their classes and organize the content of their classes in an accessible way. Another application is *HP Reveal* (Matt Mills, 2011). The implementation of this technology is in the classroom. Teachers are enabled to connect to

digital files such as videos and images and display them on the walls or on textbooks, suggesting not only that current educational approaches are constrained by conventional methods, but that education could move beyond being principally text-based.

In general, how to support and enhance the teaching experience among new college teachers is the main concentration. I would like to offer convenient, user-friendly, and innovative methods to enhance the educating experience among beginning college teachers.

Chapter 2 of this thesis discusses the social justification and conceptual justification for this project. The social justification focuses on the challenges confronting the target audience: novice college teachers. The conceptual justification focuses on the following approaches: (a) integrating augment reality technology into educational methods and (b) using mobile devices in the college classroom. In the following chapters, I will discuss the methods for identifying user requirements, demands, behaviors, and expectations; then, after reviewing peer products, I propose a mobile application with an external device to provide class information to new college teachers. The intention of the design is to help novice college teachers enhance the quality of their classes and improve amplify their teaching experience.

CHAPTER 2. LITERATURE REVIEW

The challenges and opportunities confronting novice teachers come in a variety of styles and formats. When it comes to novice teachers, one major question arises: How are we to enhance the teaching experience of novice college teachers in an effective way? There are many possible answers to this question to explore.

Starting with a review of the existing literature, I will explore some practical and effective methods for enhancing the teaching experience among novice teachers. This chapter is divided into two sections: social justification and conceptual justification. Additionally, I will also briefly demonstrate a framework for better conceptualizing the challenges and opportunities of novice teachers. For the purposes of this study, I aim to conclusively identify the relevant factors from various social perspectives, and try to figure out the main causes in the information of the teaching experience.

2.1 The Challenges Facing New College Teachers

There are several kinds of problems perceived by new college teachers in their first experience with educating, including "reality shock and changes in behaviors, and attitude" (Simon Veenman, 1984).

The shock of this transition could also be interpreted as reality shock, which can be clearly understood through these four categories (Muller-Fohrbrodt, Cloetta, & Dann, 1987):

Subjective experiences, depending on individual physiological variations, such as tension, complaints, and pressure.

Changes of behavior, which result from new teachers becoming aware of their behavior while teaching. Effective classes are associated with the behavior of teachers. Effective classroom management is helpful for reducing negative classroom behaviors and improving the engagement of students in academic tasks (Wendy W. &Teri, 2007).

Changes of attitudes. In order to respect methods of teaching, new college teachers often adjust their attitude from progressive to conservative.

Changes of Personality. New college teachers feel they must self-regulate their emotions and alter their personalities to appear as more stable and reliable.

Besides that, beginning teachers were less aware of cues and less able to respond to student problems spontaneously than other experienced teachers. However, new college teachers are very sensitive to their student's behaviors, which can often interrupt their original teaching plan.

There are several factors behind the "reality shock" of new college teachers. The first factor is that new college teachers often have no training foundations before they are employed. The second reason is that they are lacking in specific job training. The last reason is because they are not familiar with the content of the courses they will be teaching(Conversation & Darling-Hammond, 1988)

Regarding the changes in behavior aspect of reality shock, one study found that 57% percent of new teachers shifted from student-oriented educating behaviors to more autocratic or dictatorial behaviors (Mccroskey & Andersen, 1976). The behaviors were mainly apparent in their classroom management strategies. As the matter of fact, new teachers have great difficulty controlling and managing their classes in an effective way. One major feature of effective classroom management depends on the teacher's ability to

include compliments and encouragement in the class. Compliments from teachers are the most effective method for classroom management when they are behavior specific (Flanders,1961). In fact, behavior-specific praise does not require much effort, and teachers should choose to physically implement it during class time. In addition to that, performance feedback is another efficient method and useful tool for teachers to improve classroom behavior.

Regarding the changes in attitude associated with reality shock, novice college teachers tend to adopt conservative instructional behaviors due to the influence of instructions they are given, working situations, co-workers, and supervisors.

Table 1. Summary of the Results: The 24 Most Frequently Perceived Problems of Beginning Teachers

Rank order[a]	Problems	All studies ($N = 91$)			Elementary level ($N = 28$)			Secondary level ($N = 27$)			Elem. & secondary ($N = 36$)		
		Freq.	Med.	Q	Freq.	Med.	Q	Freq.	Med.	Q	Freq.	Med.	Q
1	Classroom discipline	77	13.0	1.4	22	12.3	1.4	23	13.5	1.3	32	12.5	1.5
2	Motivating students	48	12.8	1.9	11	12.0	2.5	16	14.0	1.5	21	12.0	1.8
3	Dealing with individual differences	43	13.0	1.5	15	12.0	1.3	12	13.8	0.5	16	12.0	1.5
4.5	Assessing students' work	31	10.0	2.0	9	9.0	2.5	8	9.0	2.7	14	10.5	2.3
4.5	Relations with parents	31	9.0	3.5	11	11.5	2.5	4	6.0	1.8	16	9.3	3.9
6.5	Organization of class work	27	12.5	2.8	10	12.8	3.4	2	13.8	0.3	15	11.0	2.3
6.5	Insufficient materials and supplies	27	11.0	2.5	9	13.0	1.8	6	10.5	2.5	12	9.3	3.3
8	Dealing with problems of individual students	26	12.5	1.5	7	11.0	1.3	8	13.0	1.6	11	13.0	1.0
9	Heavy teaching load resulting in insufficient prep. time	25	12.0	2.3	6	12.5	1.8	7	10.0	2.5	12	12.0	2.1
10	Relations with colleagues	24	8.0	3.0	6	9.3	3.4	8	10.5	3.4	10	6.0	2.3
11	Planning of lessons and schooldays	22	11.8	2.6	6	11.3	3.4	4	12.5	1.6	12	11.8	3.6
12	Effective use of different teaching methods	20	12.0	3.6	5	12.5	5.1	6	11.5	2.3	9	12.0	2.6
13	Awareness of school policies and rules	19	11.0	3.0	6	10.5	4.7	5	13.5	3.5	8	11.0	1.9
14	Determining learning level of students	16	10.5	2.8	3	13.0	2.8	6	9.0	2.7	7	11.0	3.3
16	Knowledge of subject matter	15	11.0	1.5	5	11.0	2.1	5	11.0	1.6	5	8.5	2.0
16	Burden of clerical work	15	9.0	1.8	4	11.0	2.3	1	7.0	—	10	9.0	1.4
16	Relations with principals/administrators	15	9.0	3.0	4	8.5	3.3	4	8.5	3.1	7	9.0	3.5
18	Inadequate school equipment	14	11.0	2.6	6	10.5	3.5	2	11.3	0.8	6	11.0	3.1
19	Dealing with slow learners	13	12.0	1.4	3	11.0	4.0	6	12.0	1.7	4	13.0	1.8
20	Dealing with students of different cultures and deprived backgrounds	12	9.0	2.6	3	3.0	4.0	2	9.0	0.0	7	9.0	2.5
21	Effective use of textbooks and curriculum guides	11	8.5	3.5	3	6.5	5.5	2	14.0	1.0	6	7.8	2.4
22	Lack of spare time	10	11.0	2.3	1	5.0	—	2	11.0	1.0	7	11.0	2.3
23	Inadequate guidance & support	9	8.0	2.5	2	9.8	1.8	1	14.0	—	6	8.0	2.2
24	Large class size	8	9.5	2.4	3	9.0	3.5	0	—	—	5	10.0	2.1

[a] The rank is based on the number of times a problem was mentioned in the sampled studies (see column 1 "frequency"). The median is based on the number of scores which could range per study from 15 (for the problem that ranked number 1) to 1 (for the problem that ranked number 15). Med. = median, Q = semi-interquartile.

In addition, the above table shows more specific perceived problems of beginning teachers from various perspectives and at several levels of education. The major issues

center on classroom discipline, motivation of students, assessment of student work, organization of class work, and insufficient materials and supplies.

In summary, novice college teachers have many concerns about class control, the sufficiency of the class content, and how to interact with students.

2.2 Class Preparation among Beginning College Teachers

There are different levels of preparation among beginning teachers that can be placed in three categories: extensive, some, or little. Beginning teachers have received extensive preparation if they have finished approximately ten or more weeks of teaching practice. The percentage of novice college teachers who have received extensive preparation is 75%. The category of some teaching preparation refers to a training practice period that is about five to nine weeks long. Twenty-nine percent of new teachers have received this level of teaching preparation. The category of little teaching practice refers to no training practice having been completed. The percentage of beginning teachers who are without any training is about 26%.

Amount of Teacher Preparation

Extensive   Some   Little/None

Teach assigned subject matter[a]
- Extensive: 72
- Some: 61
- Little/None: 49

Select curricular materials[a]
- Extensive: 72
- Some: 62
- Little/None: 43

Plan lessons effectively[a]
- Extensive: 79
- Some: 62
- Little/None: 55

Use a variety of instructional methods[a]
- Extensive: 71
- Some: 56
- Little/None: 36

Assess students[a]
- Extensive: 75
- Some: 62
- Little/None: 62

Handle classroom management
- Extensive: 60
- Some: 47
- Little/None: 52

Use computers in instruction
- Extensive: 38
- Some: 34
- Little/None: 35

0 30 40 50 60 70 80 90

Percentage of Well-Prepared Special Education Teachers

FIGURE 2. Percentage of beginning teachers in *special education* who reported being well prepared in each of seven categories of teaching capability by amount of preparation. [a]For five of the seven teaching capabilities, the differences among the three amounts of teacher preparation were statistically significant at the $p < .001$ level, or greater. *Data source:* The 1999–2000 Schools and Staffing Survey, NCES, USDOE.

Figure 1. Percentage of Well-Prepared Special Education Teachers

The figure above shows the percentages of novice teachers at the three levels of preparation listed above regarding their performance ability in different categories. It

shows that 55% of novice teachers could not plan lessons effectively and 62% of novice teachers could not assess student effectively (Erling & Shin, 2007)

To be more specific, teaching preparation consists of the following components: selection and adaption of class materials; educational psychology of coursework; observation and study from other experienced teachers; reception of suggestions and feedback from their class.

In addition, there are many factors that influence the preparation of novice teachers, such as knowledge of the teacher's emotional state and psychology.

Emotions act as an essential part of teaching and preparation for novice teachers. Usually, there two different kinds of emotions: positive emotions and negative emotions. From the psychological perspective, a positive emotion is defined as a feeling of satisfaction when people are working toward a goal. It is significant for teachers to prepare their class emotionally with pleasure. When teachers mention joy, pleasure, and satisfaction during the class, students can learn better and make more progress than normal. (Emmer, 1994; Hargreaves, 1998)

Concerning negative emotions, novice teachers often experience anxiety (Bullough & Erb, 2002) due to being responsible for the achievement of uncertain goals and the complexity of teaching. These negative emotions could result in a sense of helplessness for teachers(Mccroskey & Andersen, 1976) (Kelchtermans, 1996). Thus, negative emotions have an influence on the efficiency of novice teachers' class preparation.

There are several psychological factors that have an effect on the class preparation of novice teachers. Behavioral communication, which is defined as a kind of construction of psychology, has an effect on the individual's dissimilarity in place of more open and

an increased level of communication. Specifically, communication behavior means that the feeling received from an expression is influenced by indirect messages and behavior (Flanders,1961)

Regarding the communication behavior of beginning teachers, there are several kinds of factors and effects, including class environments, individual characteristics, limitations, resources, etc. This report argues that "what happens to the beginning teachers during their early years on the job determines not only whether they stay in teaching but also what kind of teacher they become" (McDonald, 1980; Adelman 1991). When the new teachers start their career life, join a school's faculty, and start teaching and learning lessons, they can only learn the experience and skills by themselves, as well as with the help of colleagues and students. This is a result of the resources and environment being relatively limited. And based on the report, unfortunately, the newest teachers only learn those lessons by themselves or with the help of their colleagues, which shows that currently 50% of new teachers are not participating in an induction training program (U.S. Dept of Education, 1999).

One of the reasons behind this situation is that the cost of teacher induction is high. This leads to almost one half of new teachers being lacking in sufficient training. Beginning teacher induction plays a significant role in the schooling situation; it helps the beginning teachers learn how to communicate and teach. There are several meanings to draw from this. First, induction is the first major milestone of beginning teachers; through this training opportunity, beginning teachers start to learn how to conquer teacher anxiety and nervousness, and sometimes they learn about how to control a class and deal effectively with different students. Second, effective induction gives beginning teachers a

time period of transition to move from preparation work to actual practice. The beginning teachers through practice can learn how to integrate messages, how to deliver the key information, and how to collect information in a limited time period. By intuition, beginning teachers through the induction training learn and enhance their communication and education abilities (McClellan, 1976).

In summary, there are many factors that have an impact on the class preparation of novice teachers. In the following sections, specific approaches will be discussed and proposed.

2.3 The Usage of Mobile Technology between Teachers and Students

This section concentrates on exploring a positive connection of communication behaviors between the beginning teachers and students with mobile technology. The objective is to investigate the application of data visualization in mobile technology among college students and new teachers.

Mobile phones, iPads, and laptops have become a prevalent personal items in recent years. "Now, the mobile technology starts with overtake the proliferation of personal computers in the modern professional and social context" (Attewell, Great Britain, & Learning and Skills Development Agency, 2005). Mobile technologies provide human communication, socializing and entertainment (Herrington, 2009). The basic functionality of electronic products is improving continuously, so mobile devices can now not only achieve basic functions but can give access to new possibilities. Besides that, there are many benefits from the use of mobile technologies by educators to manage students, provide course materials, review student assignments, and interact with students (Peter, 2005).

In the conventional education method, all of requirements, handouts, announcements, and notifications were produced as physical papers. However, with the development of technology, more and more advanced methods and forms are being developed, which leads to a more flexible and varied education method.

With the constructivist method, learners set up new concepts based on their experience and knowledge from before to now, which is an active learning process: "Learners are encouraged to be active constructors of knowledge, with mobile devices now embedding them in a realistic context at the same time as offering access to supporting tools" (Naismith, Sharples, Vavoula, & Lonsdale, 2009)

From the background of mobile learning view, there are now classroom response systems such as "Class-talk"(Beatty, Gerace, Leonard, & Dufresne, 2006). Now, learning and educating have a close relationship with new technologies; in other words, the new technologies are familiar to both the teachers and the students. Both can access information easily, and during class students can take photographs to take class notes, or record their thoughts in text, audio, or video to share with others (Naismith, 2009)

In conclusion, the application of mobile technologies has a great impact on educating and learning. The tendency of learning today is to move outside of the classroom. However, the most challenge part is "how to explore the mobile technologies to transform learning into a seamless part of daily life to the point where it is not recognized as the learning at all" (Mike, 2005).

2.4 Augmented Reality in Education

Augmented reality involves the integration of digital information and environment in the real time "In an AR interface, the user views the world through a handheld or head mounted display (HMD) that is either see-through or overlays graphics on video of the surround environment"(Shelton, 2002). Augmented reality could enhance real world experience based on the fact that it supports a sense of reality.

The usage of AR technology could be very comprehensive; it covers lots of subjects in the education area. For instance, math lessons could take advantage of AR technology in geometry; for the chemistry class, AR technology could be utilized to display molecular structures (Billinghurst, 1999). Furthermore, these subjects could be taught in an interactive and playful way by using augmentation.
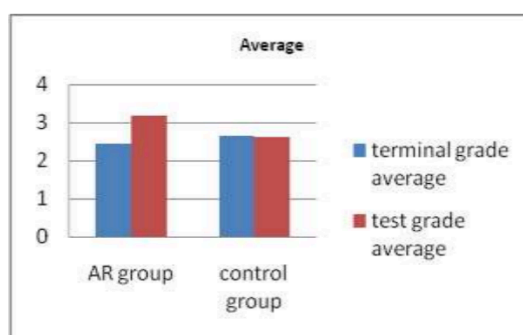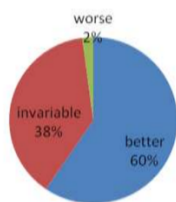

Figure 11.: Test's result in two group

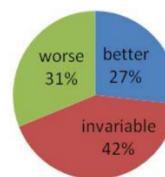Figure 12.: Test's result of AR group compared to average of chemistry

Figure 13.: Test's result of control group compared to average of chemistry

Figure 2. Test's result of AR in two groups

The graph and charts above show the results of a test between an AR group and a control group. The AR group used AR technology during chemistry class in one semester. The graph shows the average grade between these two groups. The second figure demonstrates the quality of class notes in both groups. Finally, the results show that members of the AR group have better grade outcomes than the control group. This illustrates that using AR technology in education could be a very practical and effective method for improving the quality of education and education outcomes, since AR technology supplies a virtual perspective for users to understand concepts better.

CHAPTER 3. METHODOLOGY

This section focuses on exploring the target users' needs and expectations at the beginning of their teaching careers and how to enhance the quality of their classes, and concentrates on users' need at different stages. I tried to use both qualitative and quantitative approaches.

The process of data collection contains five different phases. In the first phase, I conducted user interviews and distributed a questionnaire survey to collect the data. In the second phase, in order to analyze the data, I created an affinity diagram to organize data and identified different categories. During the second phase, I tried to identify the highlights, user needs, and user expectations. The third phase concentrates on the user journey map and business canvas model design, which aim to identify the touch points and opportunities. The fourth phase focuses on the creation of the design process based on the problem identification and suggestions to design the Hierarchical Task Analysis (HTA)(Tognazzini, 2014). The fifth phase is the heuristic evaluation, which focuses on evaluation of the current design outcomes.

3.1 Structured Methods: Interviews and Questionnaire

"Structured questionnaires and semi-structured interviews are often used in mixed method studies to generate confirmatory results" (Harris & Brown, 2010). In order to identify the user's need, expectations, and pain points, the structure methods focus on the collection of both quantitative and qualitative data. Nevertheless, quantitative data and qualitative data have their own strengths and weaknesses. For instance, the weakness of

the questionnaire is that responses are limited to fixed answers to questions, but the strength is its low cost and that it is suitable for reaching a large number of people simultaneously. In particular, another issue is that many subjects tend to remain anonymous, so the questionnaire could offer the opportunity for them to express their controversial opinions. In terms of the interview and observation aspect, the benefits include nonverbal data collection and the flexibility of questions, since oral responses involve much more information than text-based responses. Another benefit is with the leading of interviewers; they could develop more questions to get different levels of responses from subjects. Thus, questionnaires and interviews come with their own features and disadvantages.

"Questionnaires and interviews are often used together in mixed method studies investigating educational assessment"(Elyas & Grigri, 2014). By integrating the questionnaire and interviews together, I conducted the face-to-face interview for the target audience group and an online questionnaire survey. The target audiences are the core part during the process of the individual interviews. The interview is audio-recorded, with the interviewees' consent. During the recorded individual interviews, I also took notes and observed their reactions. Depending on their facial expressions and body language, I decided to give follow-up questions or switch to another level. Due to the format of the interview, I could modify the questions based on the situation of interviewees. The basic detailed questions of the interview are demonstrated in chapter 4.

The quantitative data collection is from the online questionnaire, which included general demographic problems and open questions. In order to make the responses more diverse, I designed 10 questions with different directions to understand the concerns and

behaviors of novice college teachers. Moreover, another strength of the online questionnaire website is that it gives me some related resources to help me understand how to design effective questions.

3.2 Methods of Data Analysis

The methods of data analysis could be defined as an approach to categorizing ideas, solutions, and problems and emphasizing the significant information. I used an affinity diagram to organize the qualitative data from the questionnaire survey and interview responses. It helps me to deal with large amounts of information by partitioning them into logical groups (Harris & Brown, 2010). The advantage of using an affinity diagram is that it is easy to access and can deal with amounts of data by a simple operation. Basically, affinity diagrams include three steps: (a) record ideas on sticky notes; (b) check the related ideas; and (c) sort notes into different groups. Based on the results of the data organization, the data can be identified into different groups with different categorizations. I could find more design opportunities through the final categorizations.

3.3 Methods of the Design Process

The methods of the design process are based on human-centered design, which is an approach to supporting different solutions and opportunities that are aimed at user needs, behaviors, and backgrounds. The primary goals of human-centered design are centered on designing for user-friendliness and effectiveness.

Human-centered design involves three stages: brainstorming, ideation, and prototyping. The first stage is the brainstorming stage, which could be identified with a process to generate innovative ideas and creative solutions. The second stage is ideation. During this stage, I developed some representational ideas from the first stage into more mature concepts. The third stage is prototyping. I created a Hierarchical Task Analysis (HTA) and information architecture to understand user tasks and the system structure. "Architect as in creating of systemic, structural and orderly principles to make something work" (Baker, Greenberg, & Gutwin, 2001). Hierarchical Task Analysis and information architecture allowed me to thoroughly understand the different directions of users' issues. Moreover, I created a low-fidelity wireframe to demonstrate the basic functions and the relations among different pages. After that, I designed a business model canvas (Chesbrough, 2010) to illustrate how the system would be implemented in the industry.

3.4 Method of Heuristic Evaluation

Heuristic evaluation (Nielsen & Molich, 1990) is used by evaluators "for finding usability problems in a user interface design by having a small set of evaluators examine the interface and judge its compliance with recognized usability principles" (Muree Allen, 2005) (Nielsen & Mack, 1994). The benefit of heuristic evaluation is that it is low-cost and easy to access. Each problem is identified with corresponding principles, mostly in the early stages of design. Thus, after the problems were identified by evaluators, I could modify the design promptly. Moreover, it is beneficial for me to find the major and minor problems basic to the seven problems rating and design principles. Furthermore, heuristic evaluation requires experts who have knowledge or experience to finish the

evaluation, so the results of the evaluation are valuable in some degree. In general,

heuristic evaluation tends to explore different kinds of issues throughout the system.

CHAPTER 4. USER RESEARCH

4.1 Data Collection: User interviews and Questionnaire Survey

The purpose of the user interviews and questionnaire survey is to collect the information from the new college teachers from different angles. I chose the mode of one-on-one interviews instead of multiplier interviews since one-on-one interviews are more efficient and intuitive. I interviewed different new college teachers directly to incorporate different opinions. After the user interviews, I conducted the questionnaire survey. In this section, these questions become more clear and specific. Finally, I organized the results of the survey to learn more about the factors impacting interviewers' choices. (Figure 3)

Questions	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
How long about your teaching experience?	2 months	1 month	2 months	1 month	10 months
How many classes do you have? (per week)	3 classes	2 classes	3 classes	2 classes	2 classes
How long about each class?	2 hours/per class	3 hours/per class	2 hours/per class	1.5 hours/per class	2hours/per class
Do you satisfied with the current way of your teaching?	Not very satisfied; hard to know the achievement students	Still need time to explore	Not really, hard to find "methods"	Not satisfied; It is not optima	Just so so, still can improve a little bit
How is the feeling when you teaching students at the first class?	Nervous; can not adjust the phenomenon of class immediately	A little bit shy;	Anxious; overwhelm; shy; lack of confidence	Don't know how to control a class	Unconfident; Super nervous; the voice was shaking
How do you prepare your class?	Search resources through internet	Ask for help from coordinator or senior teachers	Look up the class content before the class begin	Ask for other co-workers help to organize information	look back to other teachers; get experience
What kinds of way you usually use in your class to active students?	Organized some small class activities	Assign a group; give other suggestion as a part of final grade	Keep remind them participation is one of part of grade	Create some small activities or interactions	Get them involved in the class, work together and talk each other, pair activity

Figure 3. The results of the interview

Figure 3 continued

Will you usually ask other co-workers help?	Definitely yes	Yes, usually need ask others help	Sometimes	Frequently	Frequently
For your perspective, what is the difference between new teachers and senior teachers?	They are more skillful and more familiar with class content	Hard to find out which part is useful to students; Not sure how to pick out the important information	Senior teachers are more experienced; they know the work flow, they could handle it very well; they know the common questions in the class	Specific purpose; what kinds of information is important	New teachers do not understand their teaching materials thoroughly
Which part do you think is the hardest part during the process of teaching?	How to check the achievement of students	How to inspire the subjectivity to creativity of students	Deal with student's questions well, do not give wrong information; how to be more professional	Feedback part is the most difficult thing; Students attitude	Sometimes students ask questions but you do not have any answers in your mind
Do you have any preferred apps to assist your teaching?	Google class; Blackboard	Blackboard	Blackboard; Slack	Blackboard	Groupme
If yes, which part that you think is the most useful?	Assign grade and student could discuss	Share resource to students; Create a platform for students to discussion	Different channels to divide different information	Lots of functions; Send announcements to students	Convenient to communication among peers
What kind of functions you would expect to add in the existing app?	Give some reminders or tips during the class	Examples share video; Class video	Organized students, improve the phenomenon of class	Look up the video of other teachers	Easier to share resources to other teachers

The process of conducting the user interviews and questionnaire survey contains three stages. The first stage is an individual face-to-face interview. During the interview, I used an audio recorder to document the information. The questions are mostly focused on demographics. Through these basic questions, I tried to identify problems and understand the user's needs. In total, I have five subjects: two of them are new teaching assistants, and three of them are new teachers. Each interview took about 30-45 minutes. The location was in the individual meeting room because the environment is more professional and quiet. The interview questions are paper-based. I printed several copies of the questions out and took these physical copies to the meeting room. What's more, this interview involves face-to-face communication, so I documented notes and recorded the conversation during the different stages to make sure each part had been covered. The interview questions covered different aspects as follows:

1. How long about your teaching experience?

2. How many classes do you have (per week)?

3. Did you satisfy with your current teaching methods?

4. How was your feeling when you first time taught the class?

5. How did you prepare your class?

6. Which part do you think is the hardest part of your teaching process?

7. What kinds of way you usually used in your class to active your students?

8. Will you usually ask your colleagues for help?

9. What is the difference between the new teachers and experienced teachers?

10. What are your expectations of class?

11. What kinds of apps or products did you prefer to use?

12. Pros and cons of the existing products?

The goal of this stage is to better understand the interviewees, because different interviewees have a variety of opinions and experiences.

The second stage focuses on their teaching experience, feedback from teaching, class preparation, expectations, comparisons, and teaching methods. The purpose of this section is to learn more about their experiences and reactions during their teaching career.

The third stage focuses on the semi-structured online questionnaire survey, which was distributed through Survey-Monkey. The questionnaire survey concentrates on a comparison of the peer products. A total of eighteen new teachers and teaching assistants from Purdue University responded to the questionnaire during two and half weeks. The age group of respondents ranges from twenty-five to thirty-five. Additionally, the respondents include eight males and ten females, fourteen respondents are new college teachers, and four are new teaching assistants. (Figure 4)
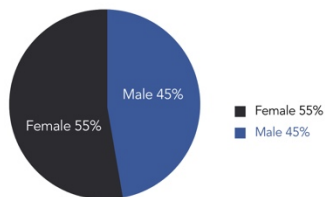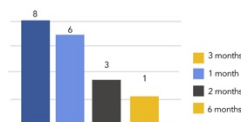
Figure 4. Results of a questionnaire survey
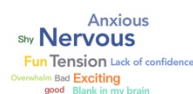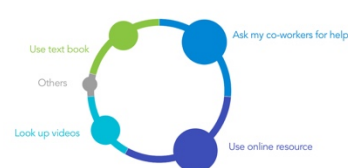
Most respondents felt nervous and anxious in their first class. Also, the teaching experience of respondents differed. Eight respondents have two months of experience, six respondents have only one month of experience, three respondents have two months of experience, and only one respondent has more than six months of experience. The favorite activity to motivate students in their classes is the group work activity. In addition, four kinds of apps are prevalent among the beginning college teachers: Blackboard, Moodle, Google Classroom, and Remind. The most useful feature among these apps is resource collaboration. After that, the most frequent approaches to prepare for the class are using online resources and asking co-workers for help. Furthermore, the expectations for the current apps include adding reminders and tips during the class, and sharing resources and communicating with other coworkers.

4.2 Data Analysis

The purpose of data analysis is to determine the design focus and user requirements. In general, the data analysis involves three stages: transcription, affinity diagraming, and sorting the results into groups.

First, I transcribed the results of the user interviews in Excel. Through their comments from the interviews, I tried to organize these key points into different categories. I also transcribed their answers from the audio recordings in the same way.

The second stage uses the method of affinity diagraming (see Figure 5: Affinity Diagram). I used colorful sticky notes to help me organize the data efficiently. I chose the highlights from the transcription stage. After that, I transferred these highlights to sticky notes, then posted the results on the board and sorted these notes into different categories. Different colors represent the opinions of the five interviewees.

Figure 5. Affinity diagram

Finally, Figure 6 identified trends and sorted the results into six groups according to frequency, feedback, functions, and teaching methods.
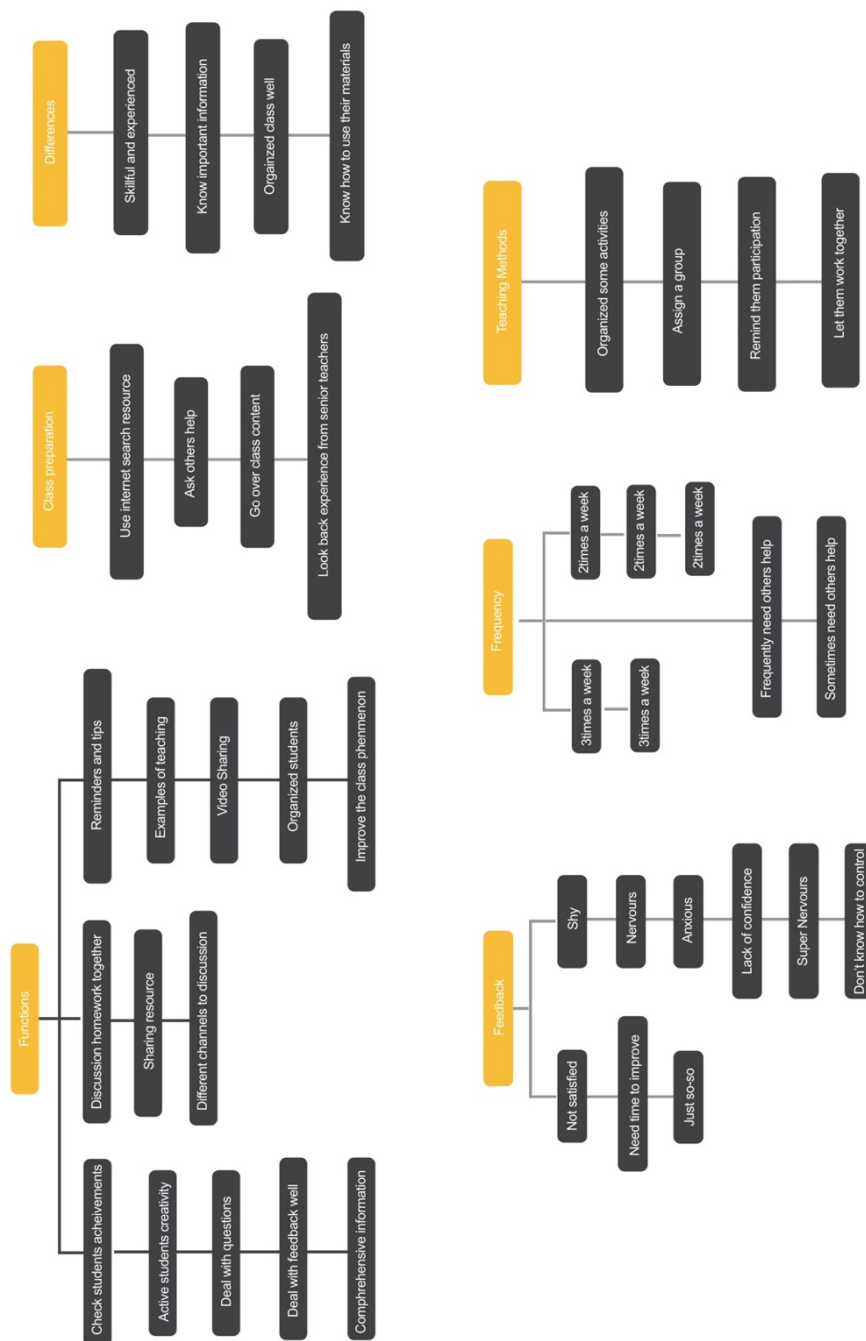

Figure 6. Data categorization

4.3 User Modeling

Based on the results of qualitative and quantitative data, I created persona and storyboards to depict the target audience. Basically, each persona contains five aspects: basic demographics (age, education level, family status, etc.), goals, frustrations, motivations, and personality. In the personae, I tried to represent the major needs and expectations of the target groups. (Figure 7) The purpose of the personae is to create an overview of users' backgrounds, functionalities, and highlights. In addition, personae help me to ensure the design is appropriate for the target users. Finally, I organized the user demographic information into a logical format.

BIO

Lily Lee is a master student at a public University. This semester, she is a novice teaching assistant in one classes. Usually, she has three sections per week. Each class will take 2 hours and 45 minutes. Every time before the class, she usually have a meeting with other co-workers and supervisor. During the meeting, she always take notes and ask others advices and tips. During her class, she is willing to answer different questions from students. After class she tends to arrange and assign assignments on time.

"Teaching is a part of my life"

Lily Lee

Age: 29
Gender: Female
Occupation: College Teacher
Location: West Lafayette, IN
Marital Status: Single
BMI Classification: Normal

DEVICE IN USE

- Mobile phone
- Apple Watch
- Computer

GOALS

- Improve the atmosphere of class, more actively
- Improve the quality of class preparation
- Plan a better class content
- Get tips and reminders in real-time

FRUSTRATIONS

- She tries to activate the class atmosphere, but the feedback from students always so-so.
- She feel exhausted, because she spends a lot time to prepare class.
- Hard to collect all of the resources of the class.
- Hard to critique students work.
- Difficult to organized the class information

MOTIVATIONS

Attracted by new technologies

Efficiency of mobile application

Easy to use and portable

PERSONALITY

Extroversion

Neuroticism

Conscientiousness

Agreeableness

Openness to experience

Figure 7. Persona

According to the information of each persona (Affairs, 2013), I designed a

storyboard based on graphics. "The storyboard form as it is known today was developed

at Walt Disney studio" (Krasniewicz & Disney, 2010). The purpose of the storyboards is

to understand the interaction between products and users. It is beneficial for designers to

illustrate what their interface would do and how it performs to target users(Reinke,

Lewis-Palmer, & Martin, 2007). Moreover, it is to the advantage to figure out the flow of

users' experiences. I divided the whole process into three sections corresponding to

before, during, and after the class. In each section, sketches are included to pre-visualize

the sequence of users' experiences and actions. (Figure 8)
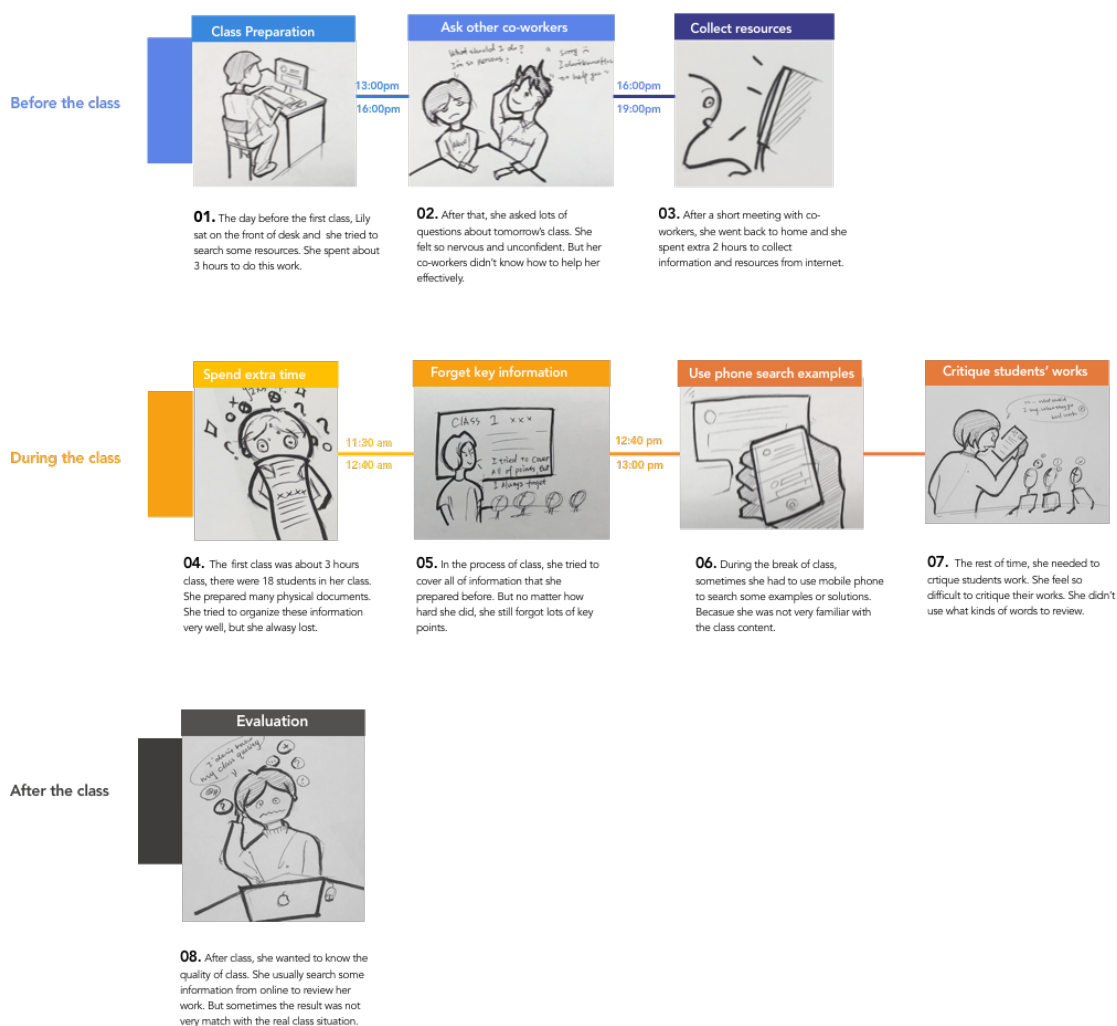
Figure 8. Storyboard

After making the storyboard, I understood the user's experience in different stages. Based on the results and the data of previous research, I tried to design cross-media channels of a user journey map to visualize the user's behavior, touch-points, feelings, opportunities, and experience. (Figure 9)

The user journey refers to a series of steps to perform the scenario and demonstrates the possibilities of interaction between users and products. The user journey map contains both the positive and negative emotions of users. Also, it helps stakeholders to understand users' needs and behavior. Furthermore, it is beneficial for the study to identify functions.
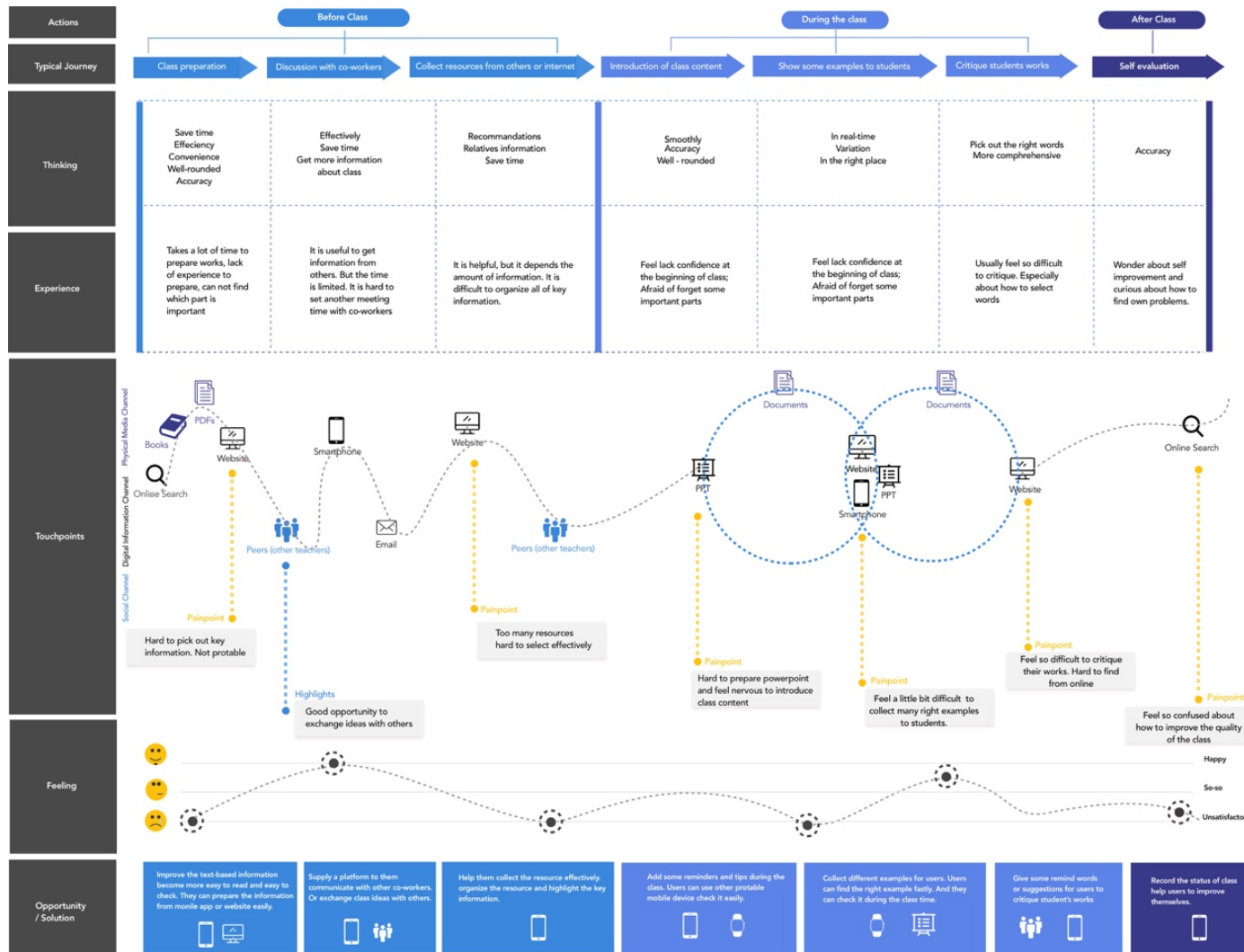
Figure 9. User journey map

I used different colors to represent the three categories and media. The categories are as follows: before the class, during the class, and after the class. The cross-media channels contain the following: the social channel, the digital information channel, and the physical channel. During this process, I discovered users' pain-points, highlights, and possibilities. In general, the main issues of the novice college teachers center on four aspects:

- Difficulty in finding out key information
- Difficulty in selecting and organizing useful information from large amounts of existing resources
- Difficulty in preparing the class content
- Confusion about how to enhance the quality of the class

4.4 Review of Existing Products

There are many apps designed for college teachers, and major focus of these apps is to help teachers manage their classes. However, it is rare to find an app that focuses on new college teachers or an app system that aims to solve the class preparation issues for beginning teachers. So here is an opportunity to add those new features and functions based on the existing resources and products.

The first existing product is Remind (Figure 10), which as a kind of communication app between teachers, students, and parents. The app is distributed by a developer based in San Francisco, CA, and is used by more than 35 million people in school districts across the U.S. This app is designed for college teachers to manage their class. In addition, it makes communication from teachers to students and their parents beyond the

classroom easy. In the Remind app, there are many functions to choose. For example, users can create announcements, group chats, or contact individual privately through the app. In addition, the messages can be translated into over 70 languages, making it possible to communicate with parents who are not native speakers.
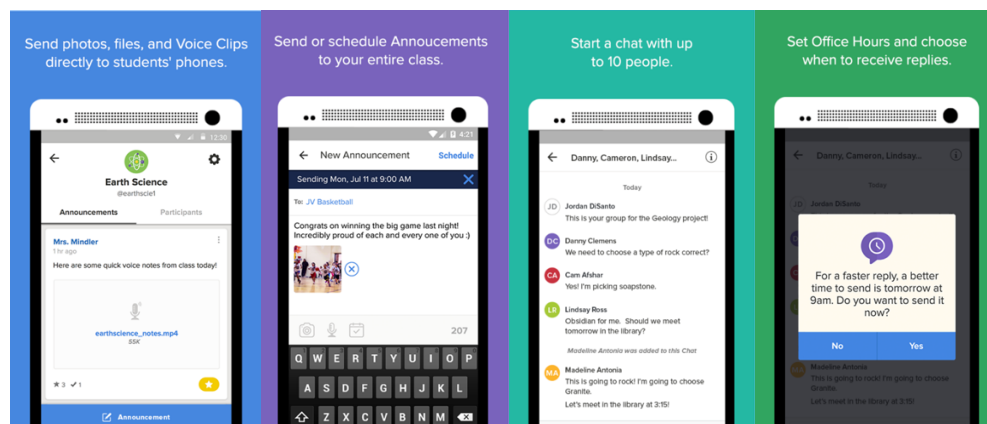

Figure 10. The interface of Remind

Apart from that, the Remind app has a very simple structure; from navigation to layouts, every step is accessible and understandable. This app also tries to re-organize and arrange all of words and information in the interface. The app has plenty of features that are very helpful and useful, such as sending schedules or announcements as pictures or sending voice documents. Those features help teachers and students use a new approach to sharing and managing information. What's more, another feature is called "start talk with more people"; this feature transfers the model of one-on-one communication to the model of multiple group communication. Through this feature, teachers can set up different communications with different students at the same time.

However, all of the announcements, schedules, and events in the app are layed out in a text-based format. Moreover, although the color scheme is visual preattentative and

easy for people to identify, it is also easy for people to lose attention when they read it or use it for a long time.
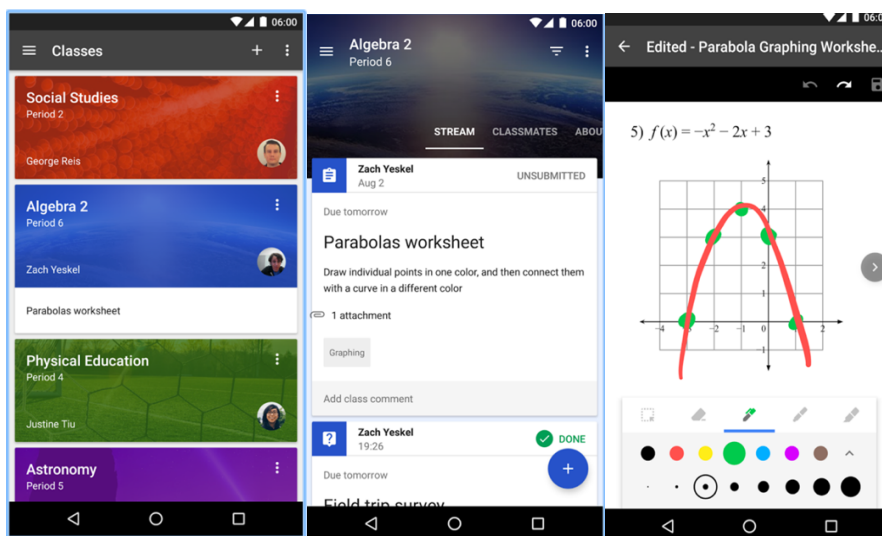

Figure 11. The main interface of Google Classroom

Another existing product is Google Classroom (Figure11), an app for people to know about the classroom. Not only can users distribute and grade assignments through the app, as well as organize all class materials and documents on Google Drive; users can also reach their students more efficiently, either to make announcements or to engage them in discussions. Compared to the Remind app, this app focuses on academic utilization and assigning tasks rather than communication between students and teachers. The most distinct feature in this app is the "graphing worksheet" function, which is helpful and visible. Through the graphic tools, regardless that it is a kind of remote environment, it still can explain and discuss work after class in real time.

Figure 12. The interface of Stick Pick

Stick Pick (Figure 12) is an app targeted at helping teachers choose from multiple and abundant methods to improve the classroom experience. Through this app, teachers can select from existing phrases to pick a student to answer the questions. The interface of this app system is simple and relatively clean because the basic functions are limited. Furthermore, this is an excellent interactive tool for encouraging teachers and all students in a class to use class time to participate. So the starting point of this design is helpful to enhance communication behaviors in the class. However, the layouts and features still use mostly text-based and list formats. As a result, it is hard for users to acquire critical information immediately since too many words are placed on the same page.
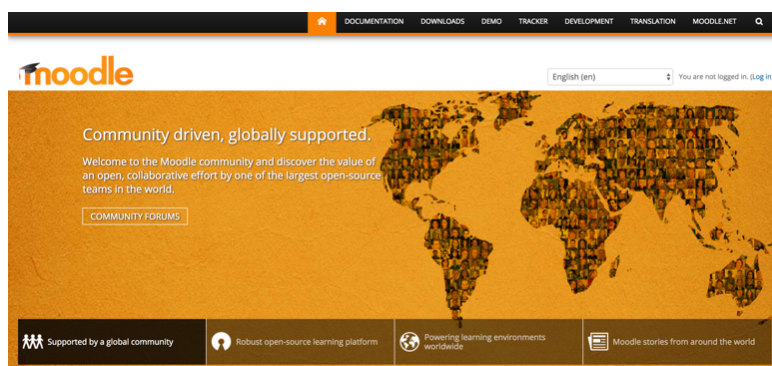

Figure 13. The main interface of Moodle

The Moodle app (Figure 13) is a global learning platform that is designed to "provide educators, administrators, and learners with a single secure and robust environment and integrated system to create a personalized learning environment" (Brett and David Kopf, 2016). The first version of the Moodle app was released in August of 2000. This app is targeted at educators from all over the world and supports more than 50 languages. The app also allows users to utilize different kinds of advanced technology to grade and assess assignments. The functionality of Moodle is powerful due to its focus on interactive and collaborative content construction. Though this app, users are allowed to create the online courses and use the app in distance education. There are plenty of functions and applications in the system, and users are allowed to search amply open sources and need to go through few steps. However, the system displays most of the information in list format, so it difficult for users to filter out unnecessary information.

The research of existing products demonstrates various applications of mobile apps between teachers and students. However, the three existing products that I have examined (see Table 2) primarily concentrate on three aspects. One aspect is that the peer product design just aims to help teachers arrange information and deliver tasks to students, for example, to create class activities or manage the class in the Remind app. Another aspect can be exemplified by the Google Classroom app, which focuses on helping teachers manage students after class, and through the app, teachers are allowed to send announcements, schedules, messages, grade notifications, and assignments to students. The final aspect is about sharing educational resources and creating an advanced education environment. Educators through the digital platform can share experiences with each other and explore more educational methods. Nevertheless, the main issue is

that for a large number of teachers who have not attended the school induction training or have no teaching experience, it is hard for them to know how to communicate behavior with their students effectively, as well as to do self-correction or self-improvement in real time. These kinds of apps, though, can help them enhance their ability to manage students.

Table 2. Pros and cons of existing products

Apps	Review	Category	Features	Pros	Cons
Stick Pick	3.2/648	Communication;	Enhance the phenomenon of the class;	1. Available on any platform; 2. easy to use; 3. phone address book synchronization	1. Can not enhance teaching skills 2. Functions are too limited 3. Interface is too simple
Remind	4.4/67016	Improve communication skills (teachers/ students/parents)	Convey the information on time; Language translate	1. Widespread messaging on time; 2. Very convenient and fast; 3. Can keep students and families connected with their schools 4. Open a new schedule; 5. Could send voice clip; 6. Update information in real-time; 7. Free download documents	1. Without mindful use it could be more enabling empowering; 2. Lack of motivations; 3. Lack of interactions during class time; 4. Students in vaping parts of the digital divide may have different access.
Google Class	4.1/42498	Class management; Distribute assignments; Send feedback;	Assign grade to your students;	1. Easy to use and accessible from all devices; 2. Effective communication and sharing; 3. Can reply feed back efficiently 4. Brief and user-friendly interface 5. Great commenting system	1. Lack of graphics; 2. Limited integration options (google calendar or others) 3. Difficult learning sharing 4. Updated can not automatically 5. Quizzes and tests can not be updated automatically as well
Moodle	4.5/43532	Facilitate learning and coloration to inspire better teaching everywhere; Resource sharing	Communication in Global scale; Open resource	1. Free download; 2. Open resource; 3. Enables administrators to add or create new features; 4. Real-time messaging	1. Hard to use; 2. Too many words in the one page; 3. Hard to pick out important information in a short term

4.5 Summary of User Requirements

In summary, through the primary and secondary research, I have documented the user requirements to identify the design goal. In the section of user requirements, it contains the user expectations and the demands of users. The features are as follows:

- Users should be able to prepare their class effectively

- Users should be able to develop teaching skills easily

- This application should support reminders or tips with the user during class

- This application should help users improve the quality of the class

- This application should connect with an external smart product

- Users should be able to use the application smoothly during and after the class

- Users should be able to collect resources efficiently

CHAPTER 5. DESIGN PROCESS AND EVALUATION

The primary and secondary research based on the pervious chapters lay a foundation for the concept of design. The design process contains six stages: defining the problem; collecting information and research; brainstorming ideas and analyzing ideas; prompting solutions with implementation; evaluating and gathering feedback and refinement. The purpose of the design process is to identify a possible functional product through development, quality, limitations, and solutions (Robbert J. Hamann, 1998). The advantage of following these steps of the design process is integrating the results and its focus on users. The design project takes advantage of the design process to boost each section efficiently.

5.1 Brainstorming & Ideation

After organizing the data from primary research and secondary research, based on users' requirements, I started the design process from a brainstorming session. The core of brainstorming focuses on the amplification of teaching experience among the new college teachers. Brainstorming helps to find more possibilities from different directions.
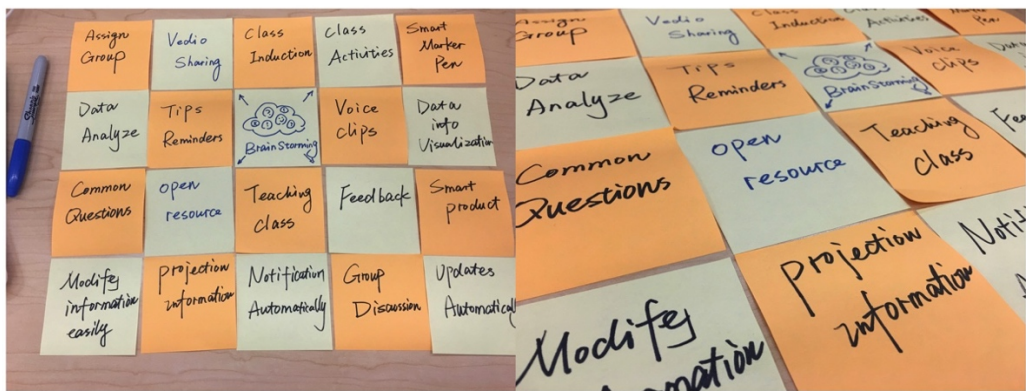
Figure 14. Brainstorming

The brainstorming session, as indicated in the image above (Figure 14), consists of two steps. The first step is to identify some keywords from different perspectives. These keywords tend to cover multiple possibilities that aim to enhance the teaching experience. The second step is sketching with different ideas. The brainstorming outcome combines the mobile application with an external portable device.
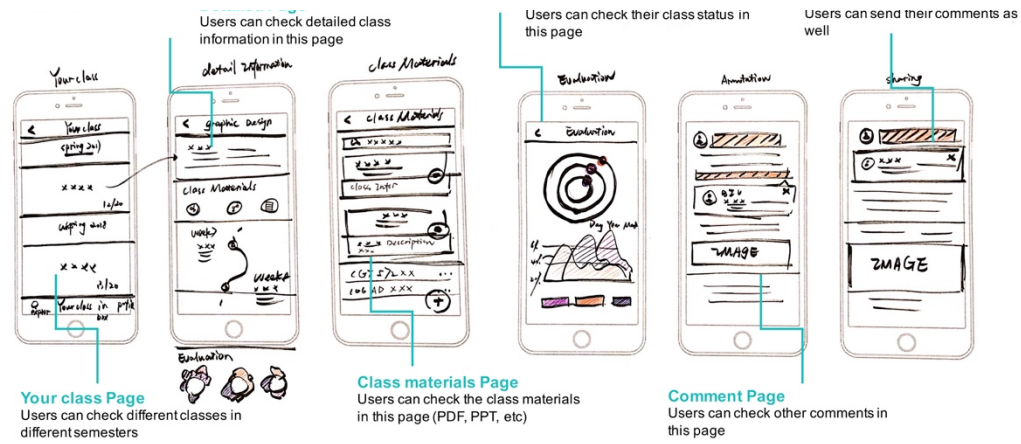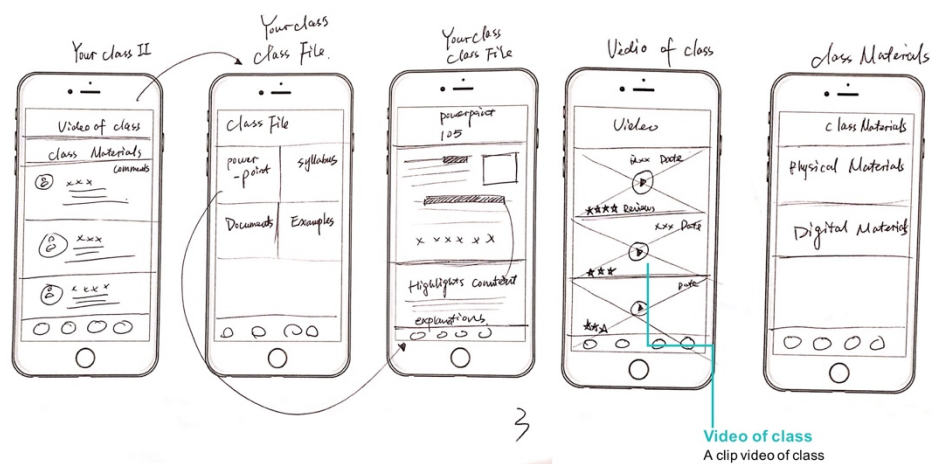

Figure 15. Ideations

Figure 15 continued

The images (Figure 15) above show how the first concept of mobile application

concentrates on resources collaboration for novice college teachers. Users could collect

resources from other experienced teachers, or they could share their individual resources

with other co-workers. The design supports ways for users to be more open to others'

resources, thereby encouraging sharing of varied resources. After the collection of these

resources, users could manage or update their individual resources effectively. The

objective of the concept is to help users prepare for class better, with a brief release of

tension.

Another concept associated with the mobile application focuses on self-evaluation of

new college teachers. The main purpose of this concept is for new teachers to understand

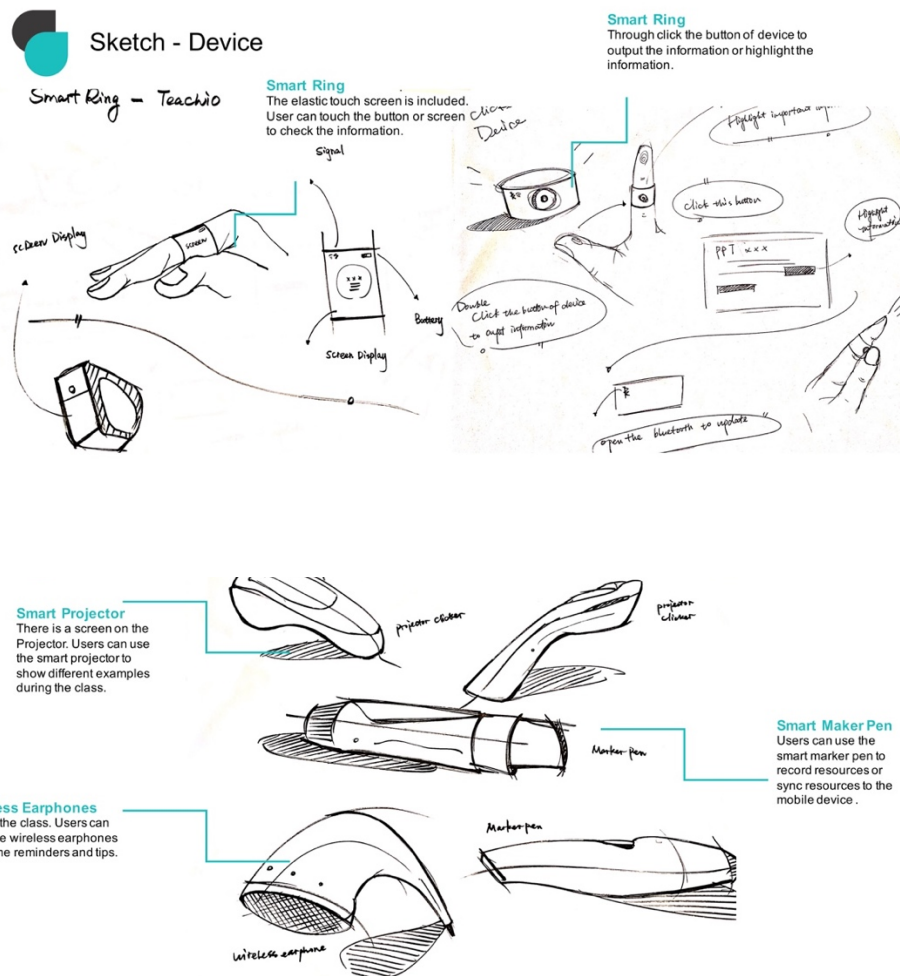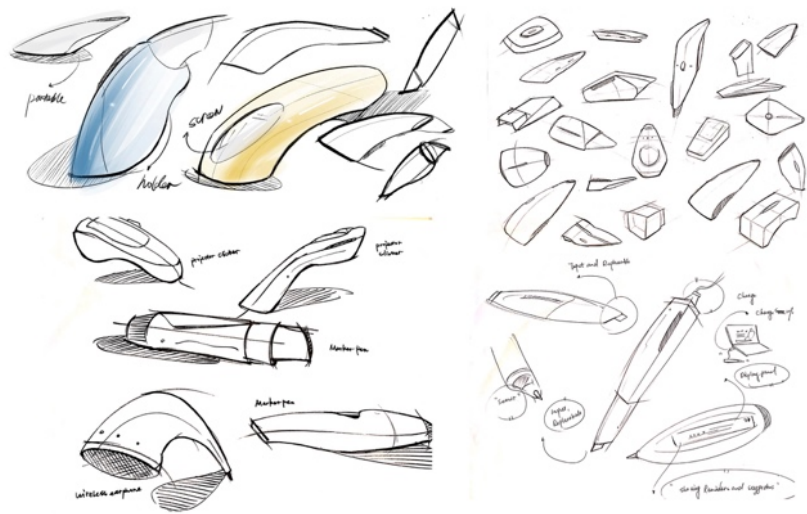themselves and enhance their classroom effectiveness.

Figure 16. Sketches

Figure 16 continued

The external mobile device (Figure 16) depicted above is one part of the design. This device could link to the app via Bluetooth. During class, users could use the app to link to the device. Based on user requirements, they need reminders, notes, and audio recordings during class. Through the external portable device, users could display or record the information effectively.

The first concept of the device is a smart-pen with a projector which is portable and saves space. Users could synchronize the information from the app to the smart pen via Bluetooth, then project essential information during class. When users write down the notes with the smart-pen, the information could be synchronized with the app as well. So, it is advantageous for new teachers to organize valuable information this way.

The second concept focuses on a portable projector with augmented reality technology. When users link the device to the app, the projector could project the information onto nearby surfaces. Users could then select examples and notes to display, or they could record some critical notes. The information will then be synchronized with

the app in the real time. Using this device as the second concept provides users with needed reminders, essential notes and recording, during class.

5.2 Information Architecture

Information Architecture (IA) helps users identify "where they are, what they have found, what around and what to expect" (Peter Morville, 2012). IA has four main components: organization structures and schemes, labeling systems, navigation, and search systems.

I created an IA for labeling, structuring and categorizing the content in a sustainable way. The objective of IA is to help users understand information so they can finish the tasks. Additionally, it helps users to know how each composite item relates to each. The structure of IA is shown in the figure below (Figure 17).

5.2.1 Heuristic Evaluation

Moreover, based on data from qualitative and quantitative research, as well as user requirements, I created the Hierarchical task analysis (HTA) to categorize the different tasks of the design. It is an effective way for me to organize the functions of the product, as well as the interaction between the users and the product. The structure of the Hierarchical task analysis is shown in Figure 18:
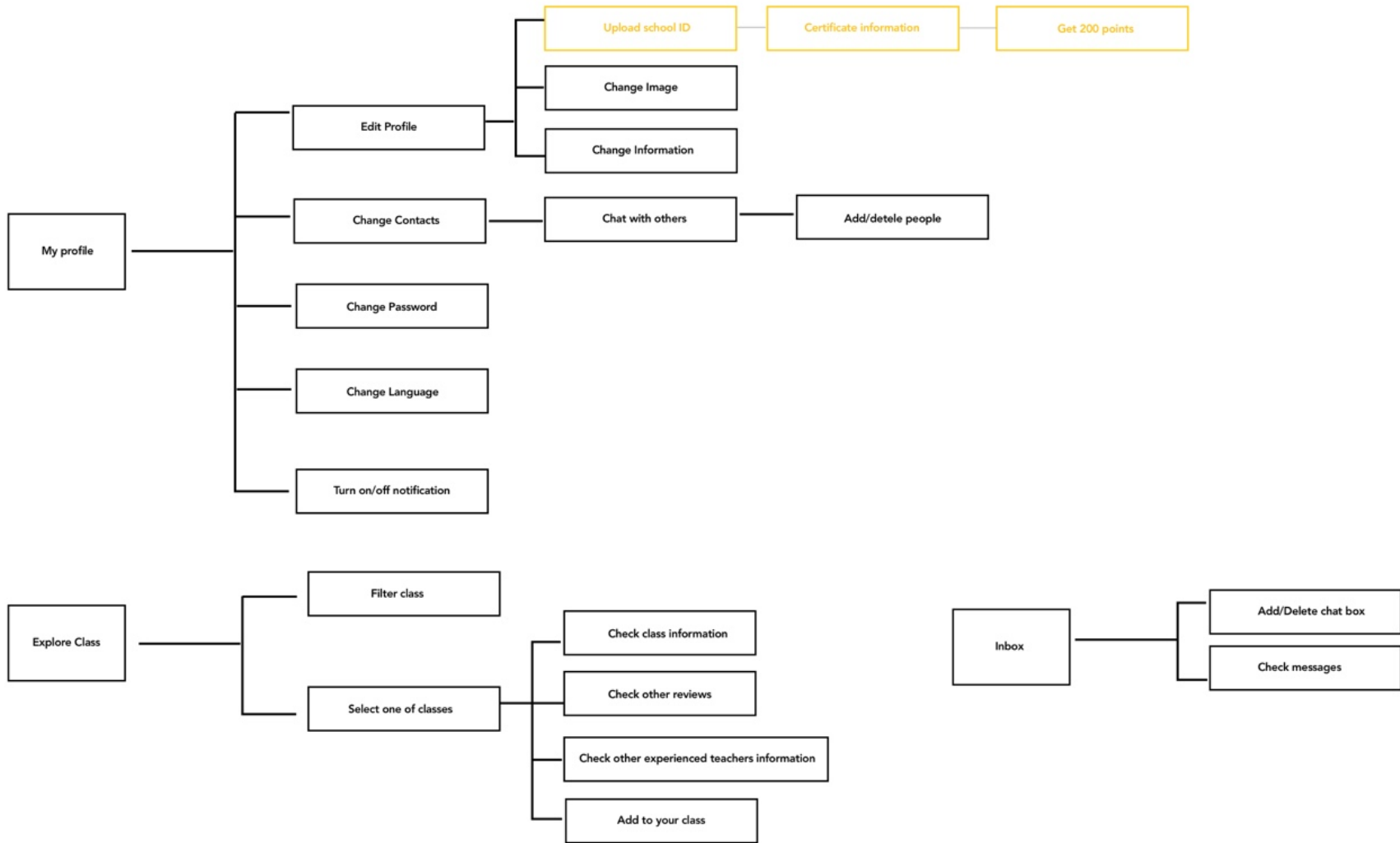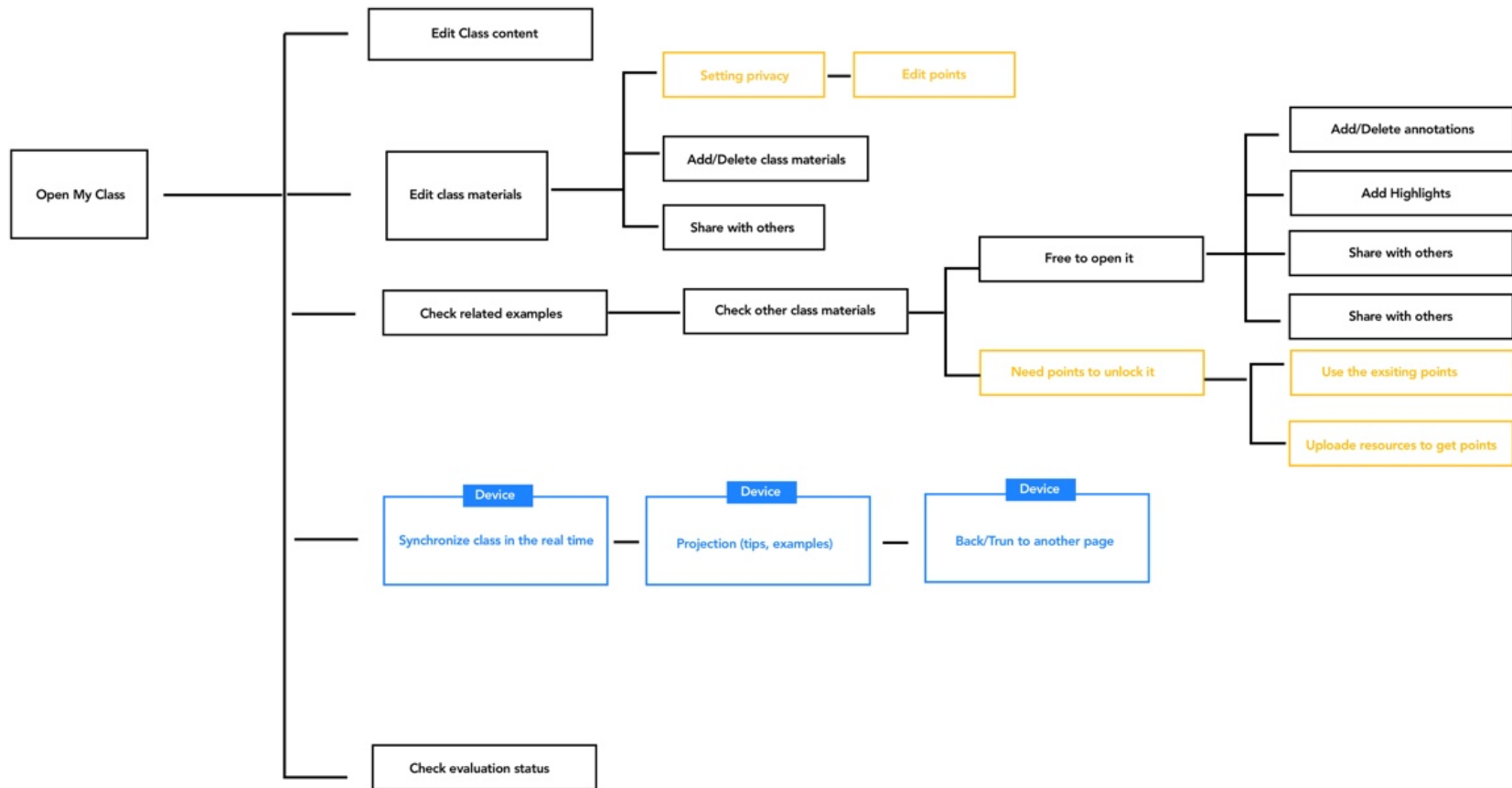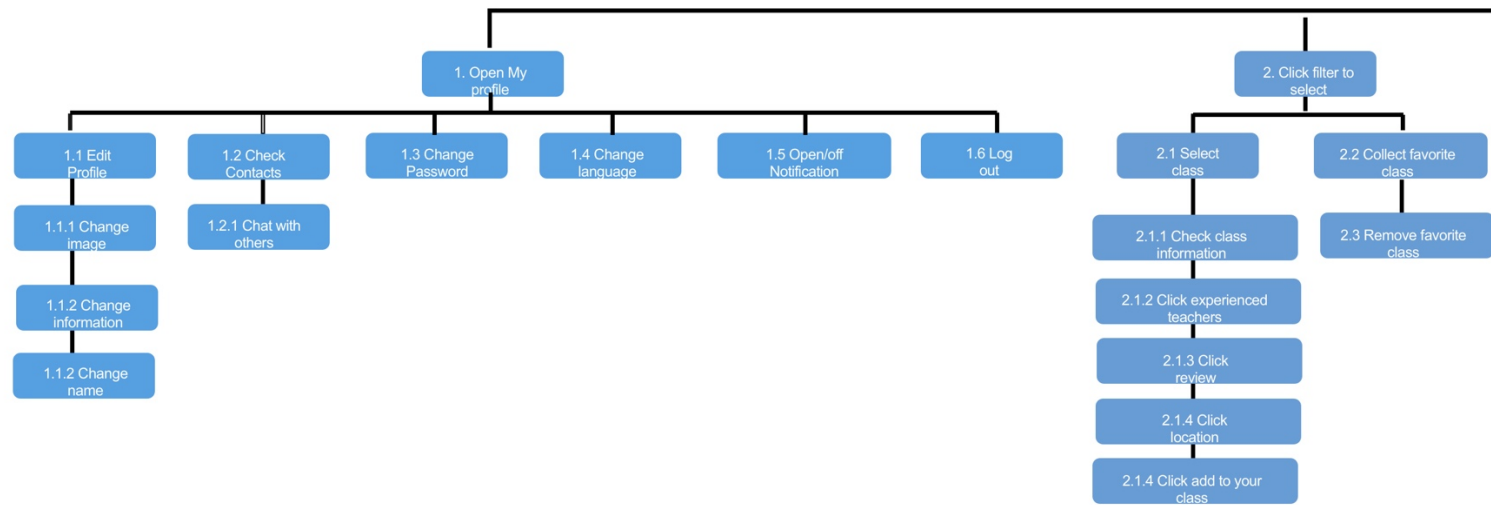
Figure 17. Information Architecture
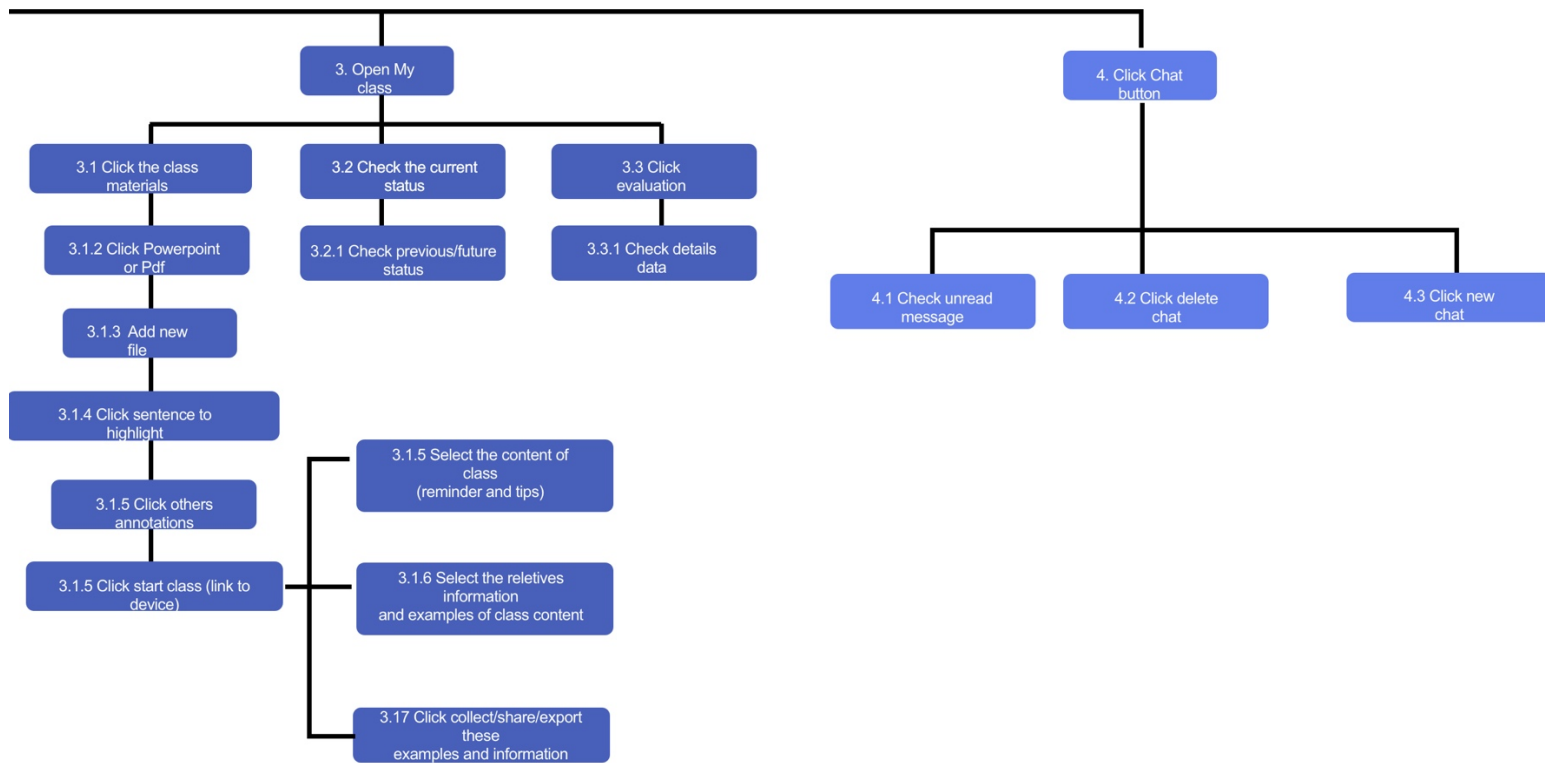
Figure 17 continued

Figure 18. Heuristic Task Analysis of TEACH.IO

Figure 18 continued

5.2.2 Color Schema

The main age group of the target audience is 25 to 35-year-old new college teachers. The color combination takes user demographic and design style into consideration. The keywords of the design include teaching experience, education, resources, technology, and quality of the class. I tried to keep a consistency between the design style and the design keynote.

First, I ascribed a meaning to each color. I selected blues as the main colors because blue commonly represents loyalty, professionalism, trustworthiness, and responsibility. Second, from a physiology perspective, blue symbolizes reliability and responsibility. Therefore, because teachers play a significant role in the education area, being reliable and responsible are core values associated with teachers. Third, blue could bring a sense of calmness and relaxation which can help reduce the nervousness of new college teachers (Figure 19).
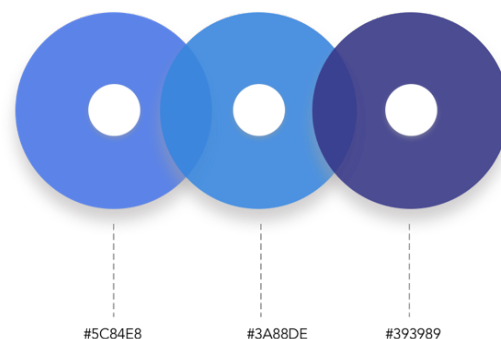
Figure 19. Color scheme

5.3 Low-fidelity Wireframing & High-fidelity Prototyping

Low-fidelity prototyping is low-tech prototyping used to translate design concepts with an easy and simple appraoch. It is usually used in the early stages of design to organize and analyze users' needs and create a testable design. The benefits of low-fidelity prototyping are to help designers visualize alternative design solutions and understand interactive features. In addition, the low-fidelity prototyping is quick to create and inexpensive to implement.

After I collected the possibilities and functionalities of the interface design, I conducted the low-fidelity prototype in Sketch, a professional design toolkit. The main features of the app include four aspects: explore, class, chart, and profile. Each auxiliary line indicates the process of navigation. Based on the auxiliary line and labels, users could quickly understand how to access it. Below is a figure of the prototype (Figure 20).
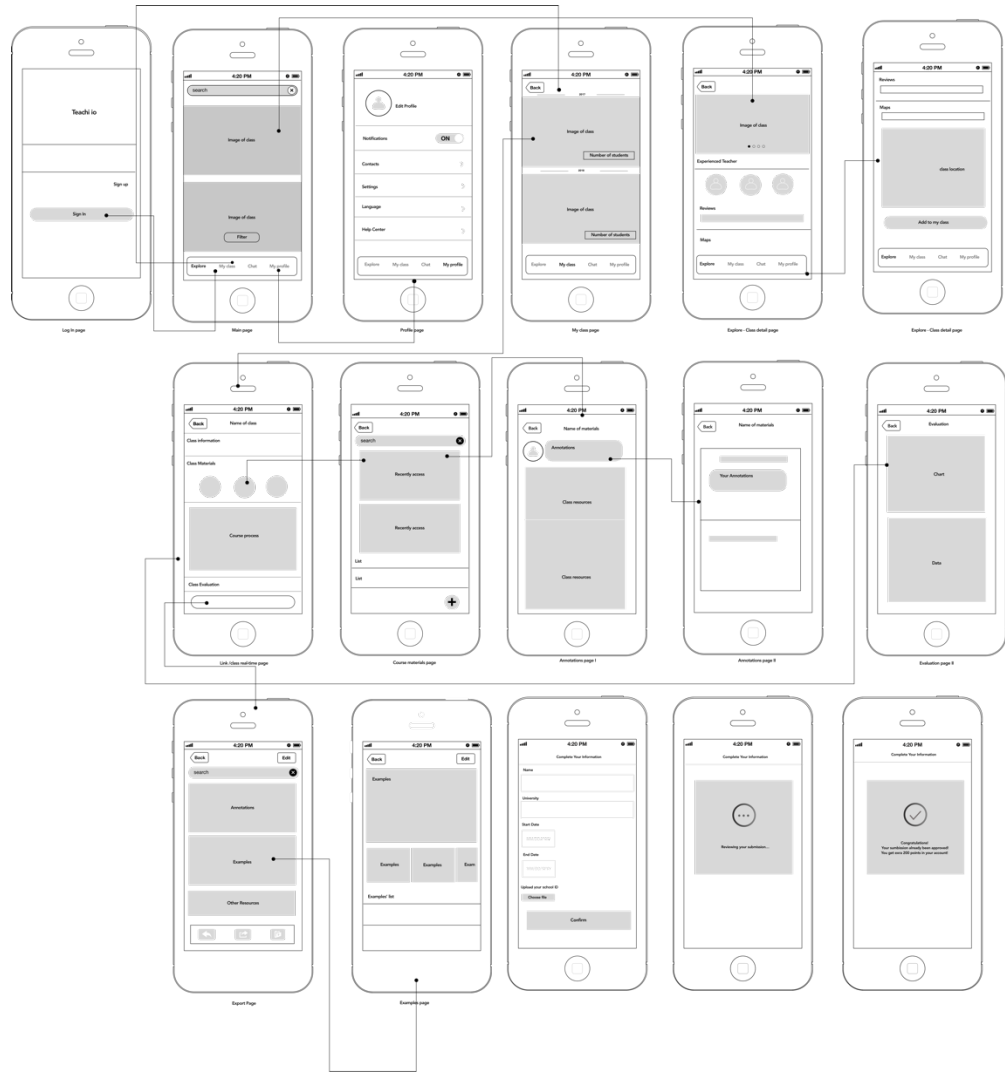
Figure 20. Early Stage Wireframing of TEACH.IO
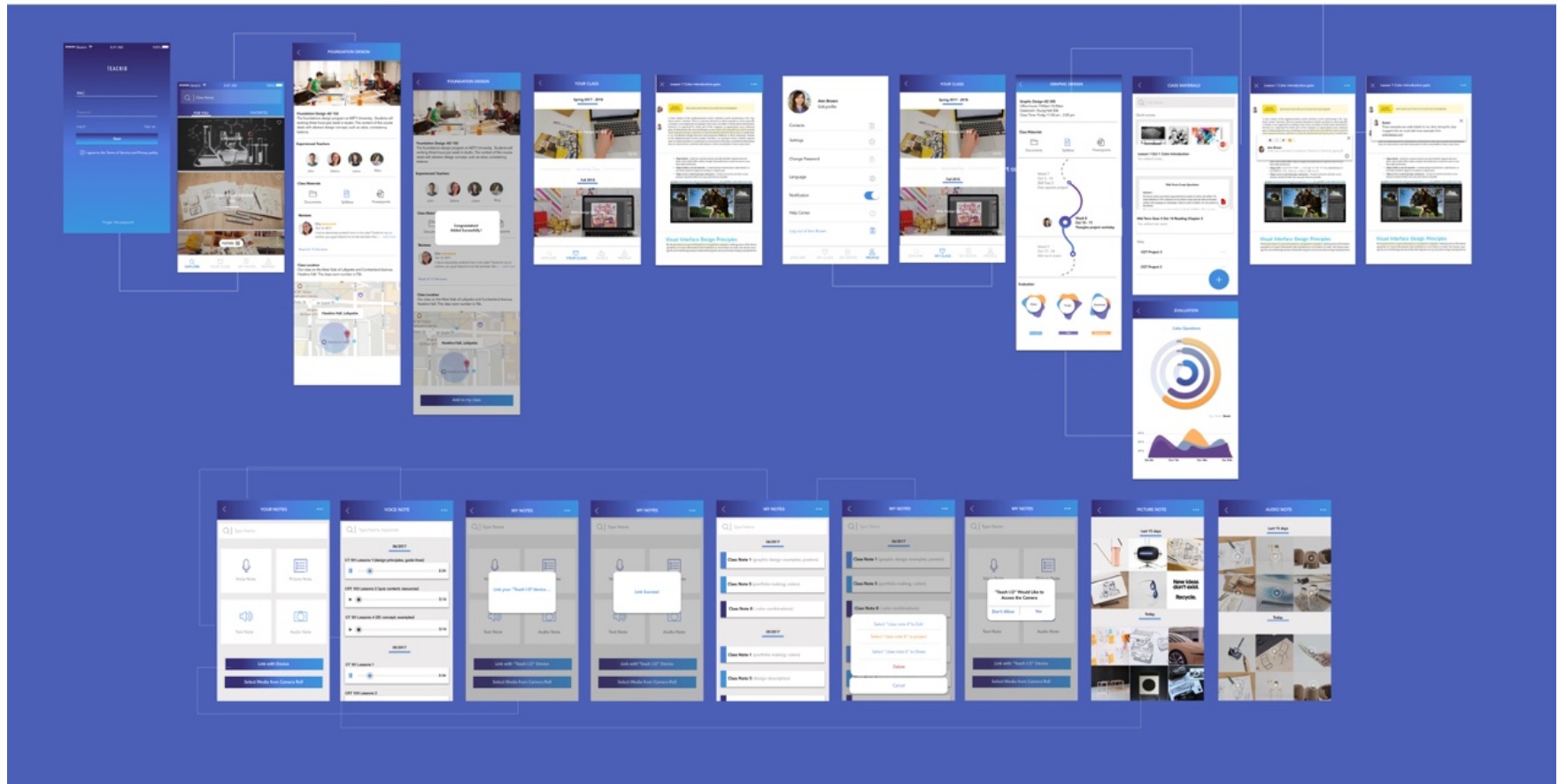
Figure 21. High-fidelity Prototyping

After creating the low-fidelity prototyping, I designed computer-based high-fidelity prototyping (Figure 21) to perform the design interactively, as indicated in the figure above. The high-fidelity prototyping version includes detailed design and functionality interfaces to discover potential issues. I designed the graphic elements and interactive effects to complement the high-fidelity prototyping. The animation effects are primary on the human behavior cognition. Using the interactive interfaces is beneficial for users' easy navigation of the prototypes. I will introduce the main, essential design features in the following sections.

5.4 Physical Prototype

Apart from the interface design, I made several mock-ups for the external device as well. The external device focuses on the portable augmented reality projector. The first round of testing was making the full-size foam mock-up. I tried to use a quick and cost-effective approach to access the shape of the device, so I chose to use foam as major prototyping material. Through the process of making a mock-up, I tried to find the possible errors and potential possibilities, as seen in the figures below (Figure 22).

Making 3D mockup..

• 3D printer (PLA)
• Foam

Figure 22. TEACH. IO product mockup making

In the second round of mock-up making, I used a 3D printing model by Rhino. Using 3D printing ensures fast production. Conventional prototype manufacture requires many tools and machines, and users have to pay the extra fee for the labor and equipment. However, 3D printing does the modeling quickly, and saves the overall prototyping time. Another benefit of 3D printing is customization. Users can personalize anything by computer setting, without any extra cost. Additionally, it is easy to use 3D printing to create a new shape and structure. The nozzle of the 3D printing could make many complex, high quality shapes, as shown in the figures below (Figure 23).

Figure 23. 3D printing

I created ten different shapes with different sizes using 3D printing. To improve their aesthetic, I painted the mock-up different colors. After that, I picked out the top three concepts to conduct a user test. Regarding the test, I tried to identify the most suitable size for users to hold, as shown in the figure below (Figure 24).

Figure 24. The test results of 3D printing

Based on the feedback from the test, each shape had its own positives based on its shape and size. The first concept had fancy shape with a perfect size for people to hold. The second concept is stable internally and can stand on the ground. Nevertheless, it is too thick and difficult for people to hold. The main issue of the third concept was that it was too large and unstable. In the end, I selected the first concept for the final selection. I will emphasize the detailed features in the following section.

5.5 Visual Design

Based on the guidelines and structures of the wire-framing, I started to improve and polish the visual design. I named the system "TEACH. IO," which represents the core of the design objectives: amplifying and supporting the teaching experience of new college teachers. The theme of the system and the logo combines two representative letters "T & O." The color scheme used a gradation of blues to keep the consistency of the theme color as shown in the figure below (Figure 25).
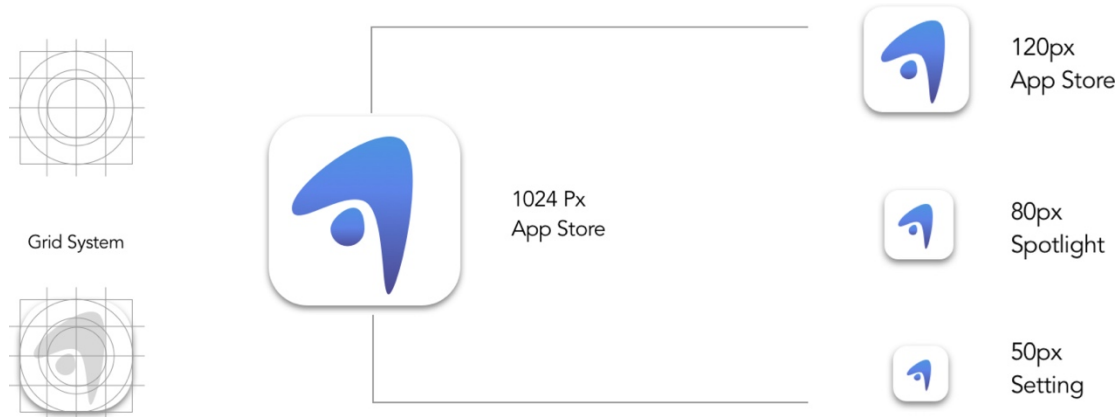
Figure 25. Logo design

The app has four major functions: explore, the class, the notes, and profile. When users log in to the app, the default page is the exploring page. The goals of this page are to give a whole concept for users to start their education career life.

On the page "Explore", users could search different kinds of classes and check for detailed information of classes. Moreover, I designed a filter on the default page for users to customize their selections. After users select one of the classes, the detailed class page will demonstrate the necessary information and materials so new teachers can peruse. Furthermore, users could check

class reviews from experienced teachers and class locations in order to know how to get there (Figure 26).
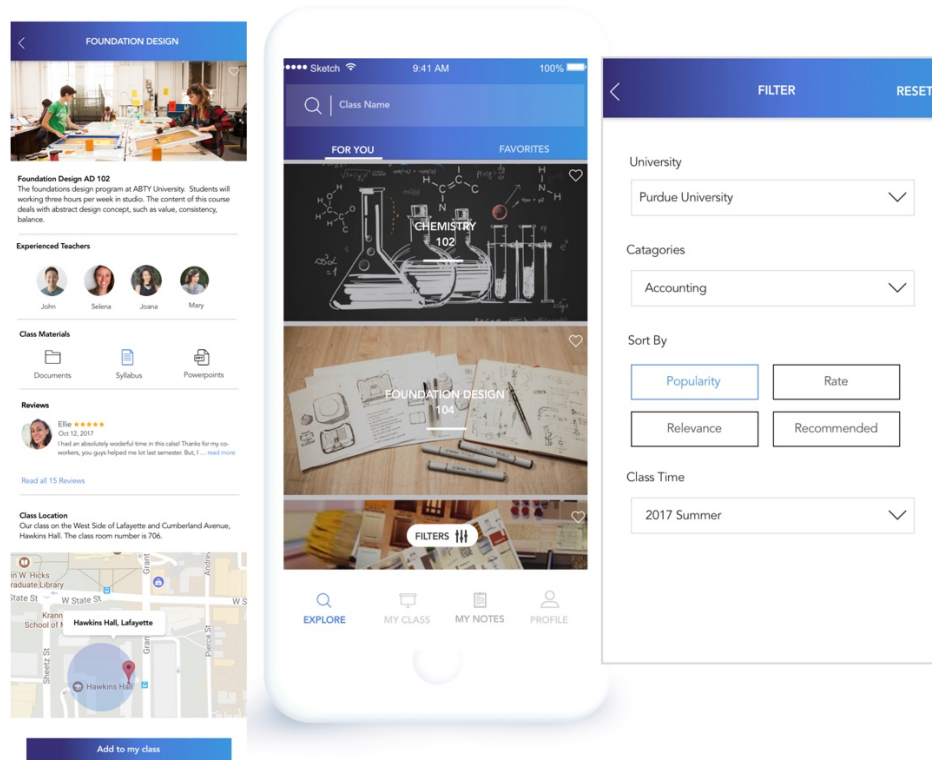
Figure 26. Explore different classes

After adding the class to their "The class," users will be allowed to manage their classes based on different semesters. The primary purpose of this function is to help users organize the class resources and materials. When users access to a detailed class page, they could find class information, schedule, materials, and evaluation status, as shown in the figure below (Figure 27).
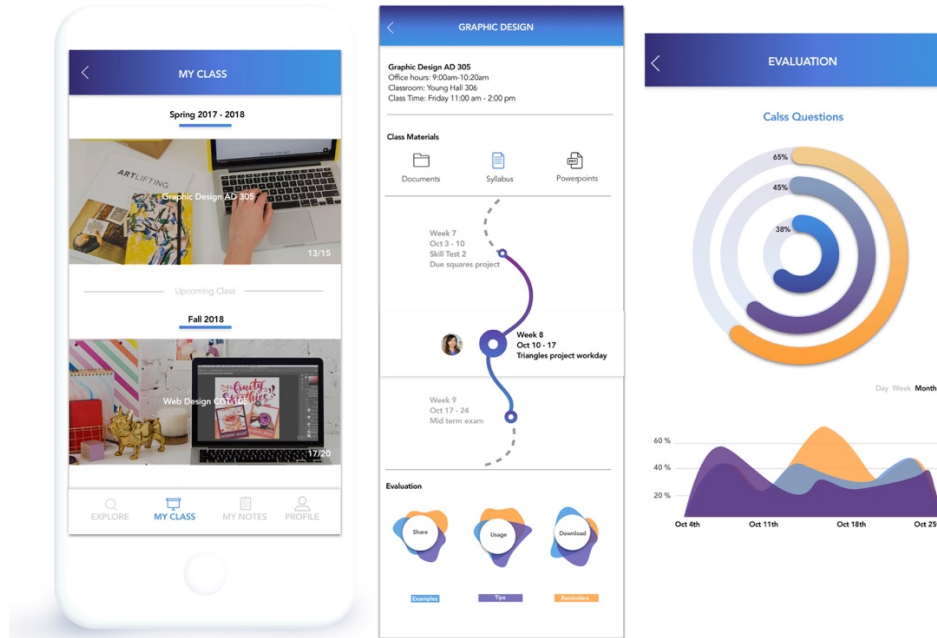
Figure 27. Check detailed information about the class

Another important feature is the sub-page of "The class," where users could check class materials, highlight critical information or leave their comments. Other experienced teachers could annotate their comments as well, so they could exchange their thoughts to the class, as shown in the figure below (Figure 28).
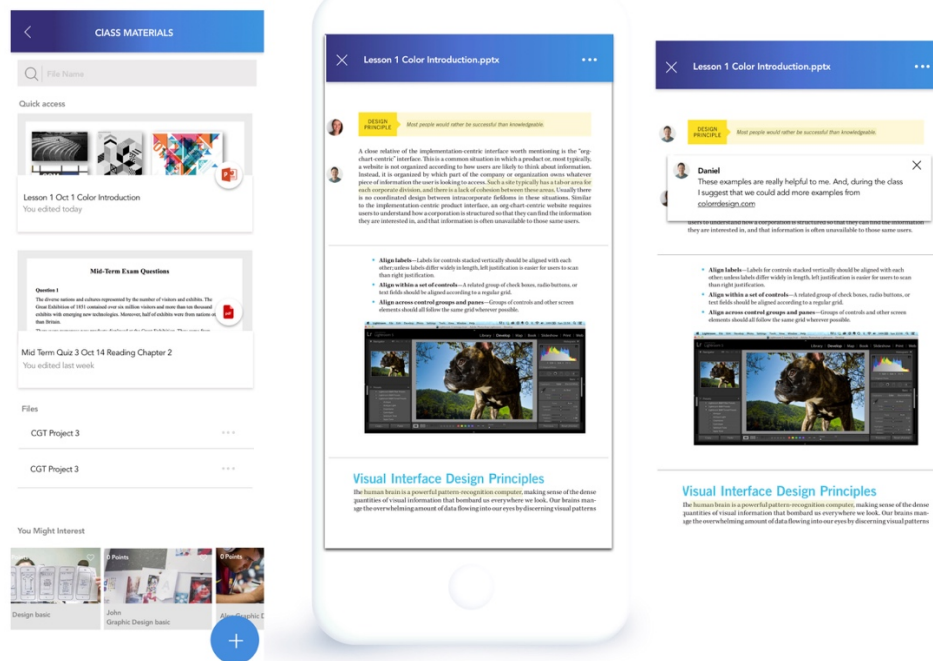
Figure 28. Annotation & Communicate with other-coworkers

Another main feature is "The notes," one of the core functions of the whole system. Based on information of user requirements, users tend to record notes and receive reminders during the class to avoid missing important information. By linking to the device, users could present their notes during the class. Different kinds of notes are included: audio, pictures, video, and text. Also, users could select other pictures from the camera roll. Furthermore, to simplify the search process, each item will be labeled using keywords to help users find important information effectively as highlighted in the figure below (Figure 29).
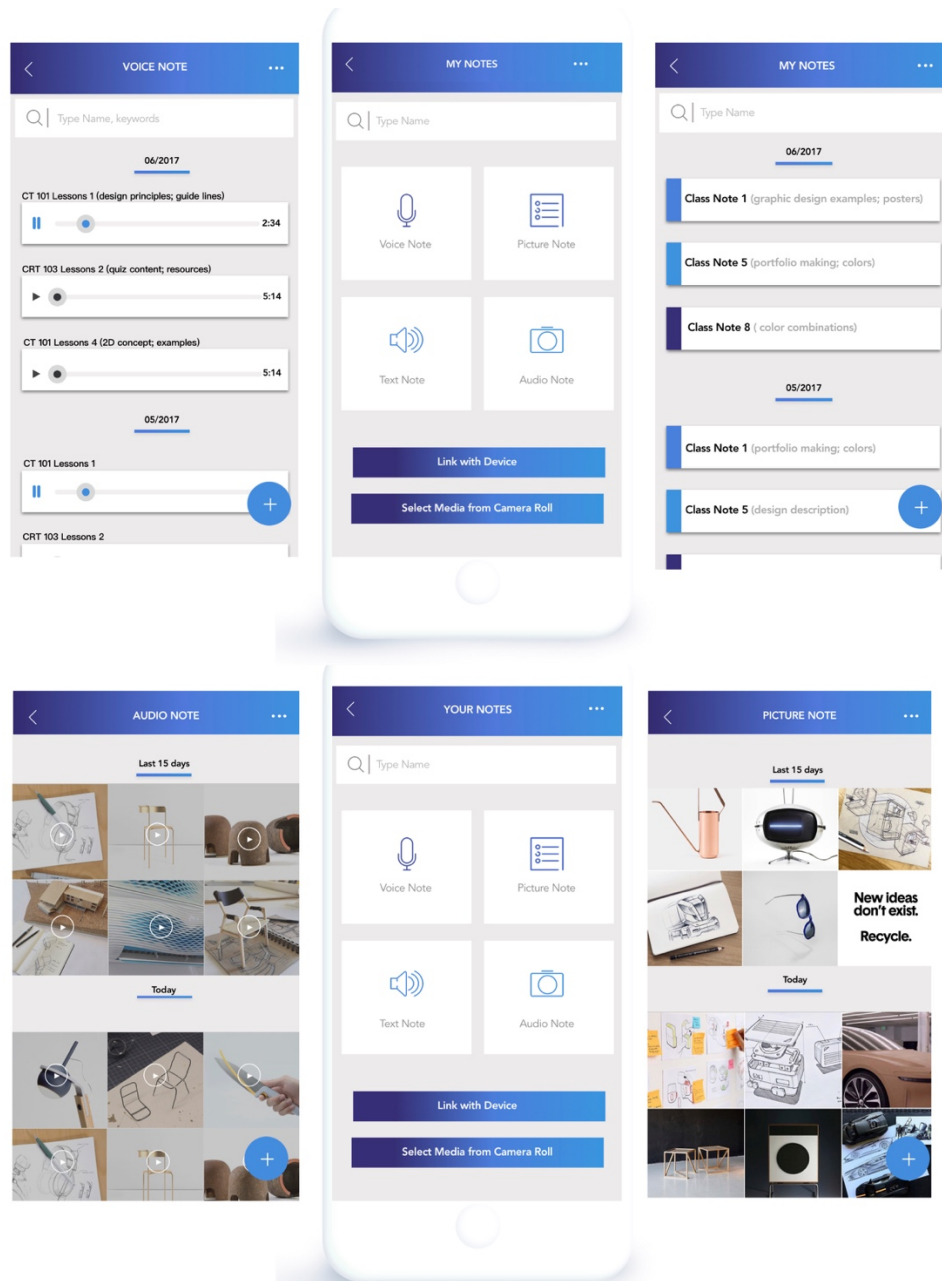
Figure 29. Notes organization & Link with the device

Moreover, in order to improve the usability of the system, users will be able to edit the notes effectively. When users click the button in the right corner of the device, the window will pop up to remind them of several options that can be selected. Users could select delete, share, edit or project on the device. The function of "select" helps the user to customize their demand and improve the functionality of the system, as the figure below shows (Figure 30).
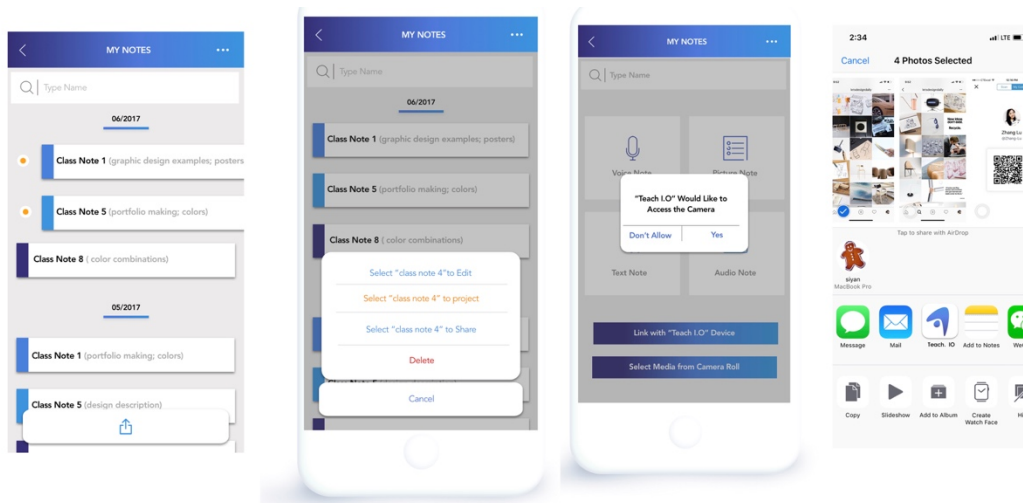
Figure 30. Link with TEACH. IO device

In summary, this chapter concentrates on visual and animation design. The final prototype was created by Flinto. I tried to design a clear connection between each page so that users could interact effectively with the main features of the full system. However, there are still some minor issues that need to be clarified. In the following sections, I will introduce how to conduct an evaluation that aims to maximize the visual design. In addition, I will demonstrate the outcomes, the result of the evaluation, and final modification.

5.6 TEACH. IO Product Design

The product design of "TEACH. IO" focuses on the augmented reality portable projector that links to the mobile application. The major ain functions of the product include an adjustable projector, zoom in/out button, USB charging, on/off button.

The purpose of this product design is to help users improve the quality of the class and release the tension in the class. By using this portable device, users could check their notes or add new notes during class-time. The augmented reality projector allows users to interact with

interfaces via different mediums. The synchronous function of the design allows the information

to flow between device and app in real time.
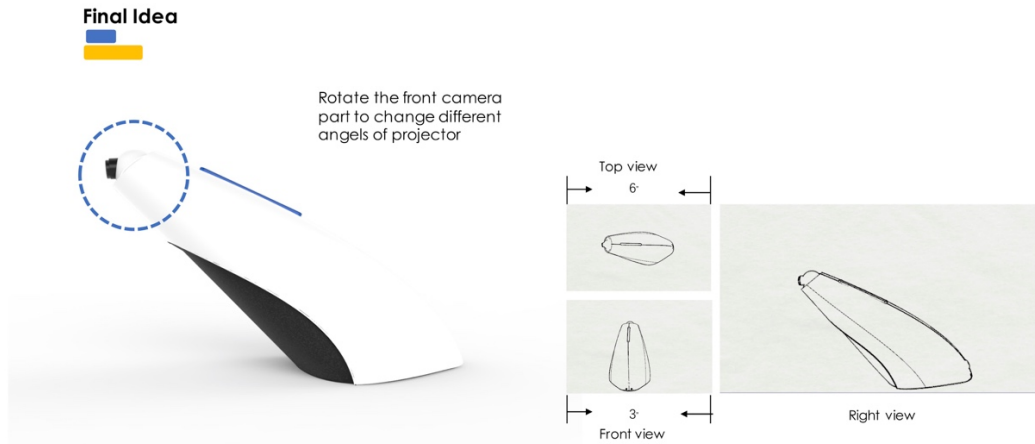
Figure 31. Final Idea

The final concept (Figure 31) was inspired by the organic shape of the "OX horn." The

design in the figure above demonstrates the shape of the horn with a filament line as it shows the

variation and rhythm of sound design principles. The whole shape is divided into two parts, with

the black part made for users to hold easily. Through the previous test, I finalized the size of the

shape. The height of the device is six inches, and the width is three inches.
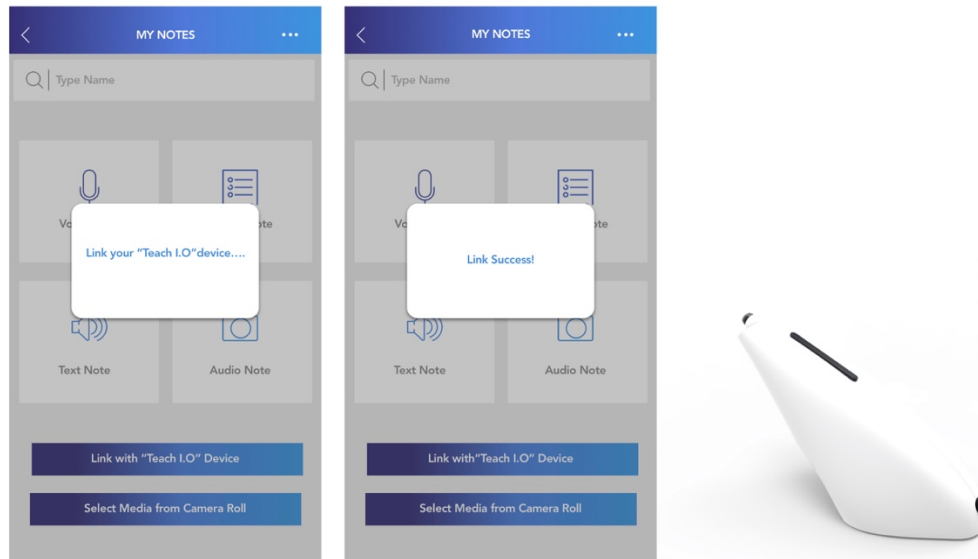
Figure 32. Link to the device via Bluetooth

New college teachers could access the device via Bluetooth (Figure 32). When the device

detects the Bluetooth, it could be successfully linked with the app. The icon of the button will

light up to indicate the device is on. The sphere structure of the projector aims to adjust different

angles to help users enhance their applicability. During class, users could put the projector on the

desk to project notes or other resources. The function of the blue bar button would adjust the

distance of the projection to satisfy different needs, as seen in the figure below (Figure 33).
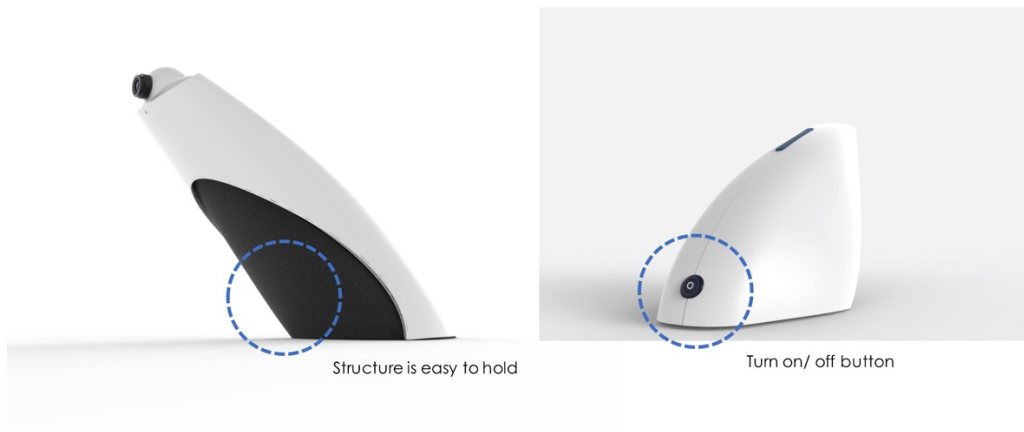
Figure 33. Main features of TEACH. IO device

The following figures (Figure 34) demonstrate different interfaces of the augmented reality projector. When linking the device to the app, all of the notes will be synchronized to the projector for projection.

Users could use hand gestures to select items. When users want to select one of the notes to display, they could swipe the different pictures and click to select it. During class time, if they would like to add other different notes, they could click the menu bar, and the sub-menu would pop up. Users could click select to add different notes to their device. After they finish the annotation, the resources will be automatically saved to TEACH. IO. Additionally, the left corner of the interface shows reminders and status of class information. Users could check these tips during class as indicated in the figure below.
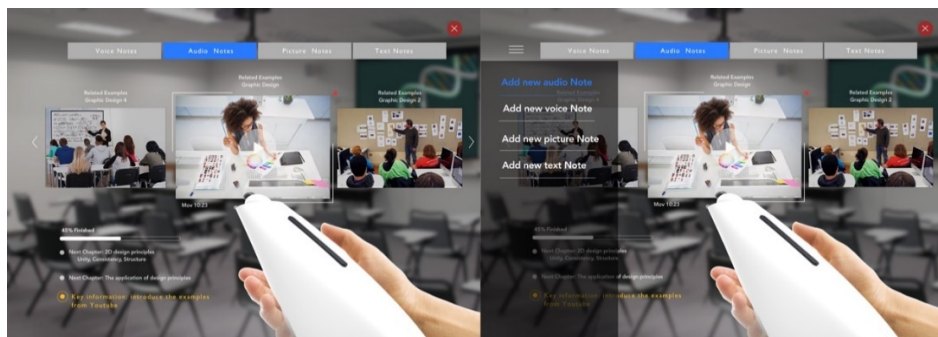
Figure 34. Interfaces of Augmented Reality (AR)

Figure 34 continued
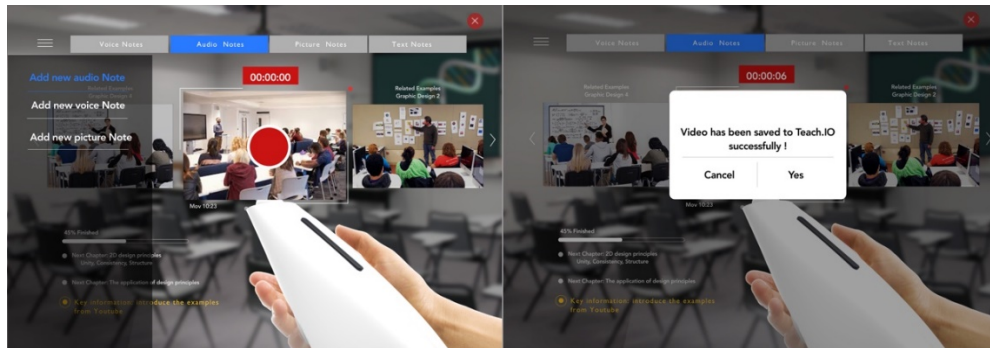
The overall use of the projector in aiding new teachers' teaching experiences not only supports class preparation but also amplifies the diversity of teaching experience.

5.7 Heuristic Evaluation

In order to conduct the user evaluation study to explore the app and device, I invited five experts in the field of user evaluation, user interface and IOS to act as the evaluators. In the first round, I conducted a Heuristic evaluation to explore usability problems of the interface by using Nielsen's heuristics principles (Nielsen, 1990). The Nielsen's Heuristic evaluation is the most-used usability heuristic evaluation for user interface design. The principles of Heuristic evaluation include:

- Visibility of system status

- Match between system and the real world

- User control and freedom

- Error prevention

- Help with recognition, diagnostics and recoveries from errors

- Consistency and standards

- Recognition rather than recall

- Flexibility and efficiency of use

- Aesthetic and minimalist design

- Help and documentation

Each expert tested every interface of the app based on the severity ranking scale (from 0 to 4) to identify the severity of the problem (Figure 35) for each interface by using these principles above.
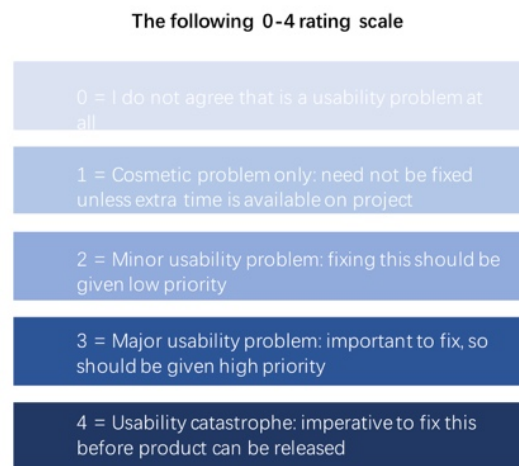
Figure 35. 0-4 rating scale

Table 3. The results of heuristic evaluation

NO.	HEURISTICS	QUESTIONS	
A.	Aesthetics	This design project should have appealing appearance, and pleasing colors	1
A1.	Visibility	Does this design work let users know how to operate it within in reasonable time? Does this design having clearly marked controls in a visible location can help user figure out what to do next?	1
A2.	Attractiveness	The design project should have fancy shape and pleasing colors	1
B.	Usability	This design project should be easy for users to access	2
B1.	Learnability	Does this project is easy to accomplish?	1
B2.	Flexibility	Does the operation methods of the project are flexible and efficient?	2
B3.	Efficiency		1
C.	Functionality	The design project should achieve the multiple functions	
C1	Reminders and Tips	Does this design project can send the reminders or notifications in the real time?	2
C2.	Quality of class	Does this design work can improve the quality of class?	1
C3	The efficiency of class preparation	Does this design work can help teachers to prepare their class efficiently?	2

Table 3 continued

D.	**Affordance**	**An affordance is a visual attendance of an object or a control that gives the user clues as to how the object or control can be used or operated**	2
D1.	**Accessibility**	Does this design is easy to access?	**3**
E.	**Error Prevention**		
F.	**Feedback**	Does this design give users feedback	1
G.	**Help and Documentation**	Does the help documentation is easily located when users require help? Is there any specific guidance to help users through the necessary steps towards solutions?	
H.	**Consistency**	Does the interface design keep the graphic elements and terminology are maintained across similar platform?	1

After the five experts finished the evaluation forms, they sent the forms with comments and suggestions back to me within five days, as shown in the figure above (Table 3). Both qualitative and quantitative data are included. I collected the data to organize the feedback, highlights, and comments pertaining to each principle. I used the color green to identify positive feedback and red to represent the negative feedback as seen in the figure below (Figure 36).

Figure 36. Feedback and comments on heuristic evaluation

Based on the results, the major issue was based on the principle of "affordance." The negative comments show that the design is challenging first time users to understand as they expected to get some indication or short introductory pages explaining how to use the interface of the app. Positive comments included praising the design style for strong consistency, and smooth process of operation.

5.8 Findings and Redesign Direction (detailed rating)

After integrating the result of the heuristic evaluation. I collected the data from the experts. After the data analysis, I found that the severe issues (list items 1-3 below) are critical problems. These issues prevented users from continuing tasks during the test. The other issues (list items 4-

7 below) were recognition problems caused by first-time users' inability to complete the task assigned.

1. Lack of brief introduction for the first time users to access the app

2. Difficulty finding where to link the device to the app

3. No introduction and information about resources collaboration for users

4. Unclear navigation of resources collaboration, no page showing "edit points."

5. No clear explanation of why points of materials are different

6. No function for users to rate the quality of materials

7. No search function for class resources by ratings

The redesign direction focuses on improvement of accessibility and usability. The goal of the redesign is to develop more positive user experience in the future. The following redesign improvements correspond to the results of the heuristic evaluation.

a) Adding some brief launch pages for new users to understand how the system works. These launch images could be worked in as an introduction or a navigational element.

b) Providing some clues or indications for users to understand how the device and app link together, possibly in the form of animation effects or reminders.

c) Giving some clear explanations or motivations to involve users. Users may become confused about the resource collaboration. Some rankings or competitions could be added to the current app to motivate users.

d) Providing clear indicators to support navigation. A page could be added to demonstrate how to edit points.

e) Providing a page or pop-up window to show how the "resources collaboration points" work. It could add a short story animation for users to understand better.

f) Adding a rating page for the class materials. It is an advantage for users to check reviews and feedback. Users like to communicate, and this is a beneficial way for them to do so.

g) Adding a filter function in the class materials page to help users filter the resources based on their needs.

5.9 Review of Functions with User Requirement

This section aims to apply the findings from the evaluation to find solutions that meet the user requirements.

The goal of the design project of this thesis is to support and amplify the teaching experience of new college teachers. The following list shows how the design proposes to satisfy the user requirements:

• Make the preparation of the class content less difficult – The system provides a platform for users to re-organize different information on the class page. Users are allowed to check different kinds of class information or look up reviews from other experienced teachers. In addition, they can check the open resources of class materials to organize these existing resources together.

• Facilitate communication of the class content with other co-workers – A challenge feature of the annotation page allows users to check other teachers' annotations

on the class materials and leave their comments. They can also add highlights, and others can give feedback as well.

- Organize and categorize the class materials effectively – The challenge feature lets users edit, upload, and download their class materials along the way.

- Receive reminders and notes during class time – The external device helps users to achieve this goal. Users can display the notes during the class that they saved in the app before. Through employing the augmented reality technology, they can access the reminders and notes in an effective way.

- Enhance the quality of the class – The challenge features of the organization of notes and categorization of class resources helps users to prepare their class effectively. Also, during class, users can use the external device to capture important moments or notes at any time to avoid forgetting the key parts of the class. Through a well-prepared class, teachers can improve the quality of their classes and release the tension.

One of the most significant features of the design is supporting a platform for users to access resource collaboration. Overall, the design solution includes four dimensions:

- Collect and accumulate resources with a collaborative approach

- Communicate with experienced teachers with multiple methods

- Employ advanced technology to enrich the teaching environment

- Enhance teaching quality and experience, and build up personal teaching confidence

CHAPTER 6. CONCLUSION

The target user group of this study is new college teachers who do not have any teacher training. The objective is to support and amplify the teaching experience by employing a design solution. The topic of this thesis is inspired by my individual experience at Purdue University. As a new teaching assistant at Purdue, I had encountered many obstacles, such as a lack of teaching experience, a lack of familiarity with class structure, communication difficulties as a second language speaker, difficulty in preparing for the class, and confusion about how to improve the quality of the class. During the iterations of design, I tried to deliver values to users by investigating and solving their problems. In order to confirm these findings, I conducted a review of the literature to gather support from the knowledge domains. The literature review contains two major parts: social justification and conceptual justification. Based on the findings from this research, I moved on to the user study to understand users' behaviors and user requirements. During the user study, I collected both qualitative and quantitative data as the resources to deeply explore the needs and expectations of the target users.

To help new college teachers amplify their teaching experience, the design aims to improve class quality and enhance the efficiency of class preparation. It can be achieved through a mobile application called TEACH. IO in concert with an external device to perform the solutions of the design. This design is based on the results of the primary and secondary research and is made with the intention that it helps beginning college teachers to amplify and enhance their teaching experience effectively.

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APPENDIX A

Participants: ____ Age: ____ Gender: ____ Major: ____ Size of the class: ____
Duration: ____

Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
Male	Female	Male	Female	Male
20-16	20-26	26-32	20-26	26-32
PHD	Master	PHD	Master	Master
Electrical Engineering	Mechanical Engineering	Accounting	Interaction Design	Interior Design
26	27	14	15	20
110mins	120mins	180mins	120mins	180mins

Questions	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5
How long about your teaching experience?	2 months	1 month	2 months	1 month	10 months
How many classes do you have? (per week)	3 classes	2 classes	3 classes	2 classes	2 classes
How long about each class?	2 hours/per class	3 hours/per class	2 hours/per class	1.5 hours/per class	2hours/per class
Do you satisfied with the current way of your teaching?	Not very satisfied; hard to know the achievement students	Still need time to explore	Not really, hard to find "methods"	Not satisfied; It is not optima	Just so so, still can improve a little bit
How is the feeling when you teaching students at the first class?	Nervous; can not adjust the phenomenon of class immediately	A little bit shy;	Anxious; overwhelm; shy; lack of confidence	Don't know how to control a class	Unconfident; Super nervous; the voice was shaking
How do you prepare your class?	Search resources through internet	Ask for help from coordinator or senior teachers	Look up the class content before the class begin	Ask for other co-workers help to organize information	look back to other teachers; get experience
What kinds of way you usually use in your class to active students?	Organized some small class activities	Assign a group; give other suggestion as a part of final grade	Keep remind them participation is one of part of grade	Create some small activities or interactions	Get them involved in the class, work together and talk each other, pair activity

	Respondent 1	Respondent 2	Respondent 3	Respondent 4	Respondent 5
Will you usually ask other co-workers help?	Definitely yes	Yes, usually need ask others help	Sometimes	Frequently	Frequently
For your perspective, what is the difference between new teachers and senior teachers?	They are more skillful and more familiar with class content	Hard to find out which part is useful to students; Not sure how to pick out the important information	Senior teachers are more experienced; they know the work flow, they could handle it very well; they know the common questions in the class	Specific purpose; what kinds of information is important	New teachers do not understand their teaching materials thoroughly
Which part do you think is the hardest part during the process of teaching?	How to check the achievement of students	How to inspire the subjectivity to creativity of students	Deal with student's questions well, do not give wrong information; how to be more professional	Feedback part is the most difficult thing; Students attitude	Sometimes students ask questions but you do not have any answers in your mind
Do you have any preferred apps to assist your teaching?	Google class; Blackboard	Blackboard	Blackboard; Slack	Blackboard	Groupme
If yes, which part that you think is the most useful?	Assign grade and student could discuss	Share resource to students; Create a platform for students to discussion	Different channels to divide different information	Lots of functions; Send announcements to students	Convenient to communication among peers
What kind of functions you would expect to add in the existing app?	Give some reminders or tips during the class	Examples share video; Class video	Organized students, improve the phenomenon of class	Look up the video of other teachers	Easier to share resources to other teachers

APPENDIX B

Evaluator: _____ Age: _____ Gender: _____ Major: ___

Experience (years): ___

Checklist:
In the following questions, please write down your suggestions and comments that corresponding to the category and discipline. After complete the evaluation, please assign the severity ratings to criteria for each heuristic principles.

Referred to Jakob Nielsen's Severity Ratings:

0	I do not agree that is a usability problems at all
1	Cosmetic problems only need not be fixed unless extra time is available on project
2	Minor usability problems fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority

4	Usability catastrophe: imperative to fix this before product can be released

NO.	HEURISTICS	QUESTIONS
A.	**Aesthetics**	**This design project should have appealing appearance, and pleasing colors**
A1.	Visibility	Does this design work can let users know how to operate it within in reasonable time? Does this design having clearly marked controls in a visible location can help user figure out what to do next?
A2.	Attractiveness	**The design project should have fancy shape and pleasing colors**
A3.	Attractiveness	Does this design project have pleasing colors to attractive people?
B.	**Usability**	**This design project should be easy for users to access**
B1.	Learnability	Does this project is easy to accomplish?
B2.	Flexibility & Efficiency	Does the operation methods of the project are flexible and efficient?
C.	**Functionality**	**The design project should achieve the multiple functions**
C1	Reminder in real time	Does this design project can send the reminders or notifications in the real time?
C2.	Improve the quality of class	Does this design work can improve the quality of class?
C3	Help new teachers prepare their class efficiently	Does this design work can help teachers to prepare their class efficiently?
D.	**Affordance**	**An affordance is a visual attendance of an object or a control that**

D1.	Accessibility	Does this design is easy to access?
E.	**Error Prevention**	Does this design can eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action?
F.	**Recognition rather than recall**	Does the instructions of design for use of the system is visible or easily retrievable whenever appropriate?
G.	**Help and Documentation**	Does the help documentation is easily located when users require help? Is there any specific guidance to help users through the necessary steps towards solutions?
H.	**Consistency**	Does the interface design keep the graphic elements and terminology are maintained across similar platform?