

# The advantages and disadvantages of multidisciplinary collaboration in design education

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**Abstract:** Multidisciplinary collaboration for innovation has become an important issue in design practice and education. This paper examines three design projects of multidisciplinary collaboration between design schools and industry. We interviewed the participants to explore the advantages and disadvantages of multidisciplinary collaboration in design education. The results show multidisciplinary collaboration leads to better skills in communication, collaboration, and professional abilities, a better understanding of the collaborative process and how different professions complement each other, and has a positive effect on future career development and sense of achievement. The disadvantages include issues caused by time pressures and different backgrounds. The results contribute to the implementation of design thinking in design education.

**Key words:** *Multidisciplinary Collaboration, Design Education*

## 1. Introduction

For the past decade, in response to the global economic, environmental, and social changes, there has been increased momentum to create awareness about design thinking among all professions by teaching design thinking in higher education. Design thinking refers to the methods and processes of designers for investigating and solving ill-defined problems [3].

The premise is that by knowing about the process that designers use to inspire, ideate, and implement, individuals and businesses will take innovation to a higher level. The hope is to create a competitive advantage in today's global challenges. The features of design thinking promoted by IDEO primarily include brainstorming, storytelling, multidisciplinary collaboration, user-centered design, prototyping, and its related innovative processes. [2, 8] Amongst them, multidisciplinary collaboration is the focus of this research.

Design education also regards multidisciplinary collaboration as an important element for the generation of products of disruptive innovation. Although the concept is well accepted, there are limited studies on the influences of multidisciplinary collaboration on design education. What are the obstacles of the application of multidisciplinary collaboration in the design studio? How could we better establish a multidisciplinary design team at school? Our research problem is to establish the advantages and disadvantages of multidisciplinary collaboration in design education.

Multidisciplinary collaboration means a team consisting of members with different professional backgrounds and skills that can compensate each other and work together toward the same direction to achieve the same goals [4]. This model is especially useful in the era of global competition to create innovative value, and has been an industry trend [6]. The different backgrounds of a multidisciplinary-team could provide different viewpoints and experience for better brainstorming across cultures. Famous international design firms, for example, IDEO and

ZIBA, have been using multidisciplinary collaboration to solve complex problems and create innovative products [9]. High quality multidisciplinary cooperation often resulted from heterogeneous backgrounds [5] and effective communication and interactions [7]. In terms of design education, a multidisciplinary design project is regarded as a wonderful and worthwhile experience, giving students a new way of thinking and the potential to create innovative products [6]. Especially, the collaboration between art and computer science provided a very diverse disciplinary environment where students were often forced to explore the boundaries of their own practice, exposed to the work of other disciplines, and better understood their own role and value in team-based collaboration [10].

The **purpose** of this paper is to investigate the advantages and disadvantages of applying multidisciplinary collaboration in design education. The objectives are threefold: first, to observe three complete design processes of multidisciplinary collaboration, second, to interview all the participants in these design processes, and third, to summarize the advantages and disadvantages of multidisciplinary collaboration in design education. Therefore, the research methods employed are observation and interview.

## 2. Research Method

We adapted and integrated the ideas of design thinking into our master design projects. In these design projects, students were required to apply information technology and design for people in need. Real users were observed in context and interviewed for a deep understanding. The result of the project had to be fully functional in order to examine its effectiveness, efficiency, and satisfaction. Due to the requirement of a fully functional design, design students were required to form a multidisciplinary team to complete the design process.

This study observed three design projects of multidisciplinary collaboration, which originated from a design studio and executed over one year to reach the level of fully working prototypes. User-centered APPs were designed for underprivileged persons with the collaboration between Information Technology and medical experts. **iCAN** was devised for kids with Autism to assist their language learning process graphically. **iListen** was designed for hearing impaired persons to overcome the obstacles encountered in their daily lives due to the lack of hearing. **Diabetes Diary**, DD in short, was invented for individuals with diabetes to smooth the process of recording their blood sugar and diet. We collected all the materials of their design process, including sketches, presentations, meeting minutes, digital documents and models. All the designers and their collaborative partners with different backgrounds were interviewed.

### 2.1 Cases

The three projects use similar developmental processes based on the concept of design thinking and have three distinguishing features. Each project is user experience centered, involves multidisciplinary collaboration, and follows the process of rapid prototyping to a fully working APP. These three APPs received four local competition awards and two Red Dot Communication Awards. The feedback from the users was overwhelming.

As shown in Figure.1, the **iListen** Project proceeded from March 2011 to January 2013. The team members had face-to-face meetings every two weeks, and used e-mail to communicate as needed. The team members included Tang as project manager, Kevin as designer, Charlie as technical supervisor, and James and Hanna as Programmers. Both Tang and Kevin are from the National Taiwan University of Science and Technology,

NTUST, while James and Hanna are from ATEN, an ICT company. Details of the iListen project can be found at <http://imkevin125.wix.com/ilisten>.

As shown in Figure.1, the **Diabetes Diary** Project ran from March to December 2012. The team members had face-to-face meeting every two weeks, and communicated by e-mail as necessary. The team members included Tang as project manager, Fish as designer, Lai as technical supervisor, and Ben, XT, and ZH as Programmers. Tang and Fish are from NTUST, while the latter two are from Dept. of Electronic Engineer, NTUST. Details of the Diabetes Diary project can be found at <http://2012diabetesdiary.tumblr.com>.



Figure.1 Screen shots of iListen and Diabetes Diary

As shown in Figure.2, the **iCAN** Project proceeded from December 2010 to December 2012 and it is currently being prepared for commercialization. Due to the long duration of the development process, it is difficult to describe the meeting patterns. In general, team members had a face-to-face meeting every week during the concept development phase, and used e-mail to communicate when necessary. When preparing for competitions, the team gathered more frequently to shape the details. iCAN has both an iOS and Android version, so we will list team members from both versions. The iOS team members included Tang as project manager, Ameng as designer, Mike as technical supervisor, and NM, YS, and MY as Programmers. Tang and Ameng were from NTUST, while the latter two are from the Dept. of Information Technology, National Taiwan University. The android team members included Blanchard as technical supervisor, Jonas as Programmer from Sabus, an APP company. Details of the iCAN project can be found at <http://contactican.wix.com/ican>.



Figure.2 Screenshots of iCAN

## 2.2 Research method

We conducted focus group interviews for each of the three trans-disciplinary teams first, and utilized a semi-structured interview for each member. Each session had two interviewers, one as the major interviewer and the other as the recorder and interview assistant. Before the interview, we established an interview outline as below addressing the issues of our interest.

- What do you think about the collaboration? Why do you need to collaborate in this project? What is your previous collaborative experience? How do you collaborate in this design project?
- What are the advantages and disadvantages of the process applying design thinking? What is its influence? Does it make a difference compared to your normal design/develop process?
- What are the advantages and disadvantages of multidisciplinary collaboration? What is its influence? Does it make a difference compared to your normal design/develop process?
- What are the advantages and disadvantages of the user-centered process applying design thinking? What is its influence? Does it make a difference compared to your normal design/develop process?
- What are the advantages and disadvantages of the prototyping process? What is its influence? Does it make a difference compared to your normal design/develop process?

The interviews followed these basic outlines: however, the interviewer reordered these questions or asked additional follow-up questions depending on the responses from the interviewee to maintain a smooth interview. The interview outline covered major features of design thinking, but this study only presents the results related to multidisciplinary collaboration.

## 3. Results

Based on the results of the interview, we present the findings regarding to multidisciplinary collaboration. The original interview was conducted in Chinese, so translating into English would inevitably generate some minor differences in terms of meanings. However, the translation has been double-checked to ensure the highest level of accuracy.

### 3.1 Previous experience of collaboration

The subjective evaluation of the satisfaction of the collaboration from the interviewees indicated that the collaboration in the DD Design Project had the highest rate of satisfaction, iCAN came second, and iListen was the least satisfactory. Based on the interview, we speculated that current collaborative satisfaction is related to previous experience in a multidisciplinary collaboration.

The iListen designer, Kevin, did not have previous collaborative experience, and said, *"In college, most cases are worked on in teams but only in teams of designers."* Similarly, the iListen IT team did not have multidisciplinary collaborative experience. Their previous work experience consisted of programming according to the spec given by their project manager.

The iCAN designer, Ameng, also lacked previous experience of multidisciplinary collaboration, and said, *"In college, most of the collaborators were other design students from the same department, so most of the cases could only progress to completion of the concept. It was hard to push to the latter part for testing."* However, the iCAN programmer, Jonas, had previous experience in multidisciplinary collaboration, and said, *"My personal learning experience included multidisciplinary collaboration because our information communication department had a technology division and a design division who were requested to collaborate with us on projects. The communication was not a big problem. We coordinated our own professions. Anyway, it was smooth."*

The DD designer, Fish, has a background in information design, so she was familiar with both design and programming, and she said, *"The difference between information design and industrial design is that all works were based on teamwork and multidisciplinary collaboration, which resulted in more tangible interactions."*

The previous experience of the DD programmers included multidisciplinary collaboration from a previous course. One of the programmers, Ben, said, *"Because our supervisor encouraged multidisciplinary collaboration, we have had experience working with the Architecture department for a mobile game, which was similar to this collaboration. We used unity to co-create a small game. That experience was hard to evaluate. Because the designers' thinking was a bit abstract, we could not understand it, and thus we could not predict or plan. At that time, the only idea was to finish it. But in the end, due to the time limit, we actually could not finish it well."*

As a result, we can speculate that if both sides of multidisciplinary collaboration have previous experience in multidisciplinary collaboration, it would result in better satisfaction of collaboration.

### 3.2 The advantages of multidisciplinary collaboration

Our main purpose was to understand the advantages and disadvantages of multidisciplinary collaboration through the current design projects. Due to the complexity of the findings, we enlisted them into several issues corresponding with the interview transcripts. The following are the advantages of multidisciplinary collaboration, which derived from the interview.

#### 3.2.1 Improve communication ability

One of the most significant advantages of multidisciplinary collaboration is that all collaborators are forced to communicate either to keep their ideas or to avoid complex programming efforts. This was reflected in their responses:

*"Of course, I have learned interview skills and communication manner etc."* Kevin

*"The process taught me the importance of persuasion. After all, we proposed the concept and asked for help to finish it, so during the process it seemed important to know how to persuade yourself."* Kevin

*"It is good for students in school to have a collaborative experience with industry. From an industry point of view, proposals fail very often. Therefore, students need to have the ability to persuade others to keep a ruby-in-the-rough concept."* Blanchard

One method of persuasion for designers is to use real user information by inviting programmers to join the user interviews.

*"In my experience, IT partners often propose suggestions according to their profession. Therefore, when they questioned our design, it was better if we could show the endorsements received from the users to persuade IT students."* Ameng

*"Learning by doing. The repeated modification annoyed IT students, so we invited them for an interview. After feeling they had truly participated, they maintained their passion until the end."* Ameng

### **3.2.2 Get acquainted with the collaborative process of product development**

The process of multidisciplinary collaboration is hard to learn without real experience, so the advantage of having such collaboration in education is to become acquainted with the complex process in industry.

*"The process helped me learn what it is like to work."* Kevin

*"Through this experience, I know that when I work in the industry, similar cases could be finished quickly and can reach similar results as the thesis."* Kevin

*"Each stage of the Master's thesis benefited me. The experience prepared me for future cases. I can understand the purpose of each stage and realize what to do next."* Fish

*"It can foster the ability of the project manager because you could at least understand how long it would take to finish a case and how to handle each stage. The ability could not be obtained by students of pure research or pure design."* Fish

### **3.2.3 Foster collaboration skills**

Similarly, multidisciplinary collaboration fosters collaboration skills especially with partners of different backgrounds. The lack of shared common language and knowledge requires better collaboration skills. Not only by being friendly and flexible, but also by sharing your own ideas in a mild-mannered way.

*"The collaboration between IT students was equal; they helped each other, and learned from each other. After all, I am not a programmer, so I would ask for the programmers' opinions and abilities to find the best way to cooperate."* Fish

*"One tip to cooperate with IT students when asking for modifications is not to give them problem lists dispersedly. Besides overviewing these new questions repeatedly, it is better to accumulate several problems before discussing the matters with them and asking for modifications."* Fish

*"During the design process, our design would inevitably be changed and modified. It is acceptable as long as the initial design purpose remains the same."* Fish

*"Learn to appreciate the difficulties of programming and avoid implementing them in the design process to reach the same design goal but with a transformed design method."* Kevin

### **3.2.4 Positively beneficial for future career development**

Executing the design project from inspiration through ideation to implementation gives students a sense of reality and prepares them for design practice in industry where every project is implemented for real. At the same time, the process gives them the self-confidence to cope with their future career.

*"From multidisciplinary collaboration, I learned about many things that I would face when stepping into industry. Moreover, I have made many friends from different domains, and maybe we will have opportunities to work on the same project in the future."* Ameng

*"The ability to undertake multidisciplinary collaboration could not be improved by personal efforts but through collective learning. For my future career, I believe the experience of multidisciplinary collaboration is a big plus. Although I do not have work experience, in an interview I could say that I do have experience of creating an APP from scratch to full operation."* Kevin

### **3.2.5 Different professions complement each other**

All the participants learned things from the other participants with different backgrounds. In industry or in design education, it is not usual to work in a heterogeneous group for a whole year. However, this experience gives everyone an opportunity to observe different ways of development and to learn how to work as a team by complementing each other.

*"This was the first time we cooperated with a professional UI designer. We used to take care of UI ourselves, looking for graphs on the internet and roughly demonstrating UI. The result of the collaboration with a designer felt better. The usability is better as well as the aesthetics."* HANNA

*"I think a designer has better experience in how users operate."* JAMES

*"The benefit was being able to see the thinking model of a designer. Kevin's design thinking was well structured with multiple layers. It was very impressive."* JAMES

*"Joining force with the designers made the visuals look much better for the demonstration and for the completed product."* JAMES

*"Multidisciplinary collaboration was good for RD (research and development staff), as it helped to increase our knowledge. For RD, besides of realization of functions, how to increase usability through UI and user-centered modification (is equally important). There are too many issues. If we do all of them, we might lose our focus and this is where designers can help us to improve."* Jonas

### **3.2.6 Improve sense of achievement and professional abilities**

Finally, this realistic design project takes enormous time and effort to finish. However, to be able to see his/her own design realized often provokes a very strong sense of achievement since most of the design students' work remind in concepts even with realistic physical or digital models.

*"In the end, the app was released onto the market. I feel a strong sense of achievement. I also obtained more knowledge of programming. During the process I would look for many data, so my professional abilities were improved."* Ben

To sum up, in terms of the collaborators, their communication, collaboration, and professional abilities are improved. During the process, they can become acquainted with the collaborative process of product development and see how different professions complement each other. In the end, the multidisciplinary collaboration has positively benefitted their future career development and improved their sense of achievement.

### 3.3 The disadvantages of multidisciplinary collaboration

We present the disadvantages of multidisciplinary collaboration in this section based on the results of interview. The initial outlines of the interviews had equal numbers of questions enquiring about the advantages and disadvantages of collaboration. After organizing the raw data, we found that the responses of the disadvantages were limited to one IT company. The followings are the results.

#### 3.3.1 Time Pressure

One of the disadvantages was the time constraint. For a multidisciplinary team, they need to not only finish their own work, but also spend time communicating and responding to the modifications given by their counterparts. The latter two elements do not exist in a non-collaborative process.

*"Sometimes it was too tight. I felt that when designers cooperate with engineers frequently, the amount of modifications should be managed better."* Hanna

This time issue was worsened by our decision to participate in a competition.

*"Because of the desire to join the SAMSUNG competition, it was too rushed."* Charlie

The background of that collaboration was that both design and IT participants decided to submit the concept to a design competition, which ended in three months, so they were all under a tremendous time pressure.

#### 3.3.2 Differences in Backgrounds

The other disadvantage was caused by the differences in the backgrounds of the collaborators. The first difference was in the level of their careers. The working schedule of a designer, being a master's student, was very different to the working schedule of an engineer, being a full-time programmer at a company. Generally, a student tended to work from noon to midnight, while a company programmer tended to work from morning to afternoon. Therefore, they had very little mutually convenient time to discuss the details of the project.

*"I was the person taking care of the communication for the design. Our jobs were different and our working schedules were different. The convenient period for both of us was relatively short. Therefore, I had to work overtime (in order to cooperate with the designer)."* JAMES

Besides the working schedule, the discrepancies between the collaborators' understanding of the work was another issue caused by their different backgrounds.

*"The improvement needed to be made for this cooperation, besides time, was the communication and problems in understanding what each other's work entailed, which further resulted in time problems. For example, I believed that designers could quickly finish their drawings, while the designers believed that the engineers could easily achieve some functions. However, the discrepancy of understanding was not easy to clarify and it took much discussion to make clear. Therefore, the best way is to communicate frequently. When problems occurred, we had a discussion. It does not have to be face-to-face. Telephone and e-mail are all fine. The point is that problems should be dealt with instantly to avoid the accumulation of too many hard-to-solve problems."* JAMES

In terms of APP design, engineers specifically mentioned flow charts as one important method to communicate between designers and engineers.

*"What we care most about is the operation process, the flow. The original version was not complete, especially the differences between Android and iOS. We did not have this mutual understanding in the beginning, so in the following process the flow was modified several times even with two face-to-face discussions. After which, we had several conversations and e-mails."* JAMES



"Before the program, the structure of the flow has to be clear. As soon as a designer has some ideas or prototypes, he needs to discuss them with the engineers to avoid wasting any time or reluctantly discontinuing any work, for example, codes of functions had to be finished piece by piece separately and then connected together."

JAMES

To sum up the disadvantages of multidisciplinary collaboration, the findings were about the difficulties caused by time pressure and the difference in backgrounds. All of the disadvantages were proposed by engineers in the iListen Design Project. We further explored the issue with the other two teams, who did not express any disadvantages of multidisciplinary collaboration. The findings were that both engineer teams had previous experience in multidisciplinary collaboration and their corresponding designers provided an animated version of flow. The iCAN designers used keynotes to simulate the interaction, while the DD designers used Axure Pro to do so. The result was a better understanding of the operation process and thus less time was spent on communicating and misunderstandings.

#### **4. Conclusions**

This research project intended to explore the influence of multidisciplinary collaboration in design education. We have recorded three complete design processes based on the ideas of design thinking with the features of user-centered design, multidisciplinary collaboration, and a fully functional end product. All the participants were interviewed and the results show multidisciplinary collaboration resulted in better skills in communication, collaboration, and professional abilities, a better understanding of collaborative process and how the different professions complement each other, a positive influence on future career development and a sense of achievement. Only a few disadvantages were mentioned, which included issues caused by time pressures and different backgrounds. The results contribute to the implementation of design thinking in design education. Future studies would explore the influence of user-centered design and prototyping in order to connect the design practice into design education.

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