

**Mapping existing and potential skills in project-based learning**

A Master's Project Proposal

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## **ABSTRACT**

This project helps learners become more aware of what they need to learn to complete the projects they are passionate about. In particular, we focus on middle and high school students in formal learning environments with project-based learning. We provide a set of online tools that gives students clarity about the skills they want to learn, the skills they already know, and the specific skills they need to reach certain goals.

In the platform, students select and add certain broad skills they want to improve on or need for a class or personal project. They then select skills they feel confident in and can teach others. A skills chart, or learning goals chart, is generated from this information. This will help teachers keep track of students' diverse learning goals. For students working in teams, this will allow teams to share information as to their goals and generate opportunities for peer learning.

## CHALLENGE

Project-based-learning (PBL) is an educational methodology where students complete projects solving authentic, real-world problems. Although the idea has been around for over a century (Dewey, 1916), PBL has recently resurfaced as a trend in education. A trend of new elementary, middle, and high schools such as the Khan Lab School in California or the Innova Schools in Peru have put PBL at the core of their curriculum. Beyond these few special schools, PBL is being adopted at a larger scale. For example, the Chilean Ministry of Education has instituted a new mandatory “Projects” course for students nationwide. The renewed appeal of PBL is in part because it has proven to have a positive effect in developing 21st century skills in secondary and post-secondary learning environments (Moylan, 2008). By 21st century skills, we mean skills like critical thinking, collaboration, communication, creativity, and self-directed learning (SDL), among others (Ravitz et. al., 2012). Job growth is outpacing our ability to develop a prepared workforce, making it more critical than ever to teach these skills. In this Master’s Project, I specifically focus on how to foster collaboration, communication, and self-directed learning through project-based learning (PBL) for middle and high school students.

One of the main challenges with PBL is getting clarity on what students learn in a project. Students should define their learning goals, and when working on project teams, teachers should make sure that students are actually working towards those goals. It is a common problem with PBL implementation over recent decades for activities to be disassociated from specific skills for learners to develop (Blumenfeld et. al., 1991, p. 383). Learners must therefore have more clarity on the critical skills they need to develop for a project. In the opening-stages of a project-based learning course, students benefit from having scaffolding that helps them develop Self Regulated Learning (SRL) skills. This includes activities that build student motivation, activate their awareness of prior knowledge, and creates a vision of what they need to learn (English & Kitsantas, 2013, p. 134).

I visited a public charter school implementing PBL to see how they dealt with these challenges. The course was generally well-implemented, but I spotted one clear area for improvement. Teachers gave students duties and skills reflection worksheets. While useful, these worksheets (see Image 1) were difficult to track and draw data from and looked cumbersome. It would be difficult for students in the midst of a project to return to these worksheets, as they may be lost or hidden in a folder. Most importantly, the multitude of skills and duties listed could be confusing to some students.

**Image 1: Skills worksheets used for PBL at a public charter school**

## Assigning Tasks to Your Group

**Directions:**

**Block 1**

- With your group, write every task that will need to be done for your exhibition plot (page 2).
- Write the "weight" of the task by circling the weighting symbol. In other words, the challenging task that will require a lot of time, power and/or time, then circle these symbols. If it's less challenging and demanding, circle one symbol. If it's easy, circle one empty.

You will return to this block in Block 3. During Block 3.

- Now that you have gone through every task and assigned it, go through the list one more time and add anything you may have forgotten. Every task has the "weight" of the task.
- Now that you have written down every task and weighted it, assign these tasks to group members (bottom 5).

# Transferable Skills Checklist

Cross off those skills you already have...  
Use those left to help kind of or more.

**Interpersonal skills**

able to interact successfully with others  
able to work with others in a team and  
use body language

**Presentational abilities**

present information and ideas clearly and  
convincingly, will address any gaps  
appreciates the audience's reaction and  
responds to it in a pleasant manner

**Communication skills**

able to make formal presentations,  
presentations and informal presentations  
in an interesting way

**Convincing skills**

responds to others when asked to  
use a new material and/or technique  
can persuade others to try something  
can persuade others to work  
can persuade others to work  
can persuade others to work

**Teamwork skills**

works well with others in a team  
can work with others in a team  
can work with others in a team

**Problem-solving skills**

can solve a problem  
can solve a problem  
can solve a problem

**Organizational skills**

can organize information, people  
and/or things in a logical way  
can organize information, people  
and/or things in a logical way

**Initiative skills**

able to become curious about others  
from other perspectives or materials, able  
to find out more about others, able to  
find out more about others, able to

**Interpreting skills**

able to interpret a person's  
feelings, able to interpret a person's  
feelings, able to interpret a person's

**Customer service skills**

able to build a relationship of mutual  
benefit with others, able to build a  
relationship of mutual benefit with others

**Goal setting skills**

able to establish goals and objectives  
and give others a sense of purpose  
and give others a sense of purpose

**Attention to detail skills**

able to pay attention to detail  
and to pay attention to detail  
and to pay attention to detail

**Critical thinking skills**

able to think critically about a problem  
and to think critically about a problem  
and to think critically about a problem

**Problem-solving skills**

able to solve a problem  
and to solve a problem  
and to solve a problem

**Teamwork skills**

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**Teamwork**

In this project, I seek to do a lot of what these worksheets accomplish: to help students reflect on the skills they are learning in a project, on the strengths they bring to it, and on what they want to improve on. As I will explain below, I do this through an online browser app that facilitates student self-reflection on skills and sharing their different levels of confidence on each skill required for a project.

## **LEARNING OUTCOMES**

How might we help middle and high school students engaged in projects define and share their learning goals and help each other achieve them?

This project helps learners in PBL courses at middle and high schools define their learning goals, become aware of the skills they bring to a project, and identify the skills they want to and need to improve on. We want to help them build self-directed and self-regulated learning skills (SRL and SDL). In projects with a team context, this includes helping students assign tasks to maximize the learning goals of each individual and create opportunities for peer-learning. Lastly, we hope to make this process transparent and trackable for teachers, giving them the data to help teams and students when needed.

We do this through student self-assessment in the skills required for the project. From this information, personal growth charts are generated for each student. Guided by these skill charts, students can find peer mentors who show confidence in desired fields and can guide others in their team in the areas where they feel stronger.

## THEORY

The literature on project-based learning and group work shows that helping students reflect on their skills and helping them see themselves as having both strengths and areas for growth can have a positive impact on group dynamics and student outcomes. Blumenfeld et. al. (1991) explain how what they call students' strategic metacognition can be crucial for success in project-based learning. By this, they mean students being able to guide and control their own activities and set goals (p. 379). The authors then suggest that technological tools can be used to provide scaffolding for students to better carry out this strategic metacognition. One example they cite is prompts to reflect about learning, which is similar to what my project entails.

Paris & Paris (2001) review studies of Australian classrooms to show that self-appraisal has positive effects on attitudes towards school. In my project, I similarly hope to increase students' enthusiasm for school by helping them in self-appraisal. The hope is that the skills growth charts will serve that function. This is also in line with what English & Kitsantas (2013) argue, namely that it is important for teachers to help students make their thinking visible. This is reminiscent of Papert's (1980) idea of creating "objects-to-think-with". My project's skills growth charts as well as other features, can provide these objects-to-think-with that make students thought process visible to them.

Cohen & Lotan (2014) explain how different expectations among socio-economic, gender, and racial groups can stymie certain learners (p. 35). As low-status learners are not expected to make a contribution, their own self-evaluation suffers, and they tend to participate less. Cohen & Lotan proceed to argue (p. 158) that teachers can help change this dynamic by "assigning competence." Since the skills growth charts generated by my project are relative to each learner, all learners will be shown to be confident in at least one area, thus helping to equalize expectations.

From each learner's area of confidence, our platform assigns each teammate in a project the title of "expert" in that specific skill. The expert is expected to lead peer-learning sessions to help their teammates improve if needed to complete a task in a project. Besides giving each student higher expectations in one area, I also hope that this will generate a protege effect between teammates. The protege effect is when a learner has the responsibility to teach others—it has been proven that this responsibility actually helps improve learning outcomes through building motivation and a growth mindset (Chase et. al., 2009).

Lastly, part of what this project achieves can be understood under the "four stages of

competence” framework. In this framework, of uncertain origin but probably developed in the 1970s (Hansen, 2012), learners go through four stages: unconscious incompetence, conscious incompetence, conscious competence, and unconscious competence. In other words, learners at first are unaware of what they do not know, they then become aware of not knowing, then they are aware of improving and using a skill, and lastly they use this skill without even realizing it. Part of the goal of this project is to bring learners from unconscious incompetence into the conscious incompetence.

## EXISTING SOLUTIONS

Project-based learning methodologies have spread widely over the past few years, spurring the development of many resources to support teachers implementing it. These include many repositories of content that teachers can implement to create a PBL course. For example, the website [unprofessionaldevelopment.org](http://unprofessionaldevelopment.org) has a library of activities that teachers can use in PBL. The [Buck Institute for Education](http://Buck Institute for Education), a research center focused on PBL, also has an extensive resource database of lesson ideas. [Aula 42](#), in Chile, offers teachers full semester-long courses with interdisciplinary, project-based content. [Workbench](#), lastly, is a US Common-Core aligned database of projects for students to complete.

There are also several platforms that help teachers manage students' projects. One such example is [Project Pals](#), a platform where teachers can assign teams and tasks and visualize project teams' progress, and where students can publish and share the files their team is working on.

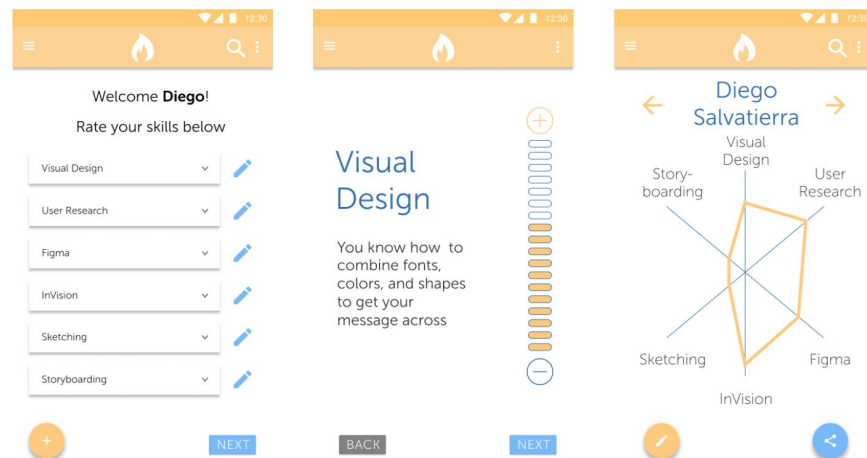
All of these initiatives are useful. My project does not seek to offer a comprehensive library of projects, or a project-management platform. Rather, it will complement these tools. What I find lacking are tools that push students out of their comfort zones when working in projects, that motivate them to do things they would not do without a project, that keep them persistent even when they are beginners in a new skill. There are few tools that actively spur children to think of the skills that they have and those that others have, that motivate them to give each other feedback or share their skills, which is what this project does.



## DESIGN & FEATURES

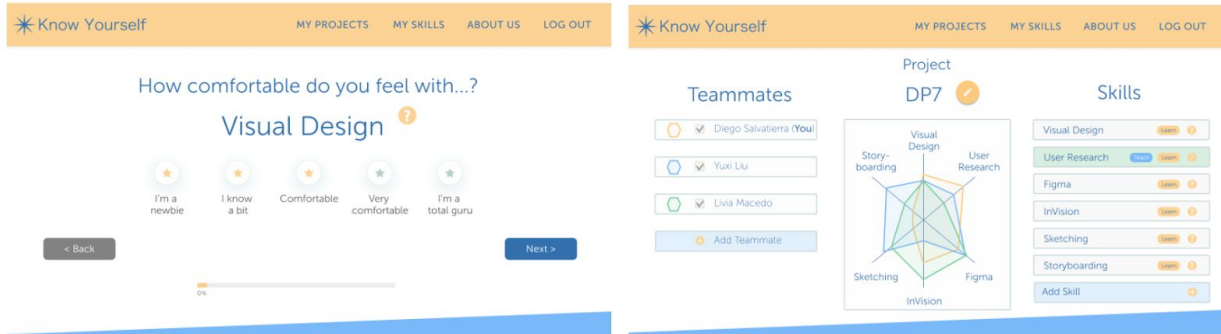
This platform will take the shape of a desktop application. The decision to create a digital interface as opposed to a paper-based one is because of the disadvantages I have seen with paper-based worksheets that fulfill a similar function, as discussed in the previous section. A digital version allows students to more easily refer to the learning goals and skills they have registered. It also allows easy comparison between teammates, and can make it easy to connect teammates or classmates with intersecting growth charts. Lastly, it makes it possible for teachers to review student growth and confidence both within the timeframe of a project as well as between cohorts or across years, if multiple teachers share data.

**Image 2: Initial mobile prototype sample screens**



At first I developed a mobile prototype, but soon shifted to a desktop version upon noticing that students in PBL contexts were already using laptops widely. The idea is for this platform to integrate into Google Classroom, both through sign-in functionalities as well as being able to export charts into Google Drive. Desktop versus mobile makes this smoother. There was some concern regarding the ability of learners in lower-income or developing countries to access laptops or desktop computers. While this may be a barrier in the lower-tier of developing countries or in very poor areas, we find that most lower-middle- and middle-income learners even in many developing countries already have access to computers. For example, the Chilean government has recently instituted a policy where all 7<sup>th</sup> graders in public schools in the country are given their own laptops. Chromebooks were also widely available in the majority-minority and low-income charter school in California that I observed.

**Image 3: Second prototype (desktop browser) sample screens**



The key feature in the platform is the ability to create skills charts where learners assess themselves on the skills required for a project. At the beginning of a project, students launching a project in a PBL course self-assess their comfort levels on a variety of skills needed for their project. These students will already be working in teams, assigned in a way a teacher best sees fit. This list is partly self-created, as identifying what you need to know is a key skill PBL. But students may not be aware of every skill they need for a project, so there will be pre-selected options in some cases. After students self-assess on each skill, a skills chart is generated (see Image 3).

From this skills chart, students select one specific skill to focus on significantly improving during the project. This feature is meant to foster students' growth mindset, to make it explicit that they can grow in a skill they choose. They also select one skill that they feel they can teach others. Alternatively, students could be automatically selected by the platform to be an expert/coach in the skill they feel most comfortable with.

## ASSESSMENT

I have already begun testing prototypes of this platform with students in PBL classes in formal learning environments, particularly in middle schools and high schools. Specifically, a prototype of the platform was tested with middle school students at Jane Lathrop Stanford Middle School in Palo Alto as well as high school students at Palo Alto High School. Both a worksheet prototype—where the basic functionality was simulated via worksheets—and digital mockups were used in this process. The digital mockup [can be viewed here](#)<sup>1</sup>. I also received feedback on the idea and the prototype from former high school teachers at Stanford University and current high school teachers visiting a Project-Based-Learning Conference in Santa Clara University. The initial reaction from learners and educators was positive. From this testing I found the following conclusions:

### *Positive/validating the concept*

1. Students like the radar chart design, finding it intuitive and new.
2. Students had not done much reflection on their learning goals, or if they had, they had forgotten it. They found the exercise useful.
3. Students are indeed willing to select a skill in which to teach others.
4. Teachers indicated they would be willing to try it when teaching projects.

### *Need to change*

1. Students already use laptops in class, so I should switch to a desktop app.
2. The “rate yourself” language can be intimidating for students—need to switch to softer language.
3. Students want to compare the charts directly in one view.
4. The rating scale is unclear: what does high or low on the bar mean?
5. Students have very different internal scales in which they measure themselves (i.e. for some a medium result is low, for others a medium result is high), so the charts should be relative between students instead of directly based on their self-assessments.
6. Why is the logo a flame? Meaning unclear.

From this feedback, I developed a second version, this time as a desktop/browser mockup. This version can be seen [here](#)<sup>2</sup>. In this prototype students again found the radar charts exciting and intuitive, and they enjoyed the new ability to view different

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<sup>1</sup> <https://projects.invisionapp.com/share/G9FV45VSB24>

<sup>2</sup> <https://www.figma.com/proto/WIgn9wfBf20HSQz7NFdtKGfk/DP7>

teammates' charts simultaneously. New pages for adding their own skills also appeared to be intuitive. They compared the general usability favorably to other online tools they use in school. They indicated that using this tool would make their teamwork better, as it would lower the frustration of teammates not knowing what to focus on.

On the critical side, students indicated some confusion at being named the “expert” in something, although they did indicate that it made them feel more confident. Perhaps for a future version I can make the language softer and the designation less sudden. More details about these testing sessions and minor changes can be found [in this Medium article](#).<sup>3</sup>

After this initial prototype testing is concluded, I plan to generate more robust means of testing the impact of this project. Since one main goal is to help students define their learning goals and reflect on their skills, one possible measure would be to ask students in the same classroom who have used the platform and some who have not to fill out questionnaires on what they learned during a project at the conclusion of a course. These questionnaires could measure, months after they initially used this platform during the project kickoff, whether they have any greater awareness of their learning goals and skills. Alternatively, we could compare the performance in a PBL course of teams that have used the platform against that of students who have not.

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<sup>3</sup> <https://medium.com/@diegosalva.ds/portfolio-project-case-study-know-yourself-4834b49c7d77>

## SUMMARY AND NEXT STEPS

The major idea behind this project is to give learners in project-based courses an awareness of what they want to learn, why they need to learn it, and where they can learn it. Ultimately, by making students aware of what they already know and what they can improve on, we hope to foster growth mindset and an ownership of their learning goals.

Regarding next steps, based on my last round of testing and the learning goals in the project, I want to add the following features to the prototype:

1. Add an “assign duties” feature for students to distribute tasks in a team. This was suggested spontaneously by the middle-school students and some teachers.
2. Connect learners to online resources to improve on weak areas. This was suggested by the high-school student testers, as well as my thought partner in my Master’s Project.
3. Add scaffolding for peer-learning, guiding students on how they should teach each other, and allowing them to connect with other students who could teach them within the same classroom. This is because students indicated willingness to teach others, but do not have much experience doing so.

I will then look for more places where I can test a third prototype. Concurrently with that (as the third prototype will have fewer changes than between the first and second), I will begin to create a functional prototype, whether through coding it myself or getting support from elsewhere in the Stanford community or freelancers to do so. Lastly, I will create the more robust testing procedure mentioned earlier, to see whether the project really is helping learners.

## **COLLABORATORS**

This project would not be possible without the support of several other people. Wenyan Hua, also in the Learning, Design, & Technology program at Stanford, is developing a platform that will help students find the most relevant online resources for their project. She has been an invaluable thought partner in developing the ideas in this project. Shelley Goldman, my academic adviser, has provided valuable feedback and helped me attend the Project-Based Learning conference at Santa Clara University, where I spoke to many teachers who gave me feedback on my ideas. Lastly, it is worth thanking the staff at the LDT program at Stanford, including Karin Forssell and Soren Rousseau, for their feedback and ideas for how to move forward with the project.

In the future, this project will be used and tested at two collaborating organizations. One is HackX, a portal with projects for students to complete based in mainland China. The other is Aula 42, which as mentioned previously offers project-based-learning curricula to schools in Chile.

## TIMELINE

Initial ideation & need-finding: *September 2017 to January 2018*

- Interviews with PBL practitioners
- Brainstorming solutions with thought partner & adviser
- Observation of PBL classes

Initial prototype development: *January to March 2018*

- Development of initial digital mockups & paper prototypes
- Initial testing of these prototypes at local schools

Prototype testing & iteration: *March to June 2018*

- Develop functional digital prototype
- Test this prototype at local schools and with collaborating organizations
- Develop robust assessment measures

Presenting results: *June to August 2018*

- Finish platform development
- Develop presentation for LDT Expo

## BUDGET

Item	Amount
Prototype testing travel & thank you gifts	\$200.00
Freelance programmer	\$2,000.00
Online advertising	\$100.00
Freelance designer	\$1,000.00
Online hosting / servers	\$200.00
<b>TOTAL</b>	<b>\$3,500.00</b>



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