

Executive Summary

Company Overview and Mission

For most students, learning mathematics is perceived to be unintuitive, time-consuming, and tedious. Despite its necessity in most careers, many students treat studying mathematics as a chore. This distaste for the subject often hinders their academic growth and future career opportunities. NousQuest was formed from our experiences of witnessing dozens of peers refrain from pursuing advanced mathematical opportunities because of poor learning experiences. By combining our unique problem bank architecture with various machine learning techniques, we will create unique gamification features that will make learning mathematics an interactive, personalized, and enjoyable experience for the next generation of students.

Problems

Through over **fifty** interviews with students from middle school to university across the Massachusetts area, we have identified three core problems (**B.A.D.**) with the current mathematics education system.

1. **Boring:** Most classes are taught in a lecture format that many students find boring and unhelpful. Almost 70% of students interviewed reported having trouble paying attention, and over a quarter of students skipped lectures because they reported learning better independently (Petrovic & Pale, 2015).
2. **Abstract:** Classes fail to give concrete examples or build intuition for the content they cover. Math teaching often emphasizes memorizing formulas, algorithms, or proofs without explaining their derivations (National Council of Teachers of Mathematics).
3. **Disjointed:** The curriculum is non-standardized across schools (Education Commission of the States), so it is hard for students to use external resources to reinforce ideas. All students interviewed reported using Google or similar sites to search for problems for math help. Over 60% reported struggling to find appropriate materials due to the content being custom-designed or locked behind a paywall (Chegg, Coursehero, etc.).

These problems are particularly exacerbated in the newest generation of learners who have become accustomed to fast and easy satisfaction through the proliferation of entertainment mediums like mobile games and social media and lack the patience and focus to struggle while studying. A report by Microsoft found that almost 70% of students who reported high social media usage and early adoption of technology also reported having difficulty staying focused and managing time. To compete with entertainment for attention, education systems must find new ways to connect with their students.

Our Unique Solution

Using the interview feedback, we plan to develop a gamified learning app to address the problems mentioned above. This app will have three unique core components:

1. **Problem Database:** Over 90% of interviewed students reported primarily using practice problems to study and learn mathematics. As discussed in **Problems (3)**, many struggle to find these practice problems. Using our app, users can search for practice problems in our database using tags or a custom LaTeX search engine or contribute problems to the database using specific tags for future users.
2. **Machine Learning Algorithms:** These algorithms will select problems from the **Problem Database** to solve. These problems will be selected using past user performance to pinpoint mathematical areas of weakness.
3. **Gamified Exercises:** Using the problems/solutions collected in the **Problem Database** and supporting **Machine Learning Algorithms**, users can generate engaging practice materials to motivate their studying. These exercises reinforce concepts using repetition and practice directly addressing **Problems (2)**. Furthermore, these exercises aim to circumvent the lack of engagement discussed in **Problems (1)** by using gamification features like problem streaks, leaderboards, and online groups commonly found in other social media apps. These features will be supplemented with LaTeX typesetting and diagram

creation tools to create a more specialized mathematics learning experience. Our UI/UX will also be modeled after popular mobile apps and social media platforms.

Our **secret sauce** lies in these components. Our **Problem Database** and **Machine Learning Algorithms** will customize the content to match the user's requirements and skill level, similar to how social media platforms recommend content to viewers. The **Gamified Exercises** will provide fast and easy entertainment like a mobile game. In combination, this will make learning an enjoyable and satisfying experience that can compete with modern entertainment.

Market and Distribution

Our product would be a part of the Mobile Learning Systems macromarket. This market is rapidly growing, worth \$35.4 billion in 2021 and expected to reach 230.1 billion by 2029. Our target segment of Math Mobile Learning Systems was \$5.2 billion in 2021 and is expected to grow to \$33.1 billion by 2029. The increasing value of STEAM education and the proliferation of mobile devices make it a lucrative investment market.

In math educational products, specialized materials are designed for math competitions like AMC, AIME, and USAMO. Unfortunately, they require a lot of self-motivation, economic resources, and advanced knowledge and often exclude the larger general population of students who want to progress their mathematical knowledge independent of competition. Our app will serve this larger market while maintaining utility for math competition enthusiasts.

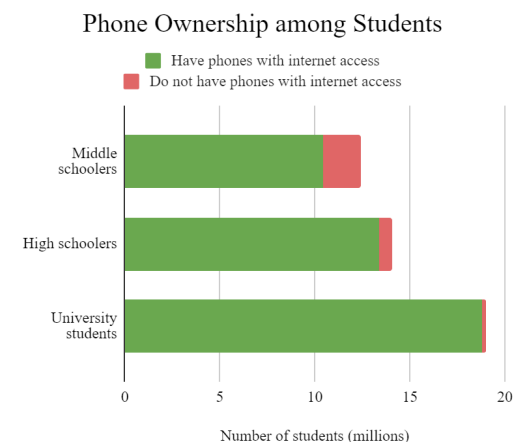
Both our **primary users and customers** are students between middle school and university. Our findings from interviews conducted with fifty middle and high schoolers from Massachusetts found that **100%** of students desire more personalized and interactive study methods. We plan to cater to mobile users because of their convenience and widespread utility.

From customer interviews, we segmented users into three categories based on their opinions about learning math:

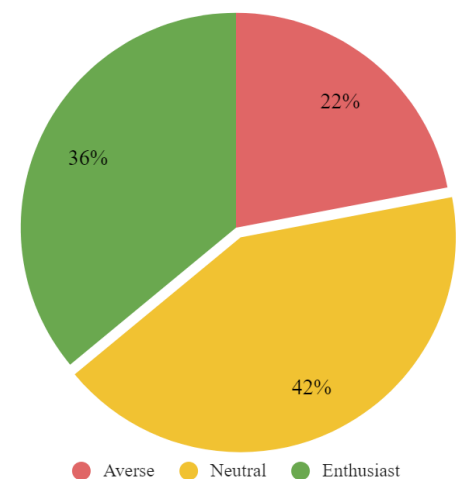
1. **Enthusiasts:** Very passionate about the subject and would take the highest level courses available. Also likely to take part in extracurricular math competitions or conduct research.
2. **Neutrals:** No strong feelings towards the subject. These students want to good grades on tests and assignments without stressing out. This group is the most likely to search questions on the internet.
3. **Averse:** Dislikes the subject and studies only to pass the course. Poor grades or experiences likely cause them to dislike the subject.

We plan to cater to **Neutrals**. The **Problem Database** mentioned in **Solutions (1)** would be more effective in completing assignments than conventional Googling, and **Gamified Exercises** discussed in **Solutions (2)** would make studying more enjoyable. From customer interviews, we found **Averse** students to be the most challenging group to cater to. If the product proves pedagogical value towards **Neutrals**, then **Enthusiasts** would also use it to supplement their learning.

Our **secondary customers** are educators who would use the app to help teach mathematical content. These educators would include 1) public and private school teachers, 2) after-school tutoring organizations like Mathnasium, Russian School of Math, Kumon, and 3) educational influencers like Po-Shen Loh and RedPenBlackPen. Marketing to secondary customers is more important as we plan to offer them in-app benefits for classroom usage and exposure. We will also use traditional marketing strategies like social media campaigns,



Distribution of Student Audience



digital ads, and word-of-mouth referrals.

At this stage of development, we are still designing the app to make it as user-friendly and feature-rich as possible. As a result, we have yet to launch officially and do not have any current users/customers. We have connected with educators, primarily public and private school teachers but notably several Mathnasium Regional Directors. When the app is ready to launch, these educators will be the first to help us share this app with students. Once launched, we will acquire customer loyalty through gamified features such as problem streaks and leaderboards to maintain usage interest.

Our business model will be spoke-and-hub with various users and distribution methods.

Competition / Differentiation

Using student interviews, we found that Averse and Neutral students mostly use Google searches and **Gamified Learning** and **Problem-solving Tools** like Quizlet, Kahoot, etc. to supplement their mathematical education. Enthusiasts would use **Comprehensive Learning** and after-school tutoring (Mathnasium, Russian School of Math, etc.).

Our competitors are other Mathematics Mobile Learning Systems. The systems can be categorized into three main categories:

Comprehensive Learning: Some apps in this category include Khan Academy, Brilliant, and Art of Problem Solving. These apps are great at building long-term mathematics knowledge and developing problem-solving skills, however, they do not take advantage of the mobile medium. Most of these platforms move textbooks and lectures to mobile devices and thus lack interactive features for students. As a result, students often get bored and disinterested while studying.

Our product will circumvent these issues using **Gamified Features** to capture and retain student attention.

Gamified Learning: These apps include Quizlet, Kahoot, and Prodigy Math. While these products have the interactive features that **Comprehensive Learning** lacks, they are less useful in learning. These apps are often repetitive, and while they suffice for low-level memorization-based math topics like multiplication tables, they are useless for older students who need to develop problem-solving skills. NousQuest will circumvent these issues using **Machine Learning Algorithms** that will customize the content for the user.

Problem-solving Tools: These include Photomath, Mathaway, and Wolfram Alpha. These apps serve very little pedagogical value but are primarily used to get solutions to math problems. While they suffice for equation-based questions, they cannot handle more complex problems and thus only have a fixed amount of functionality. Through our user-sourced **Problem Database**, the NousQuest app will provide a higher level of personalization in solving math problems.

The three key trends in the education sector are:

1. Mobile-First Approach
2. Gamification of Mathematics Learning
3. Personalized Learning Paths

The components make up Mobile Learning Systems, showing that this market will become the future of education. This information was heavily considered when deciding the features of the NousQuest App.

The inherent barrier to entry into the Mobile Learning System market is the \$150,000 baseline investment to develop a complex app. However, NousQuest aims to set up future barriers. These barriers come as popularity and user contributions. NousQuest's problem database content will be obtained through user loyalty (which will



be preserved through gamification). This surplus of content will make it hard for new platforms to match the level of personalization that NousQuests aims for.

Financials

We plan to use a freemium model to generate revenue. Basic functionalities like inputting problems and generating exercises would come with a default plan. More advanced functionalities like using the LaTeX search engine or advanced study games would charge a small premium. Similar models exist in similar competitors like Quizlet and Duolingo. We also plan to provide ad space for after-school tutoring spaces, and an ad-free subscription would be included in the premium option.

We will fund the business by applying for grants/accelerators, taking bank loans, and investing our capital. As we are still developing our product, most financial details are unknown, but based on competitor prices, we plan to price the premium option for users such as students at \$5.99 monthly and \$29.99 annually. We plan to price an educator option for teachers at \$7.99 monthly. Organizations will acquire bulk licenses to upload their curriculum at \$99.99. Further predictions are unknown until the prototype is released and initial client testing is completed.

Team Information

Our team consists of four cofounders whose profiles are listed below:

Arul Rhik Mazumder is a computer science student at Carnegie Mellon University with research experience in machine learning. He grew up as the son of a Mathnasium director and participated in many national math competitions. He has experience in social entrepreneurship as the manager of a Math YouTube channel called MathEx, with over 150 videos and 1000 subscribers. This unique background has created an interest in using technology to bolster current mathematical education methods, inspiring his founding and commitment to NousQuest.

Omar El Nesr is a high school senior at the Massachusetts Academy of Math and Science with significant experience developing useful technologies. He has developed new software for solving complex scientific problems at MIT CSAIL and created a tool for higher-quality meta-analyses of transcriptomic data at UMass Medical School. Besides research, he has also developed various applications for his school, from a community service portal to a mobile app to find available parking. Omar is passionate about making day-to-day activities and STEM education accessible to all. He hopes to use his previous experiences to bring this vision to fruition through the success of NousQuest.

Alex Chen is a high school senior at the Massachusetts Academy of Math and Science with substantial prior experience in physics and math competitions up to the national level. Additionally, he is passionate about teaching, having taught students individually and in groups in subjects ranging from Latin to computer science. He leads a club at his school centered on physics exploration. Through these experiences, he has developed a passion for expanding STEM education and making complex topics simple to understand, so when he was invited onto the NousQuest team, he was more than eager to accept.

Shreyan Ronit Mazumdar is a ninth-grade student at Acton Boxborough High School with experience in math competitions. Over the years, he has participated in the American Invitational Mathematics Examination and the American Regional Math League. He has experience in the arts, having a published short documentary called "A Nation's Feast" exploring the culinary history of America. This unique blend of liberal arts and STEM skills helps with his devout commitment as cofounder of NousQuest.

Our team possesses the technical skills and entrepreneurial mindset to develop and launch NousQuest. Our overall young age, with our team consisting solely of teenagers with extensive STEM experiences, provides us with a unique perspective that will aid us in developing a tool to help the next generation of students connect with math. As part of this generation, we possess a greater capacity to understand and cater to the idiosyncrasies of younger and new students.

Milestones

We have completed initial customer interviews through the recent Customer Discovery Program held by the Tepper Project Olympus Incubator. We have also acquired contacts with educators who will help us during the launch. Over the next three months, our next steps are to finish developing our prototype and do initial customer testing. If we were to win \$20,000, the money would go into hiring developers and accelerating product development. We would complete beta product development and testing within the next year and launch the app shortly after. We believe in our product idea and marketing plan, and the capital would greatly accelerate our growth.

Obstacles & Challenges

The most challenging technical hurdle would be the app development. Although possessing technical skills, we lack extensive experience in high-level software engineering, slowing down the development of the app. Connecting with other technical members will accelerate this process.

Three potential factors for failure (with our counters strategies) are:

Problem 1 - Lack of Starter Content: There will be no user-inputted problems when the app is launched. This lack of content could prevent initial users from generating materials.

Counter 1 - Scrape for Initial Problems: To cater to the first set of users, we will populate the problem database with thousands of initial problems to generate practice content. We have identified several math websites we can legally scrape for thousands of starter problems.

Problem 2 - Poor Marketing Strategy: This app needs to appeal to students to be successful. If marketed toward parents or educators, we will miss our primary users, and the product will not grow in popularity.

Counter 2 - Advertise Appropriately: While we connect with educators to promote the app for in-classroom educational usage, other forms of digital advertising should portray the app differently. Students will only engage with educational products if utilized in a classroom environment, as discussed in **Market and Distribution (secondary market)**. To attract more users outside of an educational environment, NousQuest must be advertised more like a game or social media to attract new users. Noting these different advertising strategies is essential to acquiring new users.

Problem 3 - Ineffective Engagement Methods: Not all gamification techniques retain user interest equally. Users will likely get bored and quit if the exercise template gets too repetitive.

Counter 3 - Use Proven Techniques: We must incorporate proven engagement strategies implemented in mobile games and social media apps. Some examples are daily streaks, missions, leaderboards, and online communities. These gamification features are proven to keep users interested in games and social media, so they will continue to retain user interest in learning and practicing mathematics. Introducing an online community aspect will create a community and prevent the exercises from being repetitive.

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