ParenThesis, an algorithm-driven pairing app that facilitates home-based education

1. Proposal summary

"ParenThesis" is a mobile app that connects parents to become "exchange tutors" for children from different families. Based on the information entered by users whose children need help with school subjects or career advice that their parents are unable to assist with, our app pairs children with parents of different strengths and professional backgrounds so that the families can form a connection based on mutual assistance.

To predict learning outcomes, understand learners' behaviors, and ultimately accelerate K-12 students' learning in literacy and math, we plan to collect data from both parents and children through our tool and work in-depth with researchers including Lukas Liu and Laura DeRose at Teachers College, Columbia University.

2. Our team

We are child-education specialists, designers, teachers, researchers, and algorithm engineers who graduated from Columbia University, Carnegie Mellon University, Wuhan University, and Scripps College. We concentrate on parental participation in children's learning and life-long development and believe that education can be more accessible, inclusive, and equitable with the support of technology.
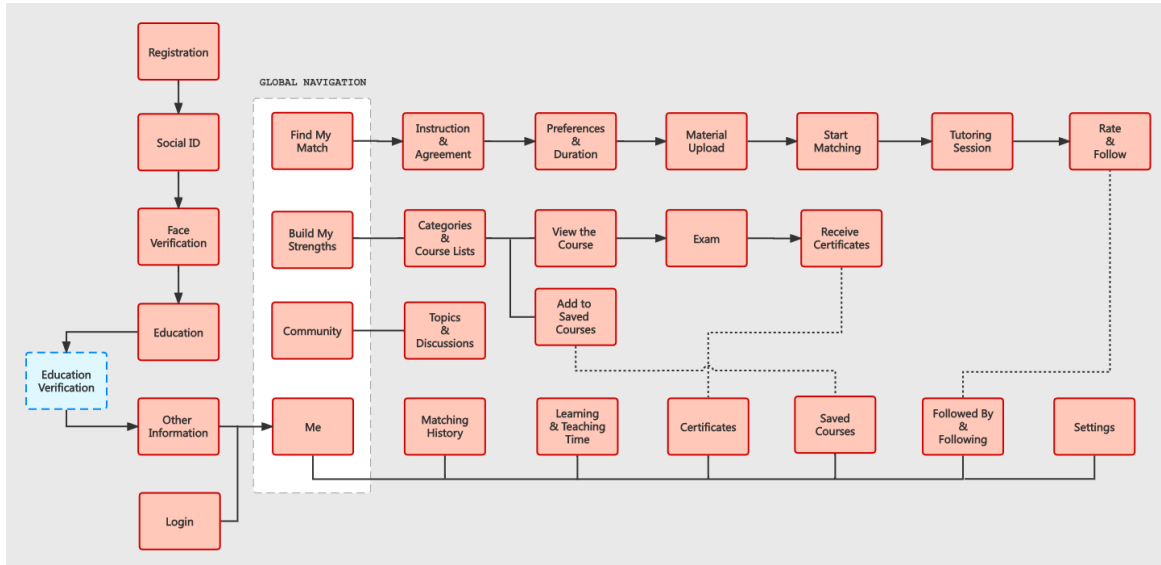
3. Description of our tool

"ParenThesis" is a combination of:
1) a matching app that connects specialized knowledge with families who need it;
2) a virtual community for parents and child education experts;
3) an online learning platform for home-based teaching.

Figure 1

Information architecture for the app "ParenThesis"

3.1 The matching, or the "parent exchange"

Based on users' subject strengths and weaknesses, the app's built-in algorithm pairs users up so that their needs can be fulfilled. For example, suppose the mother of family A is an accountant who finds it difficult to help with her child's essay questions, and that the father of family B is a freelance writer who struggles with math. They both have a third-grade child. Once they are registered on "ParenThesis", they will have their information saved to our database. When they both click for a match, our system will identify their needs and match them (see Figure 2 and Figure 3).

Figure 2

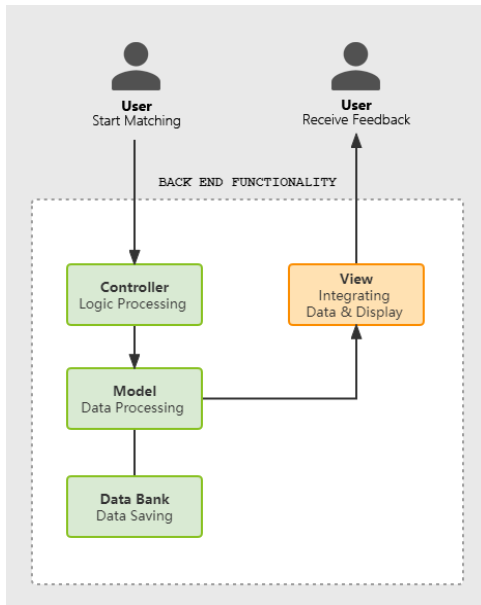*Back end functionality for tutor matching*

Figure 3

Prototype: animated loading screen for matching

After confirming the match, parents A and B will take their children to make a two-to-two voice call assisted by a real-time interface that displays exercises or essay prompts uploaded by the parents in advance (see Figure 4). In the tutoring sessions, children are encouraged to ask questions, take mini-lessons, and have customized activities with the tutors. After the sessions are over, the families can rate each other and choose whether they are willing to continue such collaboration in the future. The process is free. Participating parents only need to verify their identities and academic backgrounds upon registration, such as a degree or relative certificates.

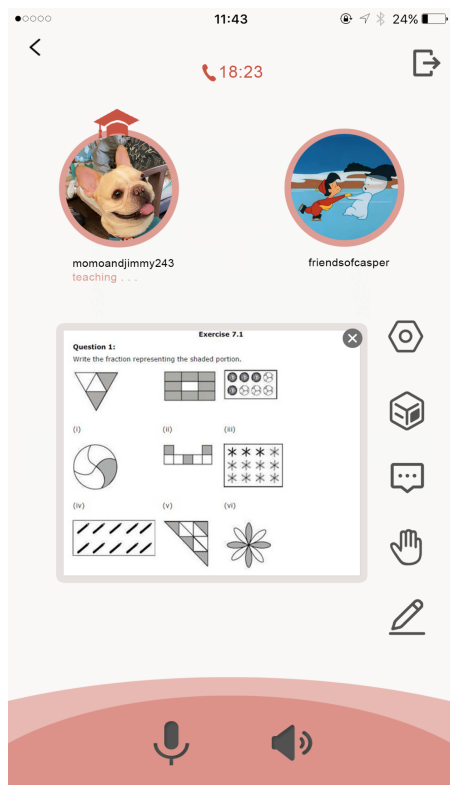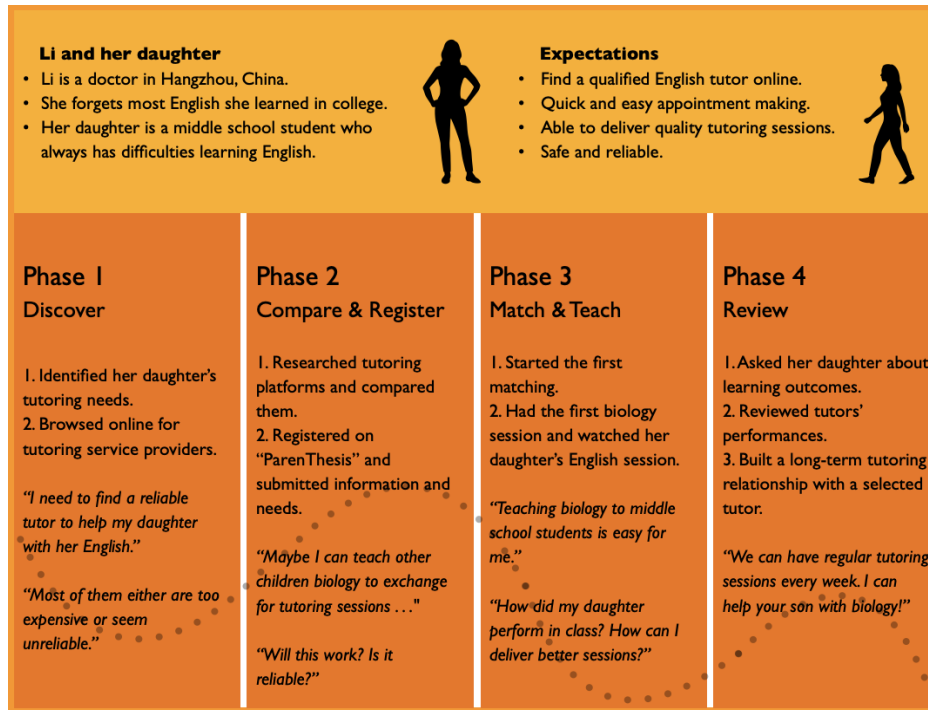**Figure 4**

Prototype: during a session

Figure 5

User journey map

Li and her daughter
- Li is a doctor in Hangzhou, China.
- She forgets most English she learned in college.
- Her daughter is a middle school student who always has difficulties learning English.

Expectations
- Find a qualified English tutor online.
- Quick and easy appointment making.
- Able to deliver quality tutoring sessions.
- Safe and reliable.

Phase 1
Discover

1. Identified her daughter's tutoring needs.
2. Browsed online for tutoring service providers.

"I need to find a reliable tutor to help my daughter with her English."

"Most of them either are too expensive or seem unreliable."

Phase 2
Compare & Register

1. Researched tutoring platforms and compared them.
2. Registered on "ParenThesis" and submitted information and needs.

"Maybe I can teach other children biology to exchange for tutoring sessions …"

"Will this work? Is it reliable?"

Phase 3
Match & Teach

1. Started the first matching.
2. Had the first biology session and watched her daughter's English session.

"Teaching biology to middle school students is easy for me."

"How did my daughter perform in class? How can I deliver better sessions?"

Phase 4
Review

1. Asked her daughter about learning outcomes.
2. Reviewed tutors' performances.
3. Built a long-term tutoring relationship with a selected tutor.

"We can have regular tutoring sessions every week. I can help your son with biology!"

3.2 The community, or the social media for parents

The app maintains a robust community where parents can discuss topics ranging from daily interactions with kids to choosing a suitable extracurricular course. This feature effectively retains users by fostering mutual communication and increases parents' attention to home-based education. We also invite experts in child education to share their insights and studies by answering parents' questions. We believe such a community will influence parents' understanding of education on a fundamental level.

3.3 The learning platform

The third component of the app provides resources for parents to learn to be better parents and better tutors. It collects and categorizes courses on parenting methods and provides teaching materials for all school subjects (leveled). Videos are made by professional instructors with built-in interactive quizzes. After completing a course and passing the exam, the parents receive digital certificates that appear as badges in their profiles, which validate their competency and authorize them to use the expertise to teach children.

4. Research base and potential for impact

4.1 How the tool accelerates K-12 learning: theoretical background and solutions

4.1.1 The basis: building motives

Instead of making home tutoring a rigid, one-way Q&A process, we encourage parents to actively nurture students' goals and provide helpful guidance. Modern pedagogy emphasizes starting from the learner's current purpose and interest (Bell, 1940), and numerous studies have provided activities and games that are easy to manage and simple to carry out in the home and are successful with oral reading, vocabulary words, spelling, and math facts (Hall et al., 1982; Thurston et al., 1982).

Our app provides online materials and interactive models for games, sets up a reward mechanism, and allows children and parents to interact with a paired tutor and playmate. The rewards from games and quizzes (virtual credits) are reflected on the user profiles, making the learning process an immersive, interactive, and gamified experience. "Motive is the basis of learning" (Bell, 1940, p. 116), and our tool helps make learning more effective by thoroughly stimulating the children's motivation and potential.

4.1.2 The safety net: parental participation and attention

Parents' behavior patterns and attention have an indelible effect on children's learning. Al-Yagon's study (2014) compared the relationship between the emotions and coping resources of parents with children aged 8 to 12 and the typical development of children with learning disabilities, exploring the impact of parents' emotions (anxiety, avoidant attachment) on children's reading, writing, and math abilities. Various studies have shown that it is necessary to further educate parents and induce positive influences on children.

In the interactive sessions we designed for "ParenThesis", parents and children spend regular, focused time together on learning. We aim to reduce the amount of unprofitable time parents spend tutoring and minimize the risks that may arise from leisurely and unplanned interactions. Through disciplinary design and systematic guidance, our tool can increase the

quality of the time parents and children spend together and allow children to master the knowledge and discover their interests in a setting where they feel safe.

4.1.3 The guideline: skills generalized to the school setting

As a supplementary education, home tutoring has proved to be as important as school-based learning. Experts pointed out that when skills tutored by parents generalize to the school setting, the parents, children, and teachers are reinforced, and they are likely to maintain such tutoring programs (Thurston, 1989).

By identifying users' schools and locations, our product provides textbooks, exercises, and visual aids that are synchronized to the courses taught by the local schools. The users can view the materials during interactive sessions, and in subsequent sessions, the app can automatically supplement exercises targeted at students' weak areas in learning. These features help parents utilize professional teaching materials to help students consolidate the knowledge they learned from school. From school to family and school again, we believe the virtuous learning cycle will significantly improve students' learning abilities.

4.2 How the tool addresses users' needs: a quantitative study

4.2.1 Method

To fully understand the needs of K-12 parents, who are our target users, we designed an online questionnaire and conducted user research in China. We received 263 answers in total. 97% of the answers were collected from Zhejiang Province in China's east coastal area (see Figure 6), where our team's office will be based. 246 answers (93.5%) were filled by parents whose children are aged 4-18. Through in-depth cross-study and visualization of the data (3198 sets in total), we identified problems that parents face and analyzed how our tool can provide effective solutions.

Figure 6

Questionnaire distribution map

4.2.2 What problems do parents face?

1) Parents' strengths often fall into one of the binaries of liberal arts or STEM, causing failure to guide their children in a comprehensive academic journey (see Figure 7 and Figure 8).

The analysis of the data shows that parents have significantly different expertises. The results suggest the need for a platform that allows parents to exchange their knowledge and solve each others' problems.

Figure 7

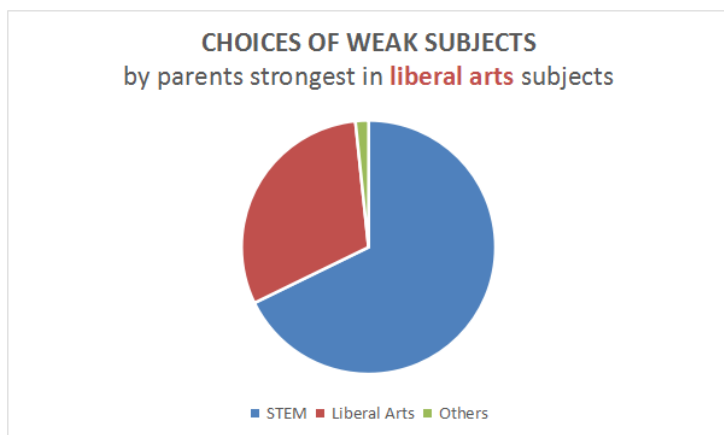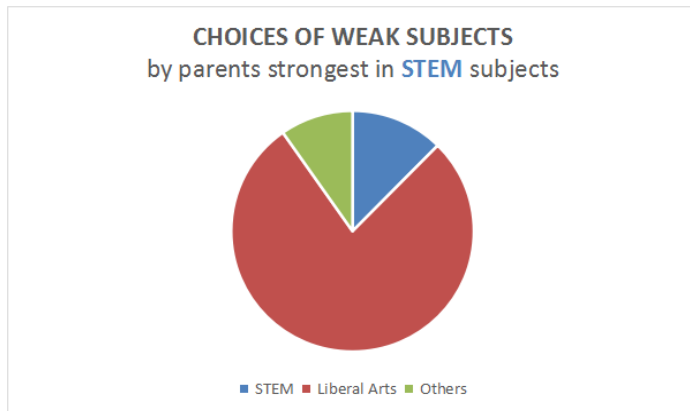*User analysis: weak subjects for parents strong in liberal arts*

Figure 8

*User analysis: weak subjects for parents strong in STEM*

2) Parents with low levels of education are more inclined to adopt passive or evasive methods when facing difficult problems (see Figure 9), which is not conducive to cultivating their children's problem-solving ability.

This analysis shows how parents' actions towards difficult problems differ based on their educational backgrounds. Parents with a bachelor's degree or above are more likely to initiate active problem-solving methods such as researching online. To increase the involvement of parents with lower education levels, we believe it is necessary to provide them with adequate training in teaching methods and help them build self-confidence as educators.

Figure 9

User analysis: actions towards difficult problems
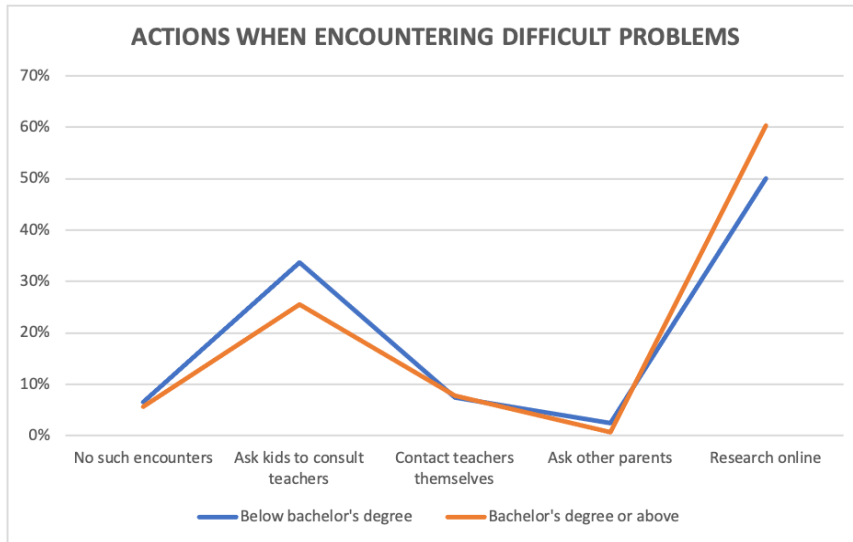
5. Learning Engineering

The data collected from our tool will help learning science researchers explore the following topics: 1) Parent-child relationship, 2) Parental involvement in K-12 education, and 3) Parenting's impact on child development.

5.1 Working with researchers

We are currently working with Learning Analytics researcher Lukas Liu at Teachers College, Columbia University to study the types of data needed for predicting learning outcomes and understanding learners' behaviors and the relationships with parental engagement. We are also working with Child Development researcher Laura DeRose at Teachers College, Columbia University, examining adults' involvement in K-12 education and its impact on child development.

In the future, we plan on connections with universities and research institutes to invite researchers specializing in parent-child relationships, parental involvement in learning, and home-based education. Once we make agreements with these institutes through formal contracts and consent forms, we will give the researchers access to the encrypted data in our cloud database which is made especially for research purposes, and provide them with data in CSV file

format. In the process, we will ensure to obey the data privacy laws to protect sensitive user information while opening up quality data to the researchers.

5.2 Types of data to be collected

1) Achievement data

Achievement data provides information on children's and parents' learning and achievements.

- Collected from children during tutoring sessions: quiz grades, performance ratings, test results, etc.
  These data can be used to evaluate children's academic improvements in different subjects.
- Collected from parents during pedagogy courses: quiz grades, essays, summative test assessment results, etc.
  These data can be used to evaluate parents' levels of knowledge in parenting styles, tutoring methods, and school subjects.

2) Perception data

Perception data provides information on the children's and parents' change of attitudes.

- Children will be prompted to fill out a questionnaire together with their parents at a given time interval such as every month. The questionnaire will ask about their feelings about programs such as games, Q&A, career advice, etc. These data will help researchers understand adults' involvement in child development and children's learning experiences.
- Parents will also be prompted to complete self-reported surveys at the given time interval. The survey will ask about their overall satisfaction with the tutoring experiences, students' improvements and shortages, their assessment of their relationships with children, and their involvement in the children's learning.

6. Attention to equity

From the perspectives of social economy and gender, this section examines the existing problems caused by an unequal distribution of educational resources and describes how our tool will close opportunity gaps among learners facing systemic barriers.

6.1 High expense and class reproduction

Scholars pointed out that though private tutors increase children's math and English scores significantly, private tutoring is a reflection of the "socio-economic advantages of upper-class students, which reproduces further socio-economic inequalities" (Park et al., 2011; Briggs, 2001; Lee et al., 2009). The expensive means of supplementary education acts as a burden on those with less social resources and power, often resulting in further marginalization.

Our tool encourages parents to educate themselves and reduces the cost of education investment. For example, a mother who is good at math can take free math pedagogy courses on our platform and become a certified math tutor. For her, spending 1.5 hours a week with three children on one-on-one math sessions can exchange for the opportunity for her child to communicate with parents who are experts in the three different fields – literature, physics, and art appreciation. The idea of "exchange tutor" maximizes the flow of resources and gives children the opportunity to get in contact with professionals in different disciplines, making it no longer necessarily a privilege for high-income classes.

6.2 Empowering the marginal class: the undiscovered values

We will not deny the fact that there must be parents who find it difficult to offer resources for exchange. The reason why "exchange tutoring" creates more value is that it dissociates social resources with educational capabilities and weaves a network according to "demand" and "supply". To give a specific example, suppose a Mexican immigrant who has not gone to college is registered on our app. He is matched with a high school student who needs Spanish practice, and the student's mother happens to be a professor. In this case, the platform provides the Spanish-speaking father with a part-time job that doesn't exchange for money but high-quality educational resources. Our goal is to let parents discover their value and understand that education is not all about high-input academic privileges, but about understanding all aspects of career and life as well.

6.3 Resource sharing: an open "university" for pedagogy

Studies have shown that the MOOC model has played a significant role in helping people with lower socioeconomic status (SES). Goglio and Parigi's variable analysis (2020) of two

MOOCs provided by Stanford University pointed out that learners with low SES will not have fewer opportunities to complete online courses, and that there is a negative association between low SES, course completion, and course engagement.

Our app refers to the MOOC model and collects a large number of parenting-related courses in our course library. We finely categorize the courses and set up learning routes that are easy for users to follow. We believe that education and pedagogy are professional fields of knowledge that require systematic learning, and we want to help low-income parents become educational experts in the different subdivisions that they choose. Parents who are confident, open, and learned can contribute to our community of mutual support and fundamentally transform their children's learning environments.

6.4 Breaking gender stereotypes: learning from real examples

Researchers pointed out that girls' abilities in STEM subjects are greatly affected by social stereotypes. Research with children and adolescents reports that knowledge of math gender stereotypes seems to emerge as early as kindergarten (Ambady et al., 2001; Tomasetto et al., 2011), and effects of stereotype threat on girls' math performance have been documented from early elementary to high school (Ambady et al., 2001; Picho et al., 2013; Tomasetto et al., 2011). In Seginer's study (1983) on school achievement in reading and arithmetic, evaluations and standards of parents (and especially mothers) have more to do with girls' school achievement but less with boys' achievements. Due to various social factors, girls not only are more likely to be affected by opinions and expectations but are also faced with systematic stereotypes questioning their abilities and producing negative self-images.

ParenThesis introduces the opportunity for these girls to communicate with successful women from all walks of life, including accountants, engineers, and scientists. These female practitioners can introduce students to the charms of the subjects as well as imaginations into different possibilities in the future. We hope that children can think a step further when facing challenges posed by unfair, easily drawn conclusions and be no longer bound by labels based on gender, social status, or any other things.
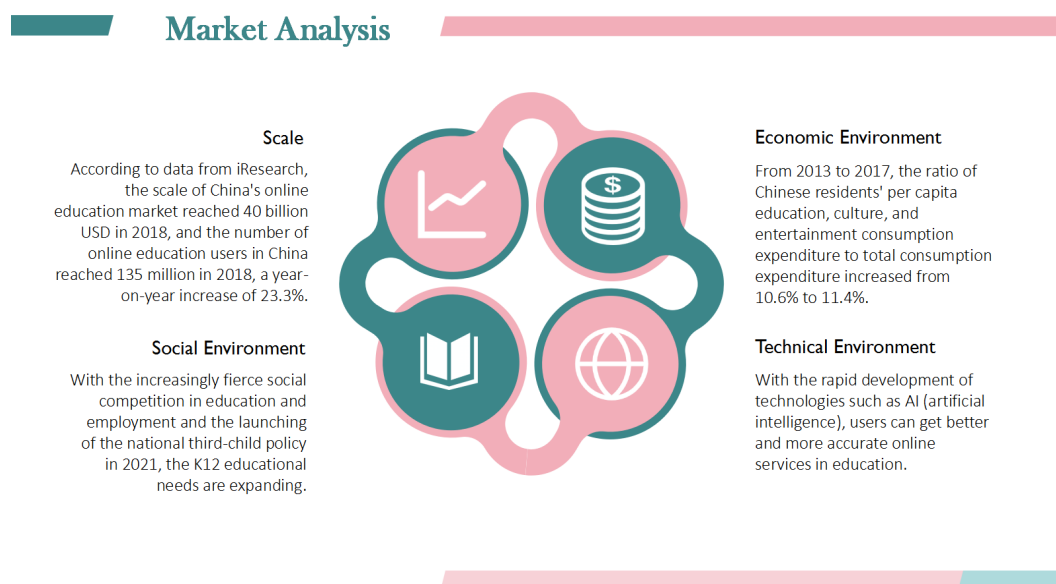
7. Plan for growth

7.1 Objectives

- To connect with more than 500 elementary and middle schools and have 15,000 parents registered in the third month of operations.
- To attract a minimum of 30,000 users and 1200 membership users in the third month of operations.
- To offer our users excellent tutoring matching services and provide outstanding user experience and customer complaints less than 1 percent.
- To cultivate the motivation and ability of users to learn, give users more value and self-worth, and improve the overall environment of home-based education.

7.2 Market analysis

Our target users are K-12 parents interested in exploring new ways to improve the quality of home-based tutoring for their children. According to our research on social, economic, and technical environments, the user base has a large potential in the market of China in the years that follow (see Figure 10).

Figure 10

Market analysis

Market Analysis

Scale

According to data from iResearch, the scale of China's online education market reached 40 billion USD in 2018, and the number of online education users in China reached 135 million in 2018, a year-on-year increase of 23.3%.

Social Environment

With the increasingly fierce social competition in education and employment and the launching of the national third-child policy in 2021, the K12 educational needs are expanding.

Economic Environment

From 2013 to 2017, the ratio of Chinese residents' per capita education, culture, and entertainment consumption expenditure to total consumption expenditure increased from 10.6% to 11.4%.

Technical Environment

With the rapid development of technologies such as AI (artificial intelligence), users can get better and more accurate online services in education.

7.3 Strategy

Our strategy is based on delivering a strong customer value in the market segment. We are looking to offer a complete lifecycle where parents can learn, find tutors, ask and answer questions, share their life moments, get achievements, and make friends. Our team members have rich experience in marketing and user growth, and we consider achieving our goals from the following aspects:

- Successful product design based on user needs:
  We conducted surveys and research to produce segmented user portraits that help us understand user needs and design features that they need.
- Effective product iterations based on scientific research:
  We will iterate the product as our user base grows and produces more data. The data will be shared with researchers to ensure that children's performances can effectively improve through using our product.

We believe that the app functions and user activities we designed will result in a better quality of family education and accelerated learning of children, which will encourage users to become members and experiment with more features.

7.4 Timeline for execution

Milestones and due dates:
- Official release – May 15, 2022
- First-round campaigns of digital marketing – June 15, 2022
- The break-even point – Aug 15, 2022
- 50,000 users – Oct 15, 2022
- Launch of the first major iteration – Nov 15, 2022

8. Budget

Our company will be located in Hangzhou, China. Based on the city's wages and rent levels (we consulted major websites for job listings such as *51job.com* and *zhipin.com*), we have formulated the following expenditure plan.

8.1 Pre-launch: product development

Excluding the work that our team members can cover, the app's development costs are as follows:

- Backend $4,000
- Development $18,800
- Design $1,000
- Content production and business cooperation $2,000
- Total cost (approx.) $25,800

8.2 Maintenance and iteration

Below is a monthly budget for maintenance and operation of the app, excluding our team member's covered work:

- Android developer $2,500/month
- iOS developer $3,000/month
- Back end developer $2,000/month
- Product manager $1,500/month
- UI/UX designer $1,500/month
- Content manager and marketing specialist $1,000/month
- Office rent and taxes $3,000/month
- Total cost (approx.) $14,500/month

According to the timeline, we will reach a break-even point after three months of operation, meaning we need a total income of $69,300 by Aug. 15, 2022. This is feasible based on the 30,000 users and 1200 membership users that we plan to have by the time. The number of membership users is expected to grow exponentially every month in the first year of the product launch. We estimate to have cumulative net profits over $250,000 and reach over 100,000 paying users over five years. In the long-term, we are considering extending our product to different countries.

9. Bibliography

Al-Yagon, M. (2014). Fathers and mothers of children with learning disabilities. *Learning Disability Quarterly*, 38(2), 112–128. https://doi.org/10.1177/0731948713520556

Ambady, N., Shih, M., Kim, A., & Pittinsky, T. L. (2001). Stereotype susceptibility in children: Effects of identity activation on quantitative performance. *Psychological Science*, 12, 385–390. doi:10.1111/1467-9280.00371

Bell, R. (1940). Notes on Child Development and Education. Journal of Educational Sociology, 14(2), 110. https://doi.org/10.2307/2262404

Briggs, D. C. (2001). The effect of Admissions Test preparation: Evidence from nels:88. *CHANCE*, 14(1), 10–18. https://doi.org/10.1080/09332480.2001.10542245

Goglio, V. & Parigi, P. (2020). The social dimension of participation and completion in moocs. https://doi.org/10.31235/osf.io/3cmv4

Hall, R.V., Delquadri, J., Greenwood, C.R., & Thurston, L (1982). The importance of opportunity to respond in children's academic success. In E.D. Edgar, N. Haring, J.R. Jenkins, & C. Pious (Eds.), *Serving young handicapped children: Issues and research* (pp. 107-140). Austin, TX: PRO-ED.

Lee, C.-J., Park, H.-J., & Lee, H. (n.d.). Shadow Education Systems. *Handbook of Education Policy Research*. https://doi.org/10.4324/9780203880968.ch70

Seginer, Rachel (1983). Parents' Educational Expectations and Children's Academic Achievements: A Literature Review. *Merrill-Palmer Quarterly,* January 1983, Vol. 29 (pp. 1-23).

Thurston, L. P. (1989). Helping parents tutor their children. *Academic Therapy*, *24*(5), 579–588. https://doi.org/10.1177/105345128902400507

Thurston, L.P., Jacobson, J., Edwards, C, Heggie, C, & Dasta, K. (1982). Utilization and evaluation of parents as tutors of young black children with special needs. *ERIC Clearinghouse on Handicapped and Gifted Children.* (ERIC Document Reproduction Service No. 209 830)