CS-6460 Assignment 7: Project Proposal (Accepted)

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Introduction

Recent advances in technology have fundamentally changed the way we live, work, and relate to one another. This digital revolution, known as the Fourth Industrial Revolution, is moving at exponential speed. Billions of people connect through mobile devices, with unprecedented access to knowledge and processing power. Recent breakthroughs in artificial intelligence, robotics, Internet of Things, and autonomous vehicles have helped create limitless possibilities which, in turn, have improved our quality of life, generated significant benefits for users, business, and economies, and increased productivity and economic growth. This revolution, however, may disrupt the labor market: new technologies will displace millions of workers, who will have to learn new skills and adapt to new careers. McKinsey's report (December 2017) suggests that up to 14% of the global workforce will need to switch occupational categories – all workers will need to adapt, as occupations will continually evolve alongside increasingly capable machines. This means all workers will have to become lifelong learners. Thus, as supported by The Economist (2017), lifelong learning is becoming an economic imperative.

The questions then becomes: how to develop lifelong learning skills? How to transform people in lifelong learners? Lifelong learning is more than adult education or training — it is a mindset and a habit for people to acquire. We can take control of our own learning with the right mindset. At its core, lifelong learning is fostered by a ***growth mindset***. According to Dweck (2006), two mindsets about learning exist: a growth mindset and a fixed mindset. A growth mindset holds that your basic qualities are things that you can cultivate through your efforts, whereas a fixed mindset holds that your qualities are "carved in stone" (i.e., your intelligence is something you can't change very much). When facing challenging problems, people who believe that effort drives intelligence tend to do better than people who believe that intelligence is a fixed quality that they cannot change. There is increasing evidence that mindsets play a key role in student achievement.

There is another skill that need to be cultivated to lifelong learning: ***grit***. We define grit as perseverance and passion for long-term goals. Grit entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress. The gritty individual approaches achievement as a marathon; his or her advantage is stamina. Whereas disappointment or boredom signals to others that it is time to change trajectory and cut losses, the gritty individual stays the course. Duckworth et al. (2007) showed across different studies that individual differences in grit accounted for significant incremental

variance in success outcomes over and beyond that explained by IQ, to which it was not positively related.

But how to develop growth mindset and grit? According to Dweck (2008), there are 3 proven ways in which educators can convey a growth mindset to students:

a) By teaching students about the new science of brain plasticity and the new view of talent and giftedness as dynamic attributes that can be developed;
b) Through the portrayal of challenges, effort, and mistakes as highly valued;
c) Through process praise and feedback.

In her work, Duckworth (2016) concludes that grit can be developed, by i) cultivating interests, ii) developing a habit of daily challenge-exceeding-skill practice (deliberate practice), iii) connecting our work to a purpose beyond ourselves, and iv) learning to hope when all seem lost. She also developed a Grit Scale, a self-report questionnaire to measure grit.

Both researchers highlight the importance of teachers and educators in developing growth mindset and grit. They have shown that it's important to communicate that we value and admire challenge-seeking, hard work, and learning from mistakes — and that we do not value easy, low-effort successes. The language used to praise students can help encourage or discourage a growth mindset and has broad implications for how students persevere in the face of challenges. The process praise and feedback, done by an expert preferrably trained about growth mindset & grit, can significantly help students developing these skills.

Although there is extensive research about these topics, very little was found about using technology in teaching growth mindset and grit. We only found in-person experiments to teach growth mindset and grit.

Related work

Research shows that growth mindset & grit are mostly developed through conversations. Naturally, we looked into current conversational technologies, especially chatbots. Conversational agents, or chatbots, provide a natural language interface to their users. Their design has become increasingly sophisticated and their use adopted in education, commerce, entertainment and the public sector (Kerry, A., Ellis, R. and Bull, S., 2009). With the growing maturity of conversational technologies, the possibilities for integrating conversation and discourse in e-learning are receiving greater attention in both research and commercial settings. Conversational agents have been produced to meet a wide range of applications, including tutoring, question-answering, conversation practice for language learners, pedagogical agents and learning companions, and dialogues to promote reflection and metacognitive skills. Conversational agents build on traditional education systems, providing a natural and practical interface for the learner. They are capable of offering bespoke support for each individual, and recognising and building upon the strengths, interests and abilities of individuals in order to foster engaged and independent learners (Kerly, A., Ellis, R. and Bull, S., 2008).

First, we looked into products, and we found an interesting initiative called MUSE: an AI-powered app that aims to use machine learning and big data to try and help parents raise creative, motivated, emotionally intelligent kids. According to Vivienne Ming, a theoretical neuroscientist and entrepreneur who created Muse with her wife, Norma, in 2016, parents ask themselves the same question every day: “What can I do right now to best help my child?” Muse is an attempt to answer that question, offering parents activities tailored to their individual children that are geared toward developing 50 skills, from growth mindset to metacognition, problem-solving, and working memory. The app asks parents one question every day: Have you and Lucas visited a library in the past month? Does Maria attend school outside of the home? Parents’ responses are fed to the AI along with unstructured data; parents might record snippets of audio or video conversation with their child, or upload photos of a toddler’s finger-painting.

Those responses help the app create a constantly evolving profile of each child that attempts to measure not just their static ability at one moment in time, but their developmental growth. The machine learning constantly searches for the best question to ask parents about their child, and the best activity to suggest that might help the child improve on areas of weakness. The daily questions also incorporate traditional survey-type assessments, such as questions relating to empathy or metacognition. By using both old-school survey type questions and naturalistic data, the AI learns how the two relate. Ming, et al., 2014, provide supporting data to their solution, which is currently small but is gaining traction all over the world: it currently has about 2,700 users: 55% in the US, 27% in Germany, and 13% in other locations around the world (data from March 2018).

Finally, we looked into academia. Ostrow, et. al., 2014, studied the addition of motivational messaging to the ASSISTments tutor. Their work provided us with a good starting point on Intelligent Tutoring Systems used to promote growth mindset. Two other papers from Ostrow (2015), give us more perspective: we believe that this is the closest academic work related to what we want to do.

Proposed work

We plan to design a mobile AI chatbot assistant to develop growth mindset and grit, testing it in OMSCS EdTech students. The chatbot will do that by:

1. Asking students self-reflection questions about their objectives, their learning strategies and plans, their interests, the course, the phases, and the assignments;
2. Asking students provocative questions to challenge them to do better;
3. Providing students praise and feedback on their answers and their grades;
4. Providing students with encouraging messages to develop and deepen their interests, stick with their commitments and participate in class;
5. Showing students videos and other relevant engaging materials about the new science of brain plasticity;

6. Alerting students about key milestones, tips from other years, and overall opportunities to improve.

The chatbot assistant will be a mobile app, with whom students will interact on a daily basis. The app will perform the 6 points listed above in specific ***core moments*** through the course:

- In the very beginning of the course;
- In the beginning of each of OMSCS EdTech 5 phases (Phase I: Acquiring Knowledge; Phase II: Demonstrating Mastery; Phase III: Proposing Projects; Phase IV: Executing Projects; Phase V: Delivering Projects);
- In the beginning of each week (engaging with students regarding current & previous week);
- In the end of the course.

On top of that these core moments, we will design an app to engage with our students daily, providing tips and encouragement to them.

While preparing to propose this work, we evaluated 2 possible scenarios. The first scenario involved the design AND implementation of a simple MVP of the chatbot. The pro is that, in this scenario, we would end the semester with a funcional MVP; the con is that it would be extremely basic, as significant time from the project development would be dedicated to learning how to code for iOS/Android platforms.

The second scenario involved the design a more robust AI chatbot assistant. The architecture will be very complete, diving into the 26 conversational topics listed in the previous assignment (Qualifying Question). In this scenario, we would end the semester with a very detailed and robust blueprint of the chatbot, explaining exactly how each conversational topic will work to teach grit and growth mindset. We will design the dialog flows & storyboards of each topic, defining the student experience with much greater detail than in scenario 1. However, in this scenario we would deliver the blueprints, not the implementation.

After thoughtful consideration and help from Tyler Bobik, who is mentoring the project, we decided to go with scenario 2.

Deliverables

By week #10, 3 weeks from now, we will deliver the **First Milestone**. We commit to create a video presentation, demonstrating project's current status, explaining the rationale, and the overall chatbot design. We will also deliver a first survey to collect early impressions from fellow students.

By week #13, 6 weeks from now, we will deliver the **Second Milestone**. We commit to create Low-Fidelity Prototypes, with screen mock-ups of the ultimate design. These prototypes will take

into consideration results from the survey presented in the first milestone. We will also deliver a second survey to collect early impressions from fellow students.

By week #16, 9 weeks from now, we will deliver the **Final Project**. We commit to deliver a high-fidelity prototype of the app, together with very detailed and robust blueprints of the chatbot, ready for implementation. We will design the dialog flows & storyboards of each conversational topic, defining the student experience in great detail. We will also deliver a final presentation and a final paper, including the results from both surveys.

Task List

To deliver the proposed project, we planned a detailed task list that can be found here (Google Sheets), or here (Dropbox, Excel). The task list is composed by 25 tasks, totalling 105 hours of work planned. The tasks are distributed from week #8 (next week) to week #16 (last week of the course), as show in the picture below:

Week #	Task #	Task Description	Task ID	Estimated Time (Hours)
8	1	Create conversational architecture for: Daily conversation, tips & encouragement	architecture #1	6
8	2	Create conversational architecture for: Beginning of each week	architecture #2	5
8	3	Create conversational architecture for: Beginning of each of OMSCS EdTech 5 phases	architecture #3	5
9	4	Create conversational architecture for: Beginning of the course	architecture #4	4
9	5	Create conversational architecture for: End of the course	architecture #5	4
10	6	Create a video presentation (status, rationale, and overall chatbot design)	presentation #1	6
10	7	Create a survey to collect early impressions from chatbot design	survey #1	3
INTERMEDIATE MILESTONE 1 DUE				
11	8	Analyze survey #1 results and adjust design based on inputs from fellow students	analysis #1	2
11	9	Design dialog flows and storyboards for architecture #1	design #1	4
11	10	Design dialog flows and storyboards for architecture #2	design #2	4
11	11	Design dialog flows and storyboards for architecture #3	design #3	4
12	12	Design dialog flows and storyboards for architecture #4	design #4	4
12	13	Design dialog flows and storyboards for architecture #5	design #5	4
12	14	Build a set of Low-Fidelity Prototypes (A: designs 1 and 2)	lofi #1a	7
13	15	Build a set of Low-Fidelity Prototypes (B: designs 3, 4 and 5)	lofi #1b	7
13	16	Create a survey to collect early impressions from lo-fi prototypes	survey #2	2
INTERMEDIATE MILESTONE 2 DUE				
14	17	Analyze survey #2 results and adjust design based on inputs from fellow students	analysis #2	2
14	18	Build a set of High-Fidelity Prototypes for design #1	hifi #1	4
14	19	Build a set of High-Fidelity Prototypes for design #2	hifi #2	4
14	20	Build a set of High-Fidelity Prototypes for design #3	hifi #3	4
15	21	Build a set of High-Fidelity Prototypes for design #4	hifi #4	4
15	22	Build a set of High-Fidelity Prototypes for design #5	hifi #5	4
15	23	Create detailed blueprints based on all designs	blueprints	3
16	24	Create the final presentation	presentation #2	3
16	25	Create the final paper	paper	6
FINAL PROJECT DUE				

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