Reaching the Entire Classroom through Technology:
Bridging the Personality Type Gap

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Chapter 1: INTRODUCTION

In the United States education system, most classic teaching methods create a heavily biased environment towards extraverted learning. Being an introvert in an environment built around discussion, class participation in which speed of response is wanted, and group work can become tiring and not highlight some of the benefits that introverts bring to a classroom. This problem is only exacerbated by the fact that it is incredibly difficult for a teacher to determine whether a student is extraverted or introverted. When a teacher enters a classroom signs of introversion, such as shyness, can also be misleading and thus misinterpreted which makes it difficult to develop and use targeted teaching methods geared for a select group of students. Therefore, to enhance education for introverts a new technique has to be developed that aids all students, extraverts and introverts, equally.

Current studies have shown that the advent of technology has opened up many more opportunities for introverts to thrive in a classroom. While, “studies have found that extraverts have an advantage in classroom participation … studies found that the advent of various online learning tools (such as asynchronous discussion boards) in the last decade further benefits introverts, who are sometimes too shy to talk in the classroom environment, and encourages their participation in a manner that is not possible in face-to-face classroom interactions” (Samuel-Azran, 2013). The correct uses of technology have not yet been pinned down to a science and the current work focuses on the best ways to utilize technology for the benefit of all students.

Schools are places where time is a valuable resource because of the short length of a school day. There is only so much time that can be invested into each topic and so
this negatively impacts introverts ability to find a deep understanding of the concept by limiting their exposure to each concept. Finding ways to gain extra minutes of active teaching time is another goal in the education field. Currently, besides making better use of time by streamlining classroom procedures such as collecting homework, teachers have to make the hard decision of whether to keep covering new material or diving deeper into material and potentially not fully covering curriculum content.

Current strategies that are being fielded within educational fields focus heavily on differentiating material once the extraverted and the introverted student and identified in the class. The real gap in the current methods is trying to find the correct balance and use of technology so that an extraverted environment does not shift into an introverted environment. There needs to be multiple methods for both introverts and extraverts to interact with the classroom in ways that play into their strengths so that the playing field is even for both personalities. Both personality types should be able to flourish through the careful use of technology in ways that promote both learning styles and all material to be done differently depending on the personality.

My project is to create a prototype program that with full development could be easily integrated into a public school system that would aid all students during classroom time to improve the ways in which teachers and students can interact with each other in the classroom. This would be accomplished by making the application integrate ways of social interaction that can provide avenues for introverts to actively participate more while empowering extroverts equally. There are three main criteria that this program needs to achieve in order to be successful as both a commercial product and an effective teaching tool.
The first is that it simple for a teacher to pick up and use efficiently so that time can be saved and spent on better education. It is important that teachers are able to easily use the application quickly and set up the application for each class. If this criteria is not met, than the teacher wastes more time dealing with logistical issues of the software rather than reaping the benefits that it could provide. Some teachers are not extremely tech savvy and if the product is going to be able to cater to school districts, the bar of entry needs to be low enough that it could be introduced to teachers quickly as a group when there are staff meetings.

The second is that it can provide an equal opportunity for all students and create an environment that does not favor one personality type over another. A classroom should have final grades that accurately show how much effort a student put into their work, rather than having a skewed perception of their effort based on tests, which are introvert favored, or lots of group work and participation, which is extrovert favored. As this paper will show, introverts and extroverts provide different benefits to the classroom and by bringing them together through the use of technology we can combine their strengths and minimize their weaknesses to improve the classroom experience.

Finally, it should not feel gimmicky to students and should enhance the way the lessons are taught rather just being a replacement to the current methods. Some applications for example, create alternatives to worksheets that provide practice problems, that don’t actually fill a different role than a typical worksheet but requires a much larger time investment. This application needs to stand out as a sleek piece of technology that can provide a new experience in the classroom that creates a want for its use in the classroom.
Chapter 2: BACKGROUND AND LITERATURE REVIEW

The problem of using technology to reach the entire classroom is based around reaching both personality types, introverts and extraverts. These two terms will be examined in depth, going into their impact in the classroom and how as a society we see both personality types. It is important to understand how each personality type operates socially and in the classroom in order to understand a technological solution that can be built to utilize strengths while addressing the limitations of both personality types. This chapter will also explain how the advent of technology opens up many new options to explore in educational pedagogy as well as what technology is most pertinent and effective to address the needs of a heterogeneous classroom. This ranges from small one-off assignments that utilize technology as the activity's component, to the online schools that utilize technology in all parts of their teaching, as well as the targeted use of specific technological advancements as a major part of the grade. We will also look into current solutions for bridging the gap between introversion and extraversion in the education system and how introverts and extroverts are impacted during a normal day in a public school environment. This will conclude with a look at where to go next with all of this information.

**Introversion**

The word introvert is often misconstrued in everyday speech to describe individuals with characteristics that are not attractive to an extravert dominated environment. Traits like shyness, quietness, or low levels of social interaction are
usually attributed to introverts which is an unfair assessment for introverts. Susan Cain (2012) described an American “extrovert ideal” that over time has come to glorify extroverted traits while profiling introverts as antisocial, shy, and having inferiority complexes, which helps explain the misconception. Being able to quickly answer questions in class or think on your feet are important traits in schooling for example, which highlights this extrovert ideal. What is at the core of how an introvert operates is how they interact with ideas and where their energy to interact comes from. This absolute definition of what defines an introvert, as well as distinguishing them from extraverts, is a contentious debate between almost all personality psychologists. This paper will follow the definitions from renowned writer Susan Cain in her books based on introversion. Susan Cain (2012) describes introverts as

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\text{Being drawn to the inner world of thought and feeling, focusing on the meaning they make of the events swirling around them [and] recharge their batteries by being alone. Introverts work more slowly and deliberately. They like to focus on one task at a time and can have mighty powers of concentration. (p. 11)}
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The societal implications of these personality features shape advantages and disadvantages in both functioning in society and the classroom.

**Introversion in Society**

Being an introvert has both its advantages and disadvantages in the context of the classroom and in interacting with society. When pursuing work, introverts tend to take their time assessing multiple options and “work slowly and deliberately” (Cain, 2005, p.6). Introverts tend to also prefer environments which are not over stimulating so
while they are working they can recharge their energy. This feature of needing time alone is not just a means of escape for introverts, but also allows for them the environment to focus more deeply on questions or the time and space to write out what they are thinking. Introverts are known to have a much better time explaining their ideas if they can write them down first to refer to later in a discussion. These attributes tend to make introverts valuable assets on teams where thinking deeply about problems is a major part of the job. Jobs like programmers, writers, and scientists that allow for more time alone or deeper thought appeal to the introvert personality type. In the age of technology and more complex research those jobs are desperately needed, so being introverted is incredibly useful to being successful in those fields of work or providing another outlook or insight to an otherwise extrovert dominated group.

In a social role, being introverted has its benefits and drawbacks as well. Susan Cain (2005) explains their preference as being towards, “social energies to close friends, colleagues, and family. They listen more than they talk.” This part of how introverts find energy in themselves can help create very close relationships with a few close friends in the classroom. Introverts however, have a typical bias towards not reaching out for help as it reaches outside of their preferred social group. This can often make helping introverts students difficult, as it is hard for a teacher to differentiate whether an introvert is looking for help or not. This can lead to crucial misunderstandings in understanding concepts that result in poor test and homework grades.

Introverted people also make up more of the population than most people believe. For a long time the Myers Briggs test created the false idea that 75% of the
population were extroverts and 25% were introverts because of how their test identified introverts. However, in studies reported on by NPR and the New York Times, the percentage of introverts in recent years is actually a little under 50% of the population. (Gouodreau 2012) This highlights how society views the more silent side of itself having the “unfavorable” skills that Susan Cain described in her book. Understanding how to interact and properly accommodate introverted people is critical for any organization that wants to have effective participants.

*Introversion in the Classroom*

During the two months of teaching at Doherty High School and multiple weeks of observations around the Worcester area I have noticed crucial details as to how introverts interact in a classroom. The most obvious structural aspect to the classroom that impacts introverts is that “There isn’t a more time-depended institution than school” (Philips, 2012). Classes can range between 40 minutes to a little under an hour which intrinsically limits the depth that a teacher can reach in one lesson period. Depth of conversation is a key aspect for introverts, so this inherent limitation of the school schedule has the potential to negatively impact the introverted student.

However, Tal Samuel-Azran (2014) argues that “introverts have a significant advantage in all other aspects of learning that contribute to final grades, such as exams and essays”. Exams provide a very separated and calm environment to assess learning which allows introverts who find energy off that environment to gain an advantage. In a similar fashion, essays allow introverts to put down all of their thoughts down on paper which is a characteristic way to express themselves.
So, if introverted students actually have an advantage in the major examinations that determine their grade, why would there be any focus to help introverts express themselves in the classroom? Helping introverts express themselves actually benefits the entire classroom by providing answers that are more detailed. Introverts are typically the students in classrooms that stay quiet but when they decide to participate they make a large impact on the conversation. Finding new ways to allow introverted students safe entry into more conversations enabling them to participate more will be crucial in allowing the classroom environment to flourish.

**Extraversion**

Extraversion encompasses a polar position to that of introverts. Where introverts have struggles interacting in social situations, extraverts flourish. Susan Cain (2005) defines the extravert in a couple ways as such:

*Extraverts are drawn to the external life of people and activities. Extraverts plunge into the events themselves. Extraverts need to recharge when they don’t socialize enough. Extraverts tend to think out loud and on their feet; they prefer talking to listening, rarely find themselves at a loss for words. Extraverts enjoy the extra bang that comes from meeting new people. (p. 10-11)*

Extraverts are the people that you see bringing life to parties or creating mountains of ideas. Typically, when extraverts start talking they are communicating without as much preparation as the introvert but rarely lose their nerve or falter in their communication. This can lead to some situations where the extrovert has no thought through their words before they have said them. This leads to the intent of the extrovert being
misrepresented in some cases. However, because of the extrovert’s confidence in social situations they are able to create a much larger social network than the introvert. These attributes are critical pieces to understanding how extraverts fit into societal and classroom environments as these attributes contribute to how extroverts interact with the classroom.

Extraversion, unlike introversion, has become the social norm in the United States due to social shifts around a century ago with the American “extrovert ideal” stated earlier. This makes expressing extraverted qualities to appear normal and favorable in society which will be further explained. This also is one of the reasons behind why partnership in the classroom is favored and group activities and projects are encouraged over individual work.

*Extraversion in Society*

Extraverts operate openly in society and are typically known for displaying societal confidence. In studies done to test communication skills with personality types, "extraverts are likely to reflect qualities such as dominance, open-ness, and relaxedness in the way in which they communicate" (Opt & Loffredo, 2003). The extravert’s social skills make them easier to communicate with in an extravert dominated society. In a classroom, extroverts are typically in the majority which gives them an edge in group activities.

There was a change in the 20th century of creating a good personality and the birth of the term “personality”. When this social shift occurred “Americans started to focus on how others perceived them. They became captivated by people who were bold
and entertaining.” (Cain, 2005, p.21) Extraverted behavior was preferable to introverted tendencies because of their ability to make strong social impacts that were able to create positive perceptions of their character. This shift helped to mold the social norms of today and influence many of the characteristics that are labeled as positive. This social shift also means that many institutions, including schools, are built around encouraging extraverted activities through means such as team building and active open discussion.

**Extraversion in the Classroom**

Public education systems are built with a focus on trying to fit as much material in as possible in order to meet educational standards, so many of the things in a class that extraverts excel in, are made to prefer the extroverted learning style that is quicker. Extraverts as stated before, are fine at speaking their mind without too much thought going into their words. Short forty minute classes make it difficult to sit on one question for too long without the possibility that material will not be properly covered. The education system is built around covering topics broadly and dives into topics occasionally for projects or other assessments. Therefore extraverts gain benefits over introverts during the active part of class.

Extraverts socially in school systems are being constantly fueled by their need to be around other people to re-energize their social energy. This creates a much more appealing environment for extraverts as they are never overwhelmed by the massive amount of students that can take up a single school. What this means for a way to
include extraverts in a new method of teaching, is to keep some of these rejuvenating aspects so that extraverts can have the attention and interaction they need.

**Technology**

Technology is a broad word that can cover a variety of materials from pencils all the way to supercomputers. From here on out, the word technology will be used to address advances that utilize electronics (phones, apps, computer programs etc.). The information age started in the latter half of the 20\textsuperscript{th} century and has given birth to the ability to acquire data easily and shorten tasks through raw processing power. With the ability to help speed up old methods of learning or create entirely new ways to interact with the class, technology is an attractive options for schools that are trying to advance their teaching to the next level. Students have the ability to gather so much information and communicate with each other in new ways that were not possible a few decades ago. This next sections will summarize some of the most popular uses of technology and how they can be used in the classroom to improve student learning outcomes.

**Online Schooling**

Online schools or some form of the virtual classroom has been experimented with recently in education. “48 states and the District of Columbia support online learning opportunities” and there are 7 fully online public schools throughout the country (U.S. Department of Education). These schools were primarily founded for the service they could provide to students who dropped out of high school education or needed the
extra credits to receive a high school diploma. Some other were also built with the intention of aiding rural communities and students with learning disabilities that wouldn’t be able to attend a traditional school. However, a study in the University of California (2017) found that “students went into online classes with the wrong mindset”, a mindset that the classes would be easy because they were online. This spiraled into a situation where most students did not have that ability to engage the material due to both lack of face-to-face time and concentration and as a result had a higher dropout rate than their on campus counterpart. Even introverted students felt lonely in a fully online schooling experience and missed some of the basic face-to-face learning that only a teacher can provide. This use of technology for the most part is a failure and shows one of the key weaknesses of technology, laziness. Julian Birkinshaw writes that, when we have so much “stimulation available at our fingertips, the capacity to focus and concentrate on a specific activity is falling” (Birkinshaw) which leads to inaction. Just looking up the answers on the same computer you are taking a class on, is intellectually easy but incredibly lazy and self-defeating for the purpose of the classroom. This means that creating a situation that separates the student from the classroom does not increase effectiveness even at the benefit of accessibility and ease of use. Furthermore, providing methods to monitor and make sure that students are focused is key to creating an environment where students never become intellectually disengaged. Finally, this makes it blatantly clear that resources should be conducive to letting students figure out the answers rather than providing resources that state the answer flat out.

*Technological Tools in the Classroom*
Most schools try for a blended approach to technology where there are more traditional methods blended with the usage of technology. This tactic has seen far more success and many of the tools such as clickers have seen widespread implementation throughout schools. This kind of use of technology is the most promising for implementing in a classroom as it blends together a teacher’s ability to teach in creative ways, with the raw productive power and information value of technology.

Clickers have seen a lot of use especially in college/university level education. Clickers and products of the similar type allow the professor or teacher to ask a multiple choice question and then provide instant feedback to students on how well they did and how they stack up against their class. On the surface, clickers seem like a time-efficient, simple, and useful tool that can make students realize misunderstandings or validate them on their knowledge. Petra Symister’s study on the use of clickers in college classrooms found that “Students overwhelmingly report that they enjoy using clickers, feel satisfied with the use of clickers in the classroom, feel more confident in their knowledge as the result of using clickers in the classroom, and find them “fun” to use” (Symister, 2014). However, the groups that had the use of clickers had a false sense of how strong their knowledge base was and performed far worse than they believed and it is shown that “exam scores did not appear to improve as the result of clicker use” (Symister, 2014). The takeaway from this is that immediate feedback provides an extremely positive feel for students and lets them focus more on areas they have trouble on. Being able to create a system that can allow for more depth to the clicker format should be able to use that immediate feedback system and allow for more discussion into those topics.
One other interesting use of technology was outlined in a study that described the use of online blogging in the classroom and how effective it would be as a tool. The reason that blogging was looked at as a possible gap between personalities was due to the fact that “introverts report that they feel comfortable with contemporary Web tools…and studies found that Facebook in particular is a social media platform that appeals to extraverts” (Samuel-Azran, 2014). The blogging challenge was to use a typical blogging site and then utilize social media to attract large amounts of traffic on topics that followed what was lectured on. The use of blogging in the classroom is still fairly limited as its use is a much more recent test in using technology. Samuel-Azran cites Chen’s work at Stanford University with blogging that “found that more than two-thirds of the students in the two classes in which the study was conducted reported that the experience increased their interest, motivation, and confidence regarding the course materials” (Samuel-Azran 2014). This trend towards increased interest in the subject highlights the defining strength of blogs, the ability to dive deeper into a topic and be more creative. Introverts inherently enjoy being able to write down their ideas, so blogging and just creating the article can help them express their ideas. For extraverts, the additional challenge of reaching audiences is the incentive to create a deep narrative and then attract some fans, creating a positive feedback loop for making quality blog posts. At the end of this test however, Samuel-Azran (2014) reported that “most students also expressed dissatisfaction with the choice of the platform [and] blogging is not an extravert-friendly tool in general”. The part of the blogging where students had to reach an audience was equally frustrating for both personalities as creating an audience is stressful and arduous work on top of creating blog posts. This
eliminates basically any interest that extraverts had in this use of technology. The key point however is that extraverts “wanted” to be able to reach out to large communities but had very little success because of the limitations they were under that required the use of unpopular and hard to reach blogging sites. It’s possible that incorporating some way to write down ideas and share them through a source that would drive attention would be a successful venture or creating smaller environments to draw a crowd from than the entire internet. Finding ways to interact and share their ideas was incredibly appealing to extraverts which means that a key element in new forms of teaching should try to incorporate this aspect. Online tutoring systems
CHAPTER 3: METHODOLOGY

The goal of this project is to utilize the advances in technology to bridge the gap between introverted learners and extroverted learners at public high schools. The project would identify key aspects of good teaching practices, highlight effective tactics for both extroverted and introverted learners, and blend them together to create a blueprint for a technological application that can be used by teachers. For a successful product a few key requirements must be met:

1. The difference between how effective the product is for extroverts and introverts must be small if at all to reduce the gap in education between the two personality types.
2. The product must be able to connect students to whatever lesson is presented and engage them in the material rather than act as a piece of gimmicky technology.
3. Educators must be able to incorporate the product seamlessly into their lesson planning so that it saves time and allows teachers to focus on content objectives.

This chapter will explore many different ways I observed or performed different teaching practices, based on teaching hours at Doherty High School and interactions/observations with teachers at different high schools in the Worcester area, so that these various pedagogies will become the basis of my proposed technological product. This chapter will also outline where there is a blend of different styles that can create a bridge between introverted and extroverted learners.
3.1: Classroom Strategies

This subsection will go further into different techniques manage classroom lessons and how effective they are. It will give a brief explanation of the techniques I have observed or used and then explain what the technique accomplishes effectively that could be transferred into a technological application.

Notetaking

Notetaking is an arguably useful skill in school that allows students to but their thoughts on paper and take note of key aspects of a lesson for the future. Ilhan Ilter in his article on notetaking noted that “Research has shown that traditional methods of instruction are still used and are in fact dominant among content area teachers” (Ilter 2017) which includes mathematics. Even though many studies he looked at used a multitude of teaching methods he found that taking notes from the board was an overwhelmingly dominant tactic. Therefore, becoming an effective note taker is an important attribute to any successful student as it will be expected in many classrooms as the main avenue of recalling information from class.

However, Ilter also found that:

*Research has shown that readers who take concise notes can distinguish critical relations between key concepts and main points, identify the main idea and details in a text, and thus comprehend reading materials by interpreting and rewriting in their own words…but many studies have shown that they [students] often copy text word for word, and thus do not benefit from varied representations. (Ilter, 2017)*
He was able to ultimately identify that students that were exposed and taught good notetaking skills were able to excel and show greater improvement when they stopped copying word for word and starting connecting concepts together. Therefore, it is imperative that the way in which a teacher conducts the process of notetaking helps students develop notetaking skills as it will be a common expectation and when trained effectively can aid most students.

During my time at Doherty, I took two approaches to notetaking to assess which one held the attention of the majority of students. I assessed the effectiveness of notetaking methods by taking counts during teaching of how many individual students were answering questions, their attentiveness to the lesson, and how much additional time was needed by the teacher in order to incorporate the strategy.

The first method I used was letting students decide on their own ways to take notes on the lessons I taught every day. My only stipulation for students was that they don’t start conversations with other students while I talked. The intention of this method was to provide more freedom for students to take in and record the information in each lesson in their own way. When I used this method of notetaking for two weeks I observed that typically 40% of students were actively taking notes. The same two or three students asked questions or answered questions every class even if I made time for other students to gather their thoughts. On top of all of these factors, a small group of students in every class would get off topic or cause disruptions within the class that took time away from the lesson. This method failed to provide any meaningful support to students when giving them the opportunity to choose how they use class time. It also impacts a teacher’s ability to teach if the interruptions become repetitive. The only
positive aspect to this method is that in a classroom where there is already a strong relationship between students and teacher, it provides freedom for students, independent accountability for their learning, and is useful for future notetaking for higher level education.

This ended up being a poor solution for both extroverts and introverts. Introverted students I taught typically didn’t ask questions during a lesson so their notes were sometimes inaccurate which caused issues down the line. They were more interested in getting to finish their own work and gain mastery via that avenue. For extroverts, the temptation to indulge their social side so as to avoid having to do a laborious task was enough to lose focus and start talking with friends and not pay attention.

The second approach to notetaking I practiced was by enforcing it as a class participation grade and waiting to start the lesson until all notebooks were out. This method was a directed at providing an orderly process to the classroom by normalizing notetaking. The theory behind this strategy is that if students are highly encouraged to have notebooks out and actively writing examples and definitions then it is more likely they will engage the material actively, waste less class time, and score higher on examinations. When I observed the results of using this approach, I found that more students took notes on the material. Multiple students would actively have me wait during lessons so they could finish taking notes before I moved on. This action provides the knowledge that this approach actively engaged students in the lesson by creating a task to complete. This approach additionally gave way to more students asking questions during class. After transitioning the class into taking out their notebooks every class, the number of questions in class from unique students more than doubled with
many students saying their main reason for asking a question was to make sure they took correct notes. This strategy’s main drawback is that it requires more time at the beginning of class to ensure that every student has a notebook and is writing down key points.

Overall this method of notetaking highlights one key element that should be recognized when creating technology for the classroom, engagement. Engagement in the class was much higher when every student had a task that was directly involved with staying focused to the lesson. Extroverted students led the way with more questions, aiding in a discussion that benefitted every student’s notes. Introverts were able to help explain the more complex problems in their own words after working on a problem for their notes which was particularly useful when diving deeper into topics. This tackles two of the three key goals of this project, engagement and bridging the gap between personality types. With more time to implement this tactic over a couple months, this notetaking management strategy would take no more time out of a teacher’s day than letting students decide whether or not to take notes. During my work, I observed multiple mathematics teachers from North High School, Worcester Tech, and Wachusett High School to learn more about teaching objectives. One of the single consensuses across all the schools was that with any procedural change, the first month or two will yield some additional time due to student’s adjusting. After that grace period, the procedure can function at its fullest when it becomes second nature. The students are then aware of what to expect from the teacher and can act and plan for the class accordingly.
The third notetaking strategy is an alteration of the previous strategy but instead of letting students create notes, teachers create “skeleton” notes, notes with blank spaces to add key information. This technique was used in 4 different classrooms from the teachers that I observed. Each teacher stated that by providing strong foundations that highlight the key points for students to remember, they empower students to have good notes to study from and provide a template for students of how to connect key concepts together. If every student has an easy way to understand the basics, this unlocks the potential to dive deeper into material with some of the busywork of typical notetaking taken away. It additionally scaffolds the learning so that all students can build upon previous material in order to grasp all the basic concepts. This decreases a student’s time spent looking at their notes to write them, and gives them the time to ask questions or examine exceptions or outliers to the concept. If a teacher keeps these skeleton notes limited to the most essential notes and examples, after one year of creating these documents time management gets much easier on the teacher side as well.

Overall, this third strategy sacrifices the practical knowledge of independent notetaking, a useful skill in higher education, for the simplicity and speed of pre-generated notes that allow more focus towards the teacher and the lesson. Extroverts can spend less time writing down necessary information, and more time expressing their immediate thoughts which helps move along class discussion. Introverts benefit only slightly from this method, as a common preferred tactic is to write down ideas on paper which is cut short in this method. However, this decrease in time spent on parts of the notes that are less important and being able to read them over can help contribute
to excellent discussion, questions, and contributions from introverts as well as providing additional time to write down questions or theorize applications. This method of notetaking highlights how decreasing student workload on simple tasks can elevate active discussion, which is the recommended status for a classroom to be in. In a technological advancement, decreasing student's busywork without sacrificing their ability to put the information to memory will need to be a balance to be played with. Notetaking with a skeleton approach, is a great example of the level to how much information can be freely given while allowing the student to still write the key parts of the lesson to memory.

**Lesson Structure**

In harmony with notetaking is the idea of how a teacher decides to structure a lesson and which aspects are the most useful to each personality type. A technology that advances the classroom should be able to adapt to multiple different parts of a lesson structure. If a lesson is repetitive and tiresome, strong notetaking strategies for students will have little use because of the lack of meaningful engagement with that freed up time. This section will detail many of the different methods of engaging students in a lesson, discuss time limitations of each, and evaluate which methods are especially effective for different personality types.

The most common and basic form of teaching a lesson is a lecture. Lectures are built around establishing key concepts, explaining terminology, and completing basic example problems for a class on the board. This form of teaching is a necessary evil to being able to adequately teach most topics because foundational knowledge is critical
to being able to establish more complex cases. Lectures have multiple downsides that make them something to avoid doing when at all possible. Lectures have the highest chance to become non-interactive for students if done improperly due to the nature of the lecture. If enough interaction is not structured into the lecture, it can become boring and stale, which can lower the lecture’s efficacy. Students have to write down notes on what is on the board, and try to absorb a barrage of information.

For extroverts, lectures are the absolute worst form of teaching a lesson due to a lecture’s inability to fuel their drive for social interaction or class engagement compared to other methods. Unless the lecture contains an active question period, this means that for extroverts, a school system’s main foundational teaching method is counter-intuitive to their ability to learn. For introverts, lectures are less painful because there is a lack for a need of engagement from students during these sections of a lesson. However, since there is no point in a lecture that requires deep thought, introverts are typically disengaged and bored. For both personality types, this method of teaching works in a disadvantageous manner. Therefore, this type of teaching should be minimized to only when basic concepts are needed to be explained.

Another teaching method is through example problems or worksheets. This method aims to enhance a student’s understanding of a concept by practicing the concept multiple times in a penalty free environment. This can be from examples as a class on the board or worksheets. This method is an effective and simple tactic that can provide greater understanding if paired with other engaging teacher practices. By also providing options for partner work, introverts can find a respite from social interaction by working alone while extroverts can work together to better understand problems. If this
option is given, classwork is a safe and simple choice that is beneficial to both personality types. Technology implementations should clearly have some mode of practice tools for subjects in them to utilize the raw effectiveness of this method as it helps cement a stable understanding of a topic. In math classes digital worksheets could be distributed through the software and be checked electronically to provide instant feedback. In addition, a teacher could create groups to work together on worksheets together that allow multiple students to work on a problem together. Each student could do one step of a calculation and be able to provide feedback for their fellow students if they feel confused or feel certain that a mistake had been made. This provides a way for students to learn off each other and discover new methods for solving problems that they had not thought of.

It is also important to note that example problems and classwork are much more effective if they implement methods to test a student’s understanding of the material rather than raw memorization. In my classroom, showing work was a requirement for homework because it helps demonstrate greater understanding in the process and resulted in students achieving better test scores. A student is able to show how a concept is applied step-by-step will have a much greater mastery of a subject. This is a feature that needs to be accounted for in a technological product, because most interfaces make showing work more difficult than in needs to be.

One other way to teach content is through student discussion times fueling the content that is taught. For example, when a test is returned a teacher could give time to allow for questions to be fielded concerning errors on the test and then focus a chunk of time to relaying information to solve that question. This works well with covering
material a student completes on their own time such as homework, quizzes, or tests. Introverted learners have the ability to think about questions before coming to class which allows them to process all the information thoroughly. This leads to questions that are more thought out and help improve the effectiveness of these discussion periods. Extroverts enjoy the more social aspect of asking the questions and interacting back and forth with the teacher and other students. This specifically is a strong way to reinforce positive work and fix work in students who have made mistakes. When done consistently it prevents any misunderstandings between teacher and student and decreases the chance that incorrect ways to solve a problem or think about a concept are reinforced. Technology products can be built around this kind of relationship between the student and teacher and allow for even more opportunities to use this method of teaching due to the ability to communicate between devices. The idea of student communication with a teacher is the key factor in this teaching method. In a math class, a teacher could potentially distribute out digitally a test and let students view it immediately and field questions through a forum that allows critical questions that many students have to be answered quickly and efficiently and reinforce material before moving on in the curriculum.

3.2 Examination

In this section I will briefly go over how effective the two main types of examination are, projects and tests, and how they play into the strengths of the introvert or extrovert. It will also briefly explore what ability technology could play in such an adaptation.
**Tests**

Examinations are built around checking the student on how much mastery they have with a given topic. For most school systems, this form of examination is the bulk of the grade and a large determining factor in how well a student performs in the grade at the end of the year. This form of examination only answers the question, “Did the student remember/understand the topic?” but is critical in some capacity for checking mastery. If a teacher moves on from a topic with assessing the level of mastery of the students, content may not be completely understood. For introverted learners, this system is wonderful for them and plays into most of their strengths. Introverts can find peace working on an examination in a quiet and personal environment that is created for examination times and they can recharge their energy when it is required the most. Introverts also are the best studiers, generally due to their process of inwards thinking, and can efficiently gather information together to utilize during tests. Examinations being a large part of their grade boosts them over their extroverted counterparts. Extroverts are hurt in their final grade because of the emphasis on examination at schools. They are primarily done as an individual activity without any social interaction which drains the energy of an extrovert and can create laziness and inaction. The environment is the key hindrance for the extrovert because unlike introverts who can think by writing information down, extroverts think through expressing their ideas out loud which is not allowed in a test. Examinations pose a difficult hurdle for correctly implemented in any system, not only technological projects, because of this disconnect between the personality types.
The other method of assessing student mastery is through project work. Project work can include short 1-2 day assignments up to multi-step projects that combine concepts and apply them to real-life situations. Projects help examine whether students can apply the knowledge they have gathered rather than assessing if they know or understand the material. Extroverts benefit a lot from project work as it gets them communicating with other teammates and working in a social setting to achieve a goal with multiple people. They are able to express their ideas vocally with a group, talk out problems, and engineer solutions because of their tendency to provide lots of ideas to a group. Introverts can show off some of their abilities during projects, by some insight into how to solve the problem since problem solving can take a higher level of thought that requires the student to look inwards, hence the introvert excels in that category. Social interaction can be tough on introverts but is generally acceptable considering the frequency of projects is low and can have individual elements to it. Projects are the premium way to assess students and can test how far someone can take an idea and apply it. Extroverts and introverts can flourish in this assessment so it should be incorporated into a technological application if possible.

4. PRODUCT/FINDINGS

This section will detail the final product of the IQP based on its different components; the forum, assessment management, and project centers. The final
product is a detailed blueprint of a theoretically effective tool that succeeds in three different key criteria. First the product needs to be able to bridge the gap between introverts and extroverts as this product is based around this concept. Second, it needs to excel in some way over more traditional approaches to make it a viable investment to implement. Third, the product needs to be an intuitive system that students and teachers alike can learn quickly. If the product is not easy to use, it becomes too much of a time investment in an environment that has very little extra time and ultimately becomes a useless product. Each aspect of the product will be valued by these three criteria and incorporates many successful components of current teaching practices gone over in the Methodology. The end of this section will explain how each section is incorporated together to form a coherent and complete product.

4.1 The Forum

A key aspect to bridging the gap between introverts and extroverts is providing a space that is comfortable for both personalities to interact in. A forum area of this product provides multiple facets for integration in a classroom while providing a notetaking space for introverts and a method of social interaction for extroverts. The forum would be only available to students in that class and could then be accessible online. This section of the product could be used in classes where discussion is a key factor, such as English classes. The shared forum that could be created from the application would allow for ideas to be carefully thought out and then shared to allow for more nuanced discussion. In math classes or science classes, these forums can be places for teachers to quickly check the classes understanding of a topic, similar to having students do problems that are on the board on a separate piece of paper.
Teachers will also be able to create separated groups within the forum for anonymous group discussion and bring them together after they have finished discussing on the forums. Teachers however will have access to the names of all the students involved in the discussions to enable them to have meaningful discussion and be able to help students.

The forum feature of this application would enhance the ability of introverts to participate in conversations and discussions while not hindering extroverts. Introverts excel with a place to write down information and properly express their ideas before speaking. Given proper implementation of this feature, introverts will feel much more empowered in heated debates and be able to formulate thought provoking questions. This will undoubtedly improve classroom discussion for extroverts and provide a different outlook on the information provided in class. While extroverts have no need to write down information to gain a deeper understanding, the usage of technology is equally as effective in both personality types and does not hinder them. The ability to have an area to show off their ideas to the class will also be a good outlet for providing social activity. As texting and communication over phones becomes the standard in high school students, this forum feature will feel very natural to everyone in the classroom.

These forums provide an opportunity that is not normally accessible to teachers without the use of technology. With the ability to remain anonymous in class, groups that might not have worked face to face due to social factors outside of the teacher’s control could now function. This means that ideas can form on these forums without being shut down in a more confrontational manner in group work and provide the basis for stronger debates on issues that have multiple sides to them. The creation of groups
so quickly with the press of a button will also accelerate group making processes in class and provide more time for learning. By utilizing this feature, teachers also consolidate all the information they need on how students understand material in one place rather than having to gather that information from mountains of paper. This would help teacher’s focus on the aiding the weaknesses of the class and detract from the amount of unnecessary resources that are currently needed to gain that same information. The fact that the teacher can pinpoint common errors instantly during a class will decrease the amount of time that students continue committing a specific mistake. Misconceptions can form bad habits that contribute to mistakes on tests, and so these forums will create an environment to potentially enhance student’s grades. Finally, this forum also provides a safe haven for students who feel embarrassed by their weakness in a subject. They don’t need to feel singled out when teacher’s take a general assessment of who understands the knowledge as the teacher can quickly see which students have a grasp of the concepts by looking at the forums.

In the case of accessibility, forums for classes will be created by selecting a class and then pressing the “Create Forum” for the teacher. These forums can be set up in advance and be activated either by reaching a specific time or manually on the teacher app. The process is incredibly simple for the teacher allowing for quick implementation of this feature into the classroom. There is also a space that can be hidden where the teacher may write in information into the forum and reveal it during discussion. This will allow for more important notes to be readily available for every student with little effort on the part of the teacher. These notes will be a great improvements for students that fail to take notes or fail to take notes that encapsulate all the essential concepts. The
teacher will then be able to go through folders that contain all of the forums for a class and group them up based on subject, which will be replicated student side. Students will just have to join an active forum that they are allowed into on either a tablet, phone, or computer. A student’s profile will contain all the information that was gathered in the forums and will be available from their device at home if they install the app.

4.2 Assessments

The next aspect of this application will be its ability to import and allow work on assignments. This part of the application will allow the uploading of PDF documents into folders. After they are in a teacher’s profile they can use an application specific editing tool to drag a box around each separate question. The program will then automatically create a box below it for work to be completed. This will allow to teachers the ability to create enough space to work out problems in math or properly explain open response type problems. Skeleton notes could also be given out and students could then complete them and have access to the notes for later use at any time. Additionally, once assessments are sent out they can be given as group assignments where students are randomly assigned together to work on them. Along with these online documents will be a critical feature for math classrooms which will allow for students to easily document their work. A calculator-like picture will appear anytime the student clicks in the workable space, and with this option turned on, any inputs on the calculator-like interface to solve the work will write. This interface will include all the symbols students will need to show their work. This finally allows work to be more easily shown using technology instead of stating the final answer. These documents will be saved to student profiles so they will be able to reference and study them for tests. These PDFs
could also become the tests that students take and be populated with the correct answers. This would allow for instant feedback in an environment where the student can do work and save it permanently as a reference. This feature could makeup test improvements much higher due to the ability to quickly receive feedback and look back at mistakes. Usually test scores come back too slowly for students to want to improve on them, due to having to relearn material again. With this feature test retakes and corrections will be able to properly assess students and help them ultimately get better grades and learn the material completely.

For bridging the gap between introverts and extroverts, this feature will aid extroverts the most. The ability for more assessments to be group based will bring more group activities to the forefront of the class where extroverts can better participate. Due to assessments being a largely introvert dominated sphere based around writing down knowledge individually, any ability to change that norm will be a change towards equal treatment of personalities. Extroverts can also be aided by the ability to move around and find a comfortable position which this technology would allow during assessments, barring places that would be places to easily cheat. Introverts would have a similar experience to what is currently available due to their already strong affinity to testing environments. The biggest part of this is that extroverts will be able to get the feedback they need on the hardest part of school for them. That extra feedback can go a long way to aiding extroverts who feel like they understand material in class but fail when it comes to assessment.

This feature is better in a number of ways over traditional assignments and assessments. First, it saves lots of paper by making everything digital which saves lots
of time for the teacher making copies and allows for more practice work to be instantly accessible to students. Challenging work for advanced students and additional practice for struggling students can be one of the most challenging factors to balance in a classroom when trying to teach a certain baseline for a test. That work traditionally has to be printed out or has to be out of the textbook, which this feature liberates. It opens up much more varied content and more of it to be available to those two groups of students. For group assignments, this feature also simplifies the process and opens up the possibility of group assessments which would help balance the act of assessment for extroverts. Other services like Google Classroom allow students access to a document but don’t offer interfaces to efficiently show work or cooperate with other students which is necessary to keep the social aspect of school prevalent.

This feature will be slightly more complicated for teachers to start with as it will require them to move most of their documents digitally. If teachers take pictures of their current assignments and assessments they will be able to quickly change them over after converting them to PDF. The process will likely take a while but once the initial conversion is complete, assignments and assessments can be given out in a similar fashion to putting files into Google Drive which is a seamless process. Once given out to a classroom, teachers will be able to look into classes and look at each assignment for each student organized by folders. The system will automatically organize by date and allow for easy book keeping for teachers. Students will just need to click to open the shared assignment and they can get right to work making it a quick and easy process.

4.3 Managerial Features/Project Work
The final key features of this product will be its managerial features to running a smooth classroom and its ability to help coordinate project work. The app will track when assignments are completed when the student presses a button to confirm its completion at home. This allows the assignment of work over the app to help students who are habitually absent or sick so they don’t fall behind. Before the class, the teacher can check how many students completed the homework thus nullifying the need to check any homework in class. Additionally, there will be a button the teacher can press to start checking attendance and all students in the class can click their appropriate student button to check in. This will easily keep track of absences and decrease initial time wasted during the beginning of class. The final managerial tool the app will introduce will be a seating chart that can be edited based on preferred arrangement. This will help with remembering student names and setting them to memory as well as keeping an on hand way to change seating. These seat changes will be reflected student side so with one announcement of a change of seats, students will know where to go. It terms of project based capabilities, there will be a project tab in the app that will allow for the creation of project groups and shared folder space. Students will also be able to access the internet and webpages can be bookmarked for further usage inside the folders if research is needed. Group members will also be able to group message each other to work out when to meet and how to complete the projects which will enable projects to have a smoother execution.

The managerial features don’t target personality types, but the project organization feature is aimed towards creating more projects as part of assessment to even out the playing field for extroverts. Extroverts thrive on social group work and this
project organization will encourage teachers to add more projects into their curriculum plans. Introverts will also have an easier time with project based work due to the organization options they can play with to consolidate all of the information and form a detailed plan for their group. If projects are able to bloom with this extra help in organizing them, than creating an even split of projects and tests will be able to more accurately assess the knowledge of students of all personality types.

Within traditional means, projects have to be more limited in scope if the teacher hopes to be able to have any work done on them during class. There would typically be no ability to work online and projects need a lot more aesthetic work than what is truly needed to display mastery of the material. With this organizational tool and hub for project work, students can easily amass knowledge together, build up interesting real world connections and plan more effectively for work outside the classroom. For the managerial tactics, every single one of them is almost instantly quicker with technology and helps the teacher to move straight into the lesson at the start of class. This does run into the problem of over reliance on the technology and not forming a bond with students, but that just requires some care on the part of the teacher. Students will also need to be trained initially on certain protocol to follow every day in order to assure that students to not get marked absent when they are present. It is also incredibly difficult as a teacher to have students fall behind on work due to extenuating circumstances which this app completely fixes. The student will have all the work at their fingertips regardless of if they are able to attend class allowed for smoother transitions back into class.

Effectively these methods are easy to understand and learn with all the managerial features being simple single button presses and lists shown of homework
completion. With all the information at a fingertip’s reach teachers will be able to deal with bureaucratic start of class work in under a minute allowing more time to check in personally with students. For the project hubs, students will have everything they need to easily consolidate work unlike ever before. Digitally storing related data in folders within the project hub will make larger projects with large groups possible due to its raw organizational ability. With a similar system to Google Drive, students will be able to intuitively put together all the information needed for a great project.

4.4 Final Remarks/Considerations

In the end, I want this product to be an application for teaching that can be accessed via a phone, tablet, or laptop specifically based around supporting more group work and discussion. The reason for the choice of an app rather than a standalone tech product is that most students have access to a phone in school and a computer at home and having a school buy tons of mini computers is an unrealistic expectation. With an app license that schools can purchase for each classroom, schools can take small steps towards converting towards a technology enhanced learning environment. The main goal of this application was for students to be able to show their mastery of the material in more appealing ways and enable students in that goal. This application is meant to go along with most conventional teaching strategies and acts as a medium to enhance class discussion and organize more group work. It should manage to not only enhance the school experience for all students in the classroom, regardless of personality type, but also help manage the classroom for the teacher and aid in book keeping of grades and work.
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