ABTRACT

The Role of Ethics in Stem Education: A Course Proposal

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In modern society, ethics and science have become increasingly intertwined. From stem cell research to artificial intelligence, many of the most controversial ethical and philosophical dilemmas facing society are tied to science, technology, engineering, and mathematics (STEM) disciplines. As such, it is important for scientists to be involved in current ethical discussion. However, the vast majority of STEM experts lack formal training in the styles of thinking and modes of communication required to be an effective contributor to philosophical conversation. Many universities do not require an ethics course for science majors, and some do not offer any courses designed to broaden science students' modes of ethical thinking. Undergraduate institutions have an opportunity to train a new generation of scientists that will be able to shape philosophical discussion. This thesis addresses the need for ethics education in STEM programs, and proposes a course that would broaden students' thinking, pique their interest, and teach important ethical theories.

APPROVED BY DIRECTOR OF HONORS THESIS

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THE ROLE OF ETHICS IN STEM EDUCATION

A COURSE PROPOSAL

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Honors Program

By

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TABLE OF CONTENTS

PREFACE

The following pages contain an argument for increased ethics education for science students at the undergraduate level. The logic and reasoning behind my thesis apply to all universities, and I sincerely hope that the future sees such an increase spanning academia. However, I am well aware that the primary readers of this thesis will be Baylor University affiliates. Thankfully, Baylor University is uniquely qualified to be a leader in this movement. The Christian values that set the framework for Baylor's policies lend themselves toward educating students in religion and ethics, while the strength of the University's science and engineering programs attract some of the brightest minds in the STEM fields. I believe that there is arguably no school whose DNA better aligns with the principles set forth in my thesis, and I therefore hope that my writing may aid in a greater emphasis on philosophical thinking within science at Baylor. I write this thesis not because Baylor University is weak in ethical education. Instead, I write to encourage Baylor to further emphasize this strength by including science students in ethical and philosophical discussion.

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CHAPTER ONE

Science and Ethics

Introduction

Fulfilling degree requirements in an undergraduate education often requires completion of a course in ethics. Religion students will find ethics ever present in their curriculum, and business students will go through an Ethics in Business class. Even Engineering students may find themselves required to learn the legal standards associated with technology and the design process. However, Science majors often find themselves uniquely immune to the requirements of moral contemplation. At Baylor University, a school not unlike many others in this regard, science students encounter no required ethics classes over the course of their undergraduate career. A biochemist, for example, can finish an undergraduate degree in its entirety without ever participating in a class about ethics.[1]

The unfortunate result of this lack of ethical education is that neither the ability nor desire to engage in deep ethical discussion is instilled in undergraduate science students. Scientists can enter the workforce without the idea that their involvement in broad ethical discussion is important. Further, even if they choose to engage in moral discussions, many scientists have no experience, having left their undergraduate careers without ever being trained in the art of meditative thinking or discourse. As such,

[1] Baylor University Undergraduate Catalog, Volume 118, 2015, http://www.baylor.edu/registrar/doc.php/245625.pdf

scientists enter their fields woefully unprepared to further society's understanding of ethics.

However, as humanity continues into an age where neural prosthetics pull ideas about cyborgization off the page of science fiction and into reality, scientists will be ever increasingly called upon to engage in discussion of what it means to be human. The most prevalent ethical issues in our society (abortion, stem cells, genetic engineering, cloning, superweapons, online privacy, and endless others) hinge on society's understanding of science and technology. Scientists are the foremost authorities on some of the most important questions facing humanity and they must lend their wisdom and understanding to the ethical deliberation process.

Through better education in ethical deliberation for science students, undergraduate institutions can enable the next generation of scientists to influence society's discussion of ethics. By lessening the fear of technology, bringing firsthand knowledge to the table, eliminating stereotypes, and establishing a deeper way of thinking, a new generation of scientist-ethicists could greatly improve both the discussion and development of ethical policies in science.

Scientists and Ethical Thought

The issues arising from the lack of ethics training for scientists become readily apparent when one considers the number of ethical dilemmas facing society rooted in scientific development. Advances in science create new and ever increasing dilemmas for society to wrestle with. The possibility of cyborgization forces society to consider the question, "what percentage of original human tissue is required in order to be considered

an authentic human being?"[2] With this come even broader questions about the nature of life and personhood. As medical advances enable humans to be kept alive nearly endlessly via machines, society wonders whether an obligation exists to maintain life even when a subjectively measured "quality of life" is lost. Stem cell research remains a controversial topic. Research regarding the mind-boggling possibilities that stem cells offer is fraught with reservations regarding their acquisition and use.[3] Brain-to-computer interface threatens to soon step off the pages of science fiction and enter the world and day-to-day life. As a result, ethical dilemmas regarding what it means to be human and how to think about autonomous robotics may soon be impossible to ignore. Even beyond biioethics, science is creating moral questions in a way never seen in previous centuries. The stunning accuracy of satellite imaging and tracking raises questions regarding the right to privacy. Though increasingly affordable satellites enable new ways to locate terrorists or to visualize areas hurt by a natural disaster, their potential for misuse concerns many.[4] Advances in weaponry continually raise issues of danger to society and of the disastrous consequences of powerful technology being in the wrong hands. The list of scientific moral issues could fill entire books. However, the vast majority of the

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[2] Bang, Seung Ho. "THINKING OF ARTIFICIAL INTELLIGENCE CYBORGIZATION WITH A BIBLICAL PERSPECTIVE." *European Journal of Science and Theology* 10.3 (2014): 15-26. *EJST*. EJST, 1 June 2014. Web. 10 Oct. 2016. http://www.ejst.tuiasi.ro/Files/45/2_Bang.pdf

[3] Lachmann, P. (2001) Stem cell research—why is it regarded as a threat? EMBO Rep., **2**,165–168 http://embor.embopress.org/content/2/3/165?ijkey=11fe746e06da2bd47ddd69d85a4857fef88adf8b&keytype2=tf_ipsecsha

[4] Barron, Jessica. "The Reilly Center for Science Technology, and Values Releases 2015 List of Emerging Ethical Dilemmas and Policy Issues in Science and Technology." *The Reilly Center for Science Technology, and Values Releases 2015 List of Emerging Ethical Dilemmas and Policy Issues in Science and Technology // News // John J. Reilly Center // University of Notre Dame*. University of Notre Dame, 8 Dec. 2014. Web. 12 Dec. 2016. <http://reilly.nd.edu/news-and-events/news/54592-the-reilly-center-for-science-technology-and-values-releases-2015-list-of-emerging-ethical-dilemmas-and-policy-issues-in-science-and-technology/>.

population lacks the scientific expertise to establish a well-informed opinion on these topics.

For this reason, scientists must become an integral part of ethical discussions. Maurizio Iaccarino, the Secretary General of the UNESCO–ICSU World Conference on Science, explained this idea well in 2001:

> "We live in a world in which scientific knowledge and new technologies continuously challenge our values. We all have to live our daily lives and make decisions based on the fundamental values of human dignity embedded in our civilization. Scientists are no exception. Rather, I am convinced that they have an obligation to make a special effort to contribute to this discussion, because they often have more information and more basic knowledge about the very issues that generate these ethical dilemmas."[5]

Engineers, researchers, and scientific academics are essentially the gatekeepers for knowledge in many ethical dilemmas. Most of the public develop their ethical stances based on secondhand information. Rather than hearing thoughts from scientists, the public hears the ideas of philosophers with little background in science that have based their own opinions on their limited understanding of current technological advances. By involving themselves directly in purposeful ethics conversations, those in STEM (Science, Technology, Engineering, and Math) fields can guide and inform the growth of ethical theories related to the advance of technology.

Science against Ethics

Instead, the relationship between ethics and science is regularly viewed as one of opposition. The "Evil Scientist" or "Mad Scientist" trope employed in countless fictional

[5] Iaccarino, Maurizio. "Science and Ethics." *EMBO Reports*. John Wiley & Sons, Ltd, 01 Sept. 2001. Web. 07 Apr. 2017. <http://onlinelibrary.wiley.com/doi/10.1093/embo-reports/kve191/full>.

depictions demonstrates society's negative thoughts about the nature of science's relation to moral goodness. While society certainly does not view all scientists as evil, the generalization remains that researchers are focused only on scientific progress and less on the ethical implications of this research. Society places little expectation on STEM fields to think meditatively about ethics and scientists are often willing to conform to this lack of expectation.

This understanding is compounded by the lack of ethics education in STEM degrees. College students often find that an understanding of chemistry is required in order to graduate, but an understanding of ethics is not. Through their lack of encouragement of science students to study ethics, colleges and universities imply that such subjects are better left to philosophy students and other liberal arts majors. Thus, the invisible wall between ethical thinking and scientific progress remains.

The Fear of the Unknown

Even in the United States, where scientific progress is lauded as central to human success, the general population often fears that science will overstep its moral bounds. A study done by Chapman University in 2015 found that the top fear in America is "Man Made Disasters" (biowarfare for example). Coming close behind in second place was "Technology" (artificial intelligence for example).[6] These fears were rated as stronger than the fears of "Natural Disasters", "Government", "Crime", or even "Personal Future." Based on this study, many Americans appear convinced that scientific advance may not

[6] Ledbetter, Sheri. "America's Top Fears 2015." *Wilkinson College of Arts, Humanities, and Social Sciences*. Chapman University, 13 Oct. 2015. Web. 12 Dec. 2016. <https://blogs.chapman.edu/wilkinson/2015/10/13/americas-top-fears-2015/>.

be in the best interest of humanity. In fact, the survey indicates a widespread belief that scientific advance may be the biggest danger to humanity.

As the adage goes, people fear what they don't understand. The U.S. Census Bureau indicates that less than 7% of the country holds a degree in science or engineering, thus leaving the vast majority of the population lacking the background necessary to fully understand many cutting-edge scientific advances.[7] As such, the prospect of genetically engineered clones, robots with artificial intelligence, or unstoppable biological weapons create a high level of fear and worry.[6] Looking at the source of these fears, one can see that America worries not only that technology might fall into the wrong hands, but that technology itself is a danger. Many people fear that scientists are advancing science for its own sake, without considering the ethical ramifications and potential dangers. These fears are not without base (current technological advances pose many potential risks). However, these fears are uninformed. By not involving themselves in the moral considerations surrounding the advance of their field, those involved in science perpetuate fear of technology.

Fear compromises decision-making. This concept is accepted almost universally, and is supported by numerous studies.[8,9] When people are in situations where they feel a lack of understanding and have a feeling of worry or anxiety, their ability to contemplate the situation objectively is severely impaired.

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[7] Siebens, Julie, and Camille L. Ryan. *Field of Bachelor's Degree in the United States: 2009*(2012): n. pag. *Census*. U.S. Census Bureau. Web. https://www.census.gov/prod/2012pubs/acs-18.pdf

[8] Hartley, Catherine A., and Elizabeth A. Phelps. "Anxiety and Decision-Making." *Biological Psychiatry* 72.2 (2012): 113-18. Web. http://www.sciencedirect.com.ezproxy.baylor.edu/science/article/pii/S0006322312000091

[9] Miu, Andrei C., Renata M. Heilman, and Daniel Houser. "Anxiety Impairs Decision-making: Psychophysiological Evidence from an Iowa Gambling Task." *Biological Psychology* 77.3 (2008): 353-58. Web.http://www.sciencedirect.com.ezproxy.baylor.edu/science/article/pii/S0301051107001962

Because lack of understanding causes fear and fear impairs decision-making, it is imperative that those involved in decision-making processes clearly understand the issue at hand. However, scientific ethics is primarily discussed by philosophers rather than scientists. As such, fear of technological advance often has a greater influence on the debate than is truly warranted. Unfortunately, it is impractical to educate philosophers in all areas of science due to the massive amount of information required in order to be proficient in an arena of science. Thus, a more realistic solution is to involve more scientists in ethical discussion. This solution requires a move from calculative to meditative thinking for STEM specialists, a move that is discussed in following sections.

Calculative Thinking vs Meditative Thinking

There are two broad categories in which thinking can be placed: calculative or meditative. Well-known philosopher Martin Heidegger discussed the two at length in his book, *Discourse on Thinking*, "There are, then, two kinds of thinking, each justified and needed in its own way: calculative thinking and meditative thinking."[10] Different groups tend to prize one at the expense of the other, however, a culture that emphasizes only one greatly risks either not advancing or advancing in the wrong direction

Calculative thinking is the form typically associated with scientists and engineers. Calculative thinking does not take place for its own sake, and a truly calculative thinker would contend that, without a concrete purpose, thoughts can become a frivolous use of time. Instead, calculative thinking is a tool to be used for problem-solving. The thinker sees a problem and limits their contemplation to subjects that relate in some way to

[10] Heidegger, Martin. *Discourse on Thinking*. New York: Harper & Row, 1966. Print. 46.

solving the problem. Such thoughts often ignore the reasons that the issue exists in the first place and the broader implications of the solution as it applies to the nature of mankind. This form of thinking races rapidly from one idea to the next, always attempting to optimize. Calculative thinking is efficient and effective.

Heidegger explains the idea of calculative thinking, saying "Its peculiarity consists in the fact that whenever we plan, research, and organize, we always reckon with conditions that are given. We take them into account with the calculated intention of their serving specific purposes. Thus we can count on definite results. This calculation is the mark of all thinking that plans and investigates. Such thinking remains calculation even if it neither works with numbers nor uses an adding machine or computer. Calculative thinking computes. It computes ever new, ever more promising and at the same time more economical possibilities. Calculative thinking races from one prospect to the next. Calculative thinking never stops, never collects itself."[11]

Meditative thinking, on the other hand, exists in order to look beyond the immediate physical issues at hand and into the nature of reality. A meditative thinker believes that thoughts have merit in and of themselves. When a meditative thinker encounters a problem, the thinker does not throw all of their brain power into considering the solution. Instead, the meditative individual considers what the existence of the problem implies about other issues, such as the nature of humanity or the existence of other dilemmas. Meditative thinking is not as linear and focused as calculative thinking, and it is therefore a slower and more deliberate process. Rather than being designed for efficiency, meditative thought is meant to broaden the scope of thought.

[11] Ibid, 46.

Heidegger describes an additional aspect of meditative thinking this way, "Meditative thinking demands of us not to cling one-sidedly to a single idea, nor to run down a one-track course of ideas. Meditative thinking demands of us that we engage ourselves with what at first sight does not go together at all."[12]

Calculative thinkers often scoff at the idea of meditative thinking, imagining meditation to be reserved for the likes of Henry David Thoreau by the side of Walden Pond, or monks on a hilltop. In addition to seeing it as reserved only for philosophers, those who oppose the idea of meditative thought consider it impractical and a waste of time. Heidegger explains that such thoughts are unfounded.

> "Yet you may protest: mere meditative thinking finds itself floating unaware above reality. It loses touch. It is worthless for dealing with current business. It profits nothing in carrying out practical affairs.
> And you may say, finally, that mere meditative thinking, persevering meditation, is "above" the reach of ordinary understanding. In this excuse only this much is true, meditative thinking does not just happen by itself any more than does calculative thinking. At times it requires a greater effort. It demands more practice. It is in need of even more delicate care than any other genuine craft. But it must also be able to bide its time, to await as does the farmer, whether the seed will come up and ripen.
> Yet anyone can follow the path of meditative thinking in his own manner and within his own limits. Why? Because man is a thinking, that is, a meditating being. Thus meditative thinking need by no means be "high-flown." It is enough if we dwell on what lies close and meditate on what is closest; upon that which concerns us, each one of us, here and now; here, on this patch of home ground; now, in the present hour of history."[13]

Unfortunately, in the technical age that we currently live in, meditative thinking is increasingly considered obsolete. Society often values the progress of science more than the evolution of philosophy. Science is seen as the road to a better future, and calculative thinking practices are the most streamlined method for advancing STEM fields.

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[12] Ibid, 53.
[13] Ibid, 46-47.

Meditative thinking is often viewed as a thing of the past, something that was reserved for the philosopher scientists of the renaissance, but is no longer useful in the modern world.

> "The international meeting of Nobel Prize winners took place again in the summer of this year of 1955 in Lindau. There the American chemist, Stanley, had this to say: "The hour is near when life will be placed in the hands of the chemist who will be able to synthesize, split and change living substance at will." We take notice of such a statement. We even marvel at the daring of scientific research, without thinking about it. We do not stop to consider that an attack with technological means is being prepared upon the life and nature of man compared with which the explosion of the hydrogen bomb means little. For precisely if the hydrogen bombs do not explode and human life on earth is preserved, an uncanny change in the world moves upon us…. the approaching tide of technological revolution in the atomic age could so captivate, bewitch, dazzle, and beguile man that calculative thinking may someday come to be accepted and practiced as the only way of thinking."[14]

Humanity is currently in a time where philosophy is by no means obsolete, but is not universally considered meritorious. Increasingly, science students lack understanding about why they would be required by their universities to take any courses in the humanities. Scientists often ignore philosophical discussion, opting only to push forward progress in their lab. More appalling to Heidegger than any specific danger associated with science was the idea that the world might move in a direction where meditative thinking would become so undervalued as to be forgotten. Though American society has not yet fully attained the greatest fear of Heidegger, much of the scientific community pushes itself toward a complete focus on calculative thinking.

> "What great danger then might move upon us? Then there might go hand in hand with the greatest ingenuity in calculative planning and inventing indifference toward meditative thinking, total thoughtlessness. And then? Then man would have denied and thrown away his own special nature that he is a meditative being. Therefore, the issue is the saving of man's

[14] Ibid, 52.

> essential nature. Therefore, the issue is keeping meditative thinking alive."[15]

Current Ethics Education

One of the primary potential objections to this thesis is the possibility that some current scientific curriculums at Universities offer an ethics course for engineers or scientists. However, many do not, and the courses that *are* offered or required typically address ethical *practices* rather than ethical *thinking*.

For example, current ethics courses for medical science students often focus on the legal and ethical requirements associated with research. At Baylor College of Medicine, one finds course listings such as "Responsible Conduct of Research- Year 1", which deals with issues relating to "data acquisition and record-keeping", "responsible authorship", and "Professionalism."[16] These topics are related to protocols rather than morals. Following years in the program cover similar topics. When exiting the Baylor College of Medicine, doctors enter the field with a firm knowledge of how to conduct research in a manner that will obey all current laws and regulations. However, they exit their educational process without ever delving deep into the ethical implications of research they might eventually conduct. Medical Doctors are often the ones heavily involved in some of the most controversial topics in bioethics: stem cell research, abortion, human enhancement, and neural prosthetics (which have implications related to cyborgization), among many others. The doctors who work in these fields are the ones best situated to dialogue with the public about the ethics associated with their fields,

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[15] Ibid, 56.
[16] "Current Curriculum Schedule." *Baylor College of Medicine*. BCM, n.d. Web. 24 Nov. 2016. <www.bcm.edu/CurrentCurriculumSchedule.html>.

however, many have not been trained or encouraged to participate in this meditative type of discussion. Doctors are trained in resolving the day-to-day moral questions associated with their work, but often their education lacks an emphasis on the ability to wrestle with the broader moral implications of scientific advance.

Similarly, many undergraduate scientists at Baylor University experience no requirement of any form of ethics class. Undergraduate biochemists learn laboratory techniques, but have no required course within their schedule that discusses the ethical implications of their actions. However, many of these same chemists will go on to do research in gene therapy, a medical procedure that bear wide implications about what it means to be an individual. Biochemists may do research in stem cells or many other arenas that have broad ethical implications as well.

While Baylor University and Baylor Medical School are certainly not a large sample from which to base broad statements about ethical education in America, it can be found with little research that the requirements of numerous other universities follow the same pattern. In fact, Baylor's scientific education is found to involve greater focus on ethics and humanities than the majority of other schools. Around the nation, STEM students are well-trained in the ability to meet existing regulations and ethical standards, but often have not had the drive to think meditatively about the issues surrounding scientific advance instilled in them. In their careers, many STEM students will be well-situated to impact society's discussion of the ethics, but few will attempt to engage in the discussion. By not training students in the art of meditative thinking, the educational system not only avoids giving students the necessary skillset for ethical contemplation,

but it also deemphasizes the importance of scientists being involved in ethics, thereby decreasing the number of future scientists that will add their voice to the discussion.

Blaise Pascal

Blaise Pascal was a French physicist, mathematician, philosopher, inventor, and writer who lived from 1623 to 1662. During his life, he showed how one can devote themselves to both calculative thinking and meditative thinking as he pushed forward progress in topics ranging from fluid pressure to Christian ethics. In addition, he displayed the impact that education can have on the development of a true renaissance scientist.

Pascal's mother died when he was a toddler, leaving the child to be raised primarily by his father, Etienne Pascal, a tax collector and brilliant mathematician. Surprisingly, despite his own mathematical prowess, Blaise's father refused to let his son study the subject at an early age. Teaching his son at home, Etienne Pascal focused his lessons on classical subjects including Latin and Greek. He believed that math was far too satisfying of a form of study to encourage at a young age, claiming that it "fills and greatly satisfies the mind."[17] By disallowing mathematical study, Etienne hoped that he could encourage his child into broader intellectual pursuits. Thus, Etienne Pascal taught his son humanities first, leaving math and science for the future.

A natural intellectual, Blaise's curiosity was aroused by the forbidden STEM studies. By the age of 12, he was exploring the principles of geometry on his own and eventually derived some of the key formulas using his own terminology.

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[17] Chew, Julia. "Blaise Pascal." *Blaise Pascal*. University of California Berkeley, n.d. Web. 12 Dec. 2016. <https://math.berkeley.edu/~robin/Pascal/>.

Seeing his son's natural proficiency in math, Etienne was proud, and allowed his son to read the writings of Greek Mathematician Euclid. Etienne taught Blaise other concepts himself, and allowed his son to travel with him to meetings of other great mathematicians. At the age of 16, Blaise had developed a number of his own theorems, and presented them to some of the seminal mathematicians of the day at Mersenne's Academy.[18] There, Blaise Pascal presented one of his key mathematical contributions, the "mystical hexagon."

As his teenage years were ending in 1642, Pascal created his first invention. Having watched his father spend countless hours working on tedious tax calculations, Blaise assembled a rudimentary calculator called the Pascaline. Though the device was not without its flaws, and was not commercially successful, the progress made in the development of the device demonstrated Pascal's ability to advance technology in addition to advancing theory.

In the 1640s, Pascal's work spread from mathematics into the physical sciences. Expanding upon Evangelista Torricelli's work with barometers, Blaise Pascal hypothesized that a change in pressure at any point in an enclosed fluid at rest is transmitted undiminished to all points in the fluid. To demonstrate this, Blaise poured water into the top of a long tube that stood upright in a closed barrel of water, eventually creating enough pressure within the barrel to cause it to burst. This fundamental principle is now known as Pascal's Law, and the SI unit for pressure now bears the name of pascal. Further demonstrating his namesake physical laws, Blaise Pascal also invented a version

[18] "Blaise Pascal." *Biography.com*. A&E Networks Television, 19 Nov. 2015. Web. 12 Dec. 2016. <http://www.biography.com/people/blaise-pascal-9434176#inventions-and-discoveries>.

of the syringe and the hydraulic press.[19] Both of these inventions were key technological advances that would go on to be used in numerous fields.

During the 1640's, while his scientific discoveries were becoming more widely known, Blaise Pascal also faced a personal crisis when his father broke his hip. This condition left his father in mortal danger, placing his health in the hands of seventeenth century medical care. The bonesetters called upon to save Etienne Pascal were followers of Jansenism (a Christian movement of the time) and their devotion to caring for those in need helped mold Blaise's faith. Blaise listened to their understanding of God and Catholicism during this time and accepted many of their teachings. After his transformation, Pascal devoted increased time to philosophical and theological thought.

Many of Pascal's theological and philosophical writings are studied to this day. His first great theological work, "The Provincial Letters" defended Jansenism and attacked lax morals in Jesuit teaching. Pascal displayed his humanities background in his letters, penning a work that became immediately popular reading. Discarding the pretentious and tedious prose of the day, Pascal advanced French literature by balancing deeper theological content with witty and concise writing. Some credit the works of Pascal with ushering in the beginnings of modern French prose.[20]

Pascal went on to write books on Christian apologetics. He made a case for skeptics accepting the faith in his *Wager*, arguing that atheists have more to lose by not believing in Christ than they do by disbelieving in Him. Pascal employed his skill in

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[19] Orcibal, Jean, and Lucien Jerphagnon. "Blaise Pascal." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 30 Mar. 2016. Web. 12 Dec. 2016. <https://www.britannica.com/biography/Blaise-Pascal#ref365125>.

[20] Orcibal, Jean, and Lucien Jerphagnon. "Blaise Pascal." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 30 Mar. 2016. Web. 12 Dec. 2016. <https://www.britannica.com/biography/Blaise-Pascal#ref365125>.

gambling probabilities to argue, "But there is here an infinity of an infinitely happy life to gain, a chance of gain against a finite number of chances of loss, and what you stake is finite. It is all divided; wherever the infinite is and there is not an infinity of chances of loss against that of gain, there is no time to hesitate, you must give all...."[21] Attempting to address the skepticism of his peers, Pascal also employed arguments from secular philosophers and skeptics such as Thomas Hobbes and Pierre Charron.[22] He also used Augustinian allegorical techniques to expound upon Biblical texts to display their meanings. Though many of his theological writings were not published before his death, Pascal's work continues to be studied by Christian interpreters and skeptical literature scholars alike.

The Renaissance was a time filled with explosive growth in areas ranging from literature, to religion, to science. Entering this era in its later part, Pascal was a man who embodied the greatest aspects of the time. He is a case study for the attainability of a life spent in both meditative and calculative thinking. Pascal pushed science forward, making key discoveries that shaped the study of pressure. He developed mathematical theorems that are studied to this day. His writings brought forth a new style in French literature. His religious works pierced the halfhearted ethics of current Jesuit teaching, helping bring about a firmer moral foundation in the Catholic Church. All of this Pascal managed in a life that never saw age 40. His contribution to society would not have been complete if he focused only on science or philosophy. By forcing Blaise to study the humanities in

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[21] Hájek, Alan. "Pascal's Wager." *Stanford Encyclopedia of Philosophy*. Stanford University, 02 May 1998. Web. 12 Dec. 2016. <https://plato.stanford.edu/entries/pascal-wager/#4>.
[22] Orcibal, Jean, and Lucien Jerphagnon. "Blaise Pascal." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 30 Mar. 2016. Web. 12 Dec. 2016. <https://www.britannica.com/biography/Blaise-Pascal#ref365125>.

his younger years, Etienne Pascal may have enabling some of the greatest writings of the era.

Conclusion

As a university, it can be incredibly tempting to enable science students to avoid ethics and humanities classes. Advancing at an unprecedented pace, science requires numerous years of study in order to know enough to make a meaningful contribution to a specific field. Numerous courses are required in order to possess the requisite background knowledge in any STEM field. In order to enable all of these courses to fit within a curriculum, many universities eliminate requirements for courses that would foster meditative thinking. Such courses occupy valuable time in a science student's schedule, and the temptation to eliminate their requirement is strong. Further, many universities offer no courses related to meditative ethical thinking that are personalized for science students. Even STEM students who desire to broaden the scope of their thinking often find it difficult or impossible to find such courses.

Thus, universities should consider creating courses targeted at STEM majors that focus on the impact of science on modern ethics and on meditatively thinking about related issues. Specifics on what such a course might entail are outlined in Chapter 3 of this thesis.

By training the scientists of the future in both calculative and meditative styles of thinking, universities have an opportunity to usher in a new renaissance of thought, pushing forward the growth of science and technology while simultaneously encouraging deeper ethical consideration about technology's implications.

CHAPTER TWO

Meditative and Calculative Thinking

Introduction

This chapter focusses primarily on the goal of summarizing, analyzing, and promoting Martin Heidegger's thoughts on Contemplative and Meditative Thinking. As such, this chapter warrants a very specific disclaimer: Heidegger was a Nazi. Opponents of the philosopher often claim that Heidegger's political affiliation during the Second World War preemptively disqualifies the legitimacy of his thoughts. Proponents contend that Heidegger's thoughts are not automatically disqualified due to one faulty or evil political leaning, and many argue that he never truly believed Nazi propaganda. This thesis sides with the former of proponents' views, but acknowledges that readers must carefully consider Heidegger's teachings before accepting them as valid. Though this thesis is limited in its address of this controversy, there are a number of well-written books discussing the matter for those wanting to further analyze Heidegger's political affiliations.[23,24,25]

This chapter deals with Heidegger's arguments about meditative thinking. As summarized in the previous chapter, Heidegger contended that the advance of technology in recent history has simultaneously narrowed society's thinking. Rather than contemplating the deeper meanings and implications of technology's progress, modern

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[23] Macquarrie, John. *Martin Heidegger*. Richmond: John Knox, 1968. Print.
[24] Lang, Berel. *Heidegger's Silence*. Ithaca, NY: Cornell UP, 1996. Print.
[25] Ferry, Luc, and Alain Renaut. *Heidegger and Modernity*. Chicago, Ill.: U of Chicago, 1991. Print.

society thoughtlessly strives to advance science. Heidegger argues for an expanded way of thinking. He explains that there are two types of thought—calculative thinking and meditative thinking. Calculative thinking is often employed by scientists as they wield their intellect to solve technological dilemmas, while meditative thinking is often ignored within the scientific community. However, Heidegger contends that both styles of thinking are required if humanity hopes to achieve the most benefit from the progress of science while simultaneously avoiding its pitfalls.

Martin Heidegger

Martin Heidegger once opened a lecture on Aristotle with the simple statement, "He was born. He thought. He died. And all the rest is pure anecdote."[26] The same could be said of Heidegger. Though his life is fascinating, his thoughts are what will live on long beyond his time. However, an understanding of Heidegger's life is not without worth. Knowledge of Heidegger's life and the events surrounding it can aid in comprehending his philosophy. To gain greater clarity regarding the Heidegarian philosophies discussed in this thesis, this first section of Chapter 2 outlines some relevant events of Heidegger's life.

Martin Heidegger was born on September 26 of 1889 in Messkirch, Germany.[27] While he was a child, Martin's parents immersed the budding intellectual in Catholic tradition and the Church. During the late 1800's, bitter conflict permeated the Church in Germany between two newly competing groups, the Romans and the Old Catholics. The

[26]Sheehan, Thomas. *Heidegger: The Man and the Thinker*. Chicago: Precedent, 1981. Print. 3.
[27] Safranski, Ruĭˆdiger. *Martin Heidegger: Between Good and Evil*. Cambridge, MA: Harvard UP, 1998. Print.

Romans, the sect to which the Heideggers belonged, consisted of Germans with primary middle to lower class financial standing. The Romans stood by the traditions of the past, upholding such doctrines as the infallibility of the Pope and consistently affirming the strict moral standards of the previous generation. The Old Catholics, in contrast, were incredibly progressive, liberal, and modern. Though their name implied a tie to the past, Old Catholics aimed to abolish many longstanding traditions like priestly celibacy and veneration of saints. Encompassing much of the wealthy, educated class in Germany at the time, the Old Catholics were often in a position to abuse the Romans, and they did so with little hesitation. Viewing the Romans as "backward little people clinging to ecclesiastical customs,"[28] the rich Old Catholics sometimes allowed their children to throw rocks at traditionally pious objects or relics.[29] It was in this time that Martin Heidegger first experienced the battle between tradition and modernism. As he watched the Old Catholics' disdain for the past, Martin likely began to develop his first ideas about the risks of running blindly toward modern ideas without contemplating the value of past thinkers' ideas and the implications of "progress." He would later pen important works warning against the dangers of thoughtlessly trying to push society forward, culturally or technologically.

Being in the lower middle class, Martin Heidegger's childhood family usually had enough money to live on, but periodically required aid from the Church. At that time, "It was the Church's usual practice to support gifted youngsters and at the same time recruit future priests."[30] Thus, when a local priest, Camillo Brandhuber, took notice of Martin's

[28] Ibid, 6.
[29] Ibid, 4-6.
[30] Ibid, 9.

promise, he taught the child Latin free of charge and enabled Martin to receive a grant to attend senior high school and attain further degrees. However, with these learning opportunities came a financial dependence on the Church and mandatory theological studies that irked the young Heidegger. At first, Martin enjoyed his theological studies, even considering becoming a priest. Yet as time went on, he came to feel that the institution was not enabling him to fully spread his wings. "Heidegger remained dependent on the Catholic world beyond the time when, in his mind, he had already begun to break clear of the Church….This institutional system, with its policy of interest in public life, became so distasteful to him that one of the reasons he later sympathized with the Nazi movement was its declared anticlericalism."[31] However, Heidegger did not consider his education that he received through the funding of the Church to be without gain. In fact, he stated that he "acquired everything that was to be of lasting value."[32] It was under the scholarship of the Church that he learned "Greek, Latin, and French, in addition to history, mathematics, and the natural sciences….Finally, it was here that he first became acquainted with philosophy, which would eventually become the subject of his main interest."[33]

At the end of Heidegger's formal education, he officially abandoned the idea of becoming a clergy. Instead, he threw himself into philosophy. Though there are few publications from Heidegger during the ten years after receiving his doctorate degree, Heidegger gave important lectures during this time, and caused great excitement though

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[31] Ibid, 10.
[32] Kockelmans, Joseph J. *Heidegger and Science*. Washington, D.C.: Center for Advanced Research in Phenomenology, 1985. Print, 21.
[33] Ibid.

his interpretations of Aristotle.[34] Studies of Heidegger's lectures during this time also hint at the development of his thoughts that would later manifest themselves in *Being and Time,* a book thought by many to be his most important work.

In 1927, Heidegger published *Being and Time.*[35] Here, Heidegger sought to analyze the concept of Being. He believed that this work had fundamental implications for the field of philosophy, but that the question had been ignored since the time of the ancient Greeks. Heidegger contended that the "business of the philosopher is to investigate some of these dimly understood notions that we already have, such as this notion of 'Being' of which we make constant use, and to clarify them and bring them into the light of day, rather than just say they are 'self-evident'".[36] Heidegger set out in his book to create what in some ways amounts to a proof of Being. He contended that man is distinct from other entities in that he has the capacity to dig deeper than surface-level thought and contemplate what it means to be. Man has a unique position in the cosmos in that he has a measure of freedom to contemplate his existence. To some extent, a humans are responsible for what they are. Their sense of Being is what makes them what they are.[37,38] Heidegger's call to think beyond the surface hints at his later lectures on technology, where he criticizes the lack of deeper thought that takes place in modern society. His discussion of what makes mankind distinctive from other entities also parallels his later contentions in *Discourse on Thinking*, where he states that meditative thinking is what makes humanity human.

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[34]Safranski, RuÌˆdiger. *Martin Heidegger: Between Good and Evil*. Cambridge, MA: Harvard UP, 1998. Print.
[35] Ibid.
[36] Macquarrie, John. *Martin Heidegger*. Richmond: John Knox, 1968. Print, 5-6.
[37]Macquarrie, John. *Martin Heidegger*. Richmond: John Knox, 1968. Print, 4-50.
[38] Heidegger, Martin, John Macquarrie, and Edward S. Robinson. *Being and Time*. New York: Harper, 1962. Print.

On the heels of publishing his seminal work, Heidegger moved to Freiburg to become a professor of philosophy.[39] It was there that he would have most of his remaining influence. He continued his groundbreaking philosophical writings and lectures on metaphysics.

In 1933, Heidegger was elected rector of Freiburg. Within only a couple weeks of the election, he joined the Nazi party. This event is well-summarized by John Macquarrie, a Priest, philosopher, and well-known Hiedegger Scholar whose translation of *Being and Time* is considered canonical.

"Soon after Hiedegger went to Freiburg, Germany began to experience troubled times as the new National Socialist Party began to make its influence felt. Though there seems to be little in his philosophy that would be sympathetic to the fanatical pseudo-philosophy that would be sympathetic to the pseudo-philosophy of such Nazi 'intellectuals' as Alfred Rosenburg, Heidegger, like many other Germans, joined the party in the belief that it offered the best hope for the renewal of the nation. There has been much controversy over the question of his relation to the Nazi regime….In his official capacity [as Rector], he identified himself with the policies of the government. Some of Heidegger's opponents have made as much as possible of his connections, in attempts (sometimes quite unscrupulous) to discredit him. However, study of his speeches and writings during the time of his Rectorship shows that although he was a firm supporter of the party, he did not share in its excesses. In any case, he soon became disillusioned. He gave up the Rectorship and his favorable mentions of the regime

[39] Macquarrie, John. *Martin Heidegger*. Richmond: John Knox, 1968. Print, 2.

ceased. His defenders praise his actions at this time, and claim that he left the party at a juncture when it was extremely difficult to do so."[40]

Regardless of any current opinions, after the Second World War, because of his misguided affiliations, Heidegger was not a lauded figure. From the end of the war until 1951, Heidegger developed his philosophy in private, and for much of the time was forbidden from lecturing.[41]

In 1953, Heidegger's postwar career began.[42] In the following years, Heidegger spent much of his time wrestling with the philosophy of modernity, the atomic age, and the advance of technology. He began this new era in his life with the lecture *The Question Concerning Technology,* and then later expounded on related thoughts in his *Discourse on Thinking.* It is in these works that this chapter finds much of its foundation. In these post-WWII works*,* Heidegger talked about our modern world in which technology has become God. Humanity races toward the next discovery with giddy abandon, never pausing to contemplate Being or what the dangers of their advance might be. However, with all of the risks that an age of atomic power brings, Heidegger had greater fears than the physical dangers that come with technology. He feared a loss of humanity. His seminal work, *Being and Time,* had earlier postulated that humanity's distinction is their ability to think more deeply, and yet much of society, especially scientists, appeared to be sacrificing that privilege.

Martin Heidegger died in 1976, but his concerns and thoughts possess the same weight and validity today as they did during his lifetime.

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[40] Ibid, 2-3.
[41] Safranski, RuÌˆdiger. *Martin Heidegger: Between Good and Evil*. Cambridge, MA: Harvard UP, 1998. Print.
[42] Ibid.

Heidegger and Thinking

Many readers of Heidegger's later writings come quickly to the conclusion that the philosopher opposes the spread of technology. However, Heidegger does not hate science; instead, he is aware of its power. For good or evil, technology is an imposing force. In *The Question Concerning Technology,* Heidegger quotes Hölderlin, saying "where danger is, grows the saving power also."[43] To Heidegger, the far greater concern was not the nature of technology, but the mindless push for technological advance that permeates society. As Heidegger scholar Trish Glazebrook puts it, "The danger is not technology, but an unthinking relation to it on the part of the human being."[44] The greatest minds in the world throw themselves into the progress of technology, and yet they never pause to consider its implication.

Heidegger contends that thinking consists of two forms, calculative and meditative, and that these forms were never meant to be separated. Unfortunately, society appears to have broken the relationship that drives the best thoughts, and instead values only calculative thinking. As Heidegger analyst Joseph Kockelmans puts it, "It is not the fact that the world is becoming ever more scientific and technical which is really uncanny. For most uncanny is the fact that we are not prepared for this change and are unable to confront meditatively what really is dawning in this age."[45] In order to best understand science and use it to the greatest benefit of humankind, society must

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[43] Heidegger, Martin, William Lovitt. *The Question concerning Technology, and Other Essays*. New York: Harper & Row, 1977. Print, 28.
[44] Glazebrook, Trish. *Heidegger's Philosophy of Science*. New York: Fordham UP, 2000. Print, 215.
[45] Kockelmans, Joseph J. *Heidegger and Science*. Washington, D.C.: Center for Advanced Research in Phenomenology, 1985. Print, 253.

encourage meditative thought in the scientific community, rather than emphasizing only calculative thought.

"The most thought-provoking thing in our thought-provoking time is that we are still not thinking."[46] One of his more famous quotes, this statement comes from Heidegger's book, *What is Called Thinking?.* In *Discourse on Thinking,* Heidegger voices a similar thought saying that "man today is in flight from thinking."[47] The claim that humankind is void of thought is a seemingly bold one. In a time when some of the greatest discoveries of history are being made, and science is making progress faster than any other time period, it appears that human minds are hard at work. Yet this thinking is of a specific kind. Heidegger contends that humanity needs thought in its fullest form in order to flourish. When Heidegger explains that "there are two types of thinking… calculative thinking and meditative thinking," he takes care to emphasize that *both* are "needed."[48] Just as a marriage cannot consist of one individual, so thinking cannot truly take place unless both calculative and meditative forms exist in union.

Calculative thinking is purposeful and powerful. Using calculative thought, a scientist applies his mind to a problem and defeats it. Calculative thinking achieves results. This style of thinking takes place "whenever we plan, research, and organize, we always reckon with conditions that are given. We take them into account with the calculated intention of their serving specific purposes. Thus we can count on definite results."[49] The results-oriented nature of calculative thinking is part of its strength.

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[46] Heidegger, Martin, Fred D. Wieck. *What Is Called Thinking?* New York: Harper & Row, 1968. Print.
[47] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 45.
[48] Ibid, 46.
[49] Ibid.

Calculative thought takes a concept, understands it, and then uses it. It does not ponder. "Calculative thinking races from one prospect to the next."[50] Through its streamlined nature, calculative thinking pushes forward technology at an ever-increasing pace. With this advance come many advantages for society. As Heidegger put it, calculative thinking "computes ever new, ever promising and at the same time more economical possibilities."[51] Sicknesses can be cured, energy shortages solved, and lifetimes lengthened. However, with this great promise comes great danger, and thus an expanded style of thinking must help guide humanity's progress.

Meditative thinking is broader, and therefore more time-consuming, than calculative thinking. One must "leave time for meditating by slowing down."[52] Heidegger admits that it "requires greater effort."[53] While calculative thinking asks only "how?" before it attacks a problem and arrives at a solution, meditative thought asks "why?" Meditative thought expands beyond the one-track thought process needed to solve a problem and also considers the implications of that problem. Advocating this expanded version of thinking, Heidegger wrote the second half of his book *Discourse on Thinking* as a conversation between a teacher, a scholar, and a scientist. As Heidegger expert Robert Mugereauer explains, "this yields an obvious reason why Heidegger chose a conversation and not a lecture. The form forces the reader to consider diverse ideas and approaches through the diversity of the characters."[54] Meditative thinking is both deeper and broader than calculative thinking, and by forcing readers to mentally compare and

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[50] Ibid.
[51] Ibid.
[52] Ibid, 60.
[53] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 47.
[54] Mugerauer, Robert. *Heidegger's Language and Thinking*. Atlantic Highlands, NJ: Humanities International, 1988. Print, 11.

contrast the statements of his various characters, Heidegger actually gives his readers practice in meditative thinking. Mugereauer again words it well stating, "the point is reflexive: readers will gain the meaning not so much by what is specifically said at any point, but by letting themselves struggle with the conversation as it takes its course."[55] In this way, Heidegger shows that meditative thinking involves an open-minded conversation between ideas. He also demonstrates that discourse is central to the nature of meditative thinking. In order to fully engage in meditative thinking, one must also be prepared to engage in the important conversations of the day. Thus, while it is clear that meditative thinking is more time-consuming than the more straightforward calculative thought, it is also clear that meditative thinking can serve as a catalyst for important thoughts that otherwise would not exist.

Meditative thinking is also what makes humanity human. Heidegger explains in his seminal work *Being and Time* that contemplation of Being is something unique and central to the nature of humanity. He then further contends that the deeper thought required to understand the question of Being is found only by using meditative thought. Thus, the logical conclusion follows that meditative thinking is central to humanity. Heidegger most clearly emphasized this idea when he wrote, "Man is a *thinking,* that is, a *meditative* being."[56] Heidegger hated the thought that humankind would lose sight of their humanity amidst their striving for technological growth. "What great danger then might move in upon us? Then there might go hand in hand with the greatest ingenuity in calculative planning and inventing indifference toward meditative thinking, total

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[55] Ibid, 13.
[56] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 47.

thoughtlessness….Then, man would have denied and thrown away his own special nature—that he is a meditative being. Therefore, the issue is the saving of man's essential nature. Therefore, the issue is keeping meditative thinking alive."[57]

Heidegger also emphasizes that meditative thinking is not a style of thought reserved only for professional philosophers like himself. Meditative thinking is for everyone, including scientists. "Anyone can follow the path of meditative thinking in his own manner."[58] It is not "above the reach of ordinary understanding."[59] Because meditative thinking is tied to the nature of being human, Heidegger states that all of humanity has both the capability and the responsibility to participate in it. Scientists are not only included in this generalization, but are the focus. Modern society is shaped by science, and therefore scientists must be at the forefront of modern philosophy. As analyst Trish Glazebrook explains, "Heidegger makes science his theme because he finds it not only symptomatic but also *formative* of the modern epoch. Modern philosophy is also therefore grounded in the essence of science rather than offered as an alternative."[60] Heidegger's lifetime saw the beginning of the atomic age, the symbol of which is the atomic bomb, whose use presented one of the greatest ethical dilemmas of all history. This period arguably marked a transition, after which philosophy has been marked by its tie to science. In modern times, the most important ethical questions tend to be rooted in the power of science. Atomic threats, genetic engineering, cloning, cyborgization, stem-cells, satellite imaging, and other impressive scientific advances all simultaneously create new ethical questions. As such, Heidegger believed that meditative thinking was not

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[57] Ibid, 56.
[58] Ibid, 47.
[59] Ibid, 46.
[60] Glazebrook, Trish. *Heidegger's Philosophy of Science*. New York: Fordham UP, 2000. Print, 215.

something to be kept separate from scientific thought. Instead, Heidegger believed it was imperative that science, technology, and meditative thinking always be intertwined.

What then is the ideal relationship between calculative and meditative thinking? To put it simply, meditative thought should guide calculative thought. Like the engine of a muscle-car, calculative thought moves society forward, and it does so rapidly and mindlessly. Meditative thinking must serve as the driver of the car. Glazebrook explains Heidegger's thoughts, "the sciences have a limit: heavy on knowledge, light on self-scrutiny, they are one-sided."[61] Meditative thinking provides the scrutiny. Rather than furiously working toward any scientific advancement that seems attainable, scientists and others should often take a step back and analyze the implications of such an advance. Heidegger knew that the "technological revolution" could easily "captivate, bewitch, dazzle and beguile" humankind.[62] Scientists should possess both the skill and the fortitude to periodically pause amidst the excitement of technological progress and consider what is truly best for mankind. Heidegger calls this ability to step back "releasement."[63] The word "releasement" implies that technology and calculative thinking do not have a permanent hold. Instead, humanity can "affirm the use of technical devices, and also deny them the right to dominate… warp, confuse, and lay waste to our nature."[64] Thus, meditative thinking is an essential tool. It can provide calculative thinking with its goals, so that society benefits from the incredible power of calculation

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[61] Ibid, 216.
[62] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 56.
[63] Ibid.
[64] Ibid, 54.

while simultaneously avoiding many of the pitfalls that thoughtless technological progress can bring. In this way, meditative thinking can guide calculative thinking.

"Yet releasement… and openness… never happen of themselves. They do not befall us accidentally. Both flourish only through persistent, courageous thinking."[65]

Heidegger and Technology

Martin Heidegger was himself an avid practitioner of meditative thinking. To be anything less would make him a hypocrite. In addition, Heidegger's education gave him a strong background in science. Joseph Kockelmans writes that it was "clear that Heidegger had a remarkable knowledge of both physics and biology and that he was able to conduct a penetrating discussion on important topics with leading scientists."[66] This combination scientific knowledge and meditative prowess enabled Heidegger to delve into some of the deepest philosophical questions of technology. Heidegger's thoughts on technology were characterized both by hope for its promise, misgivings about its dangers, and a striving for understanding of its essence.

Heidegger believed that science is what defines modern society. Kockelmans summarizes this viewpoint stating, "sciences constitute an essential dimension of our modern world."[67] Glazebrook gives a similar summary saying that "for Heidegger, science is essential to the modern epoch."[68] As such, Heidegger believed that contemplation of technology was key to understanding the modern world and vice versa. As with society in general, science has both positive and negative aspects. "Heidegger

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[65] Ibid, 56.
[66] Glazebrook, Trish. *Heidegger's Philosophy of Science*. New York: Fordham UP, 2000. Print, 248.
[67] Kockelmans, Joseph J. *Heidegger and Science*. Washington, D.C.: Center for Advanced Research in Phenomenology, 1985. Print, 1.
[68] Glazebrook, Trish. *Heidegger's Philosophy of Science*. New York: Fordham UP, 2000. Print, 209.

saw a worth in the sciences themselves as the location of the human desire to know, [but] his questioning of the setting of goals for the sciences led him to the insight that reflection upon the sciences is called for."[69]

Heidegger devoted much of the end of his career to contemplating numerous questions regarding the nature and intent of science. Joseph Kockelmans explains that Heidegger spread his thoughts among "the question of precisely what science is, how it is related to all other orientations of man toward the world, what its prospects and limitations are, and what kinds of contributions the sciences can make to meaningful discourse about religious, moral, aesthetic, social, political, and educational issues."[70]

Heidegger's most well-known thoughts on science and technology are his fears of its overreach. In one of his most prominent works, *The Question Concerning Technology,* Heidegger states, "Everywhere we remain unfree and chained to technology, whether we passionately affirm or deny it."[71] As he looked at technology, he feared humanity's growing attachment and dependence. "We depend on technical devices; they even challenge us to greater advances," Heidegger states, "But suddenly and unaware we find ourselves so firmly shackled to these technical devices that we fall bondage to them."[72] However, what he feared most was that technology's growth would simultaneously bring with it a decrease in deeper thinking. Because science lends itself toward the calculative thinking style, and because the modern age is characterized by the advance of

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[69] Ibid, 161.
[70] Kockelmans, Joseph J. *Heidegger and Science*. Washington, D.C.: Center for Advanced Research in Phenomenology, 1985. Print, 3.
[71] Heidegger, Martin, William Lovitt. *The Question concerning Technology, and Other Essays*. New York: Harper & Row, 1977. Print, 4.
[72] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 53-54.

technology, Heidegger feared that the modern era would also be characterized by a decrease in meditative thinking.

Despite his fears, Heidegger did not consider the sciences to be a form of evil. As analyst Joseph Kockelmans states, "Heidegger was not guided by a basic mistrust of the sciences; rather he was always engaged in a serious effort to stake out their positive possibilities."[73] Heidegger saw that technology had life-giving qualities and the potential to save time and lives. He knew that the atomic age presented an opportunity for energy and power like the world had never seen, and he was as excited as he was worried by the prospect of it. "What we know now as the technology of film and television, of transportation, of news reporting, as medical and nutritional technology, is presumably only a crude start."[74]

Thus, both excited and worried about the future of a society so heavily based in technology, Heidegger devoted a large portion of his final writings to the subject of science. He had numerous complex and deep thoughts regarding the nature of technology, all of them worth reading. However, his most important point was this: the way to avoid the pitfalls of technology and reap only its benefits is to be trained in the art of meditative thought and discourse. By thinking deeply about the ethical and philosophical issues of science and discussing them, society can ensure that the positive possibilities of science are realized.

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[73] Kockelmans, Joseph J. *Heidegger and Science*. Washington, D.C.: Center for Advanced Research in Phenomenology, 1985. Print, 3.
[74] Heidegger, Martin, John Anderson, and Hans Freund. *Discourse on Thinking*. New York: Harper & Row, 1966. Print, 51.

Meditative Thinking in Science

So, what should meditative thought look like within the scientific community? As discussed in the previous chapter, STEM fields now generate many of the complex ethical debates in our society. Scientists should make an effort to recognize these issues, contemplate them, and engage in the societal discussion of them. Moreover, STEM fields should allow themselves to be guided by meditative thought. By asking deeper questions about society's needs and goals, scientists can ensure that their skill in calculative thought is then directed into important and commendable endeavors.

There are key moral questions that face society that scientists could greatly assist in discussing. The nature of life and personhood serves as an obvious example. Heidegger himself devoted much of his career to the understanding of Being and personhood. Though these are questions that science certainly cannot answer on its own, those that are experts in related scientific fields are important to have involved in the discussion. Questions of when heartbeats start in the womb, when pain can be felt, when cells are no longer divisible into twins, when brain function initiates, what the process of conception entails, and many others all contribute to society's understanding of the beginning of life, and by extension, the nature of personhood. Scientists who are developmental experts are able to speak into these questions and are also able to give well-developed opinions on what the answers might imply about what it means to be human. In this way, scientists have a unique role in the discussion of personhood, and can help shape society's understanding of life. At the same time, by engaging proactively in the moral discussion about the beginning of life, scientists can also allow their research to be guided by the conclusions reached. Scientists could allow the discussion to guide their choices regarding the ethicality of stem cell research, cloning, or gene therapy. However,

scientists should broaden their thinking beyond whether these research areas are morally acceptable. By expanding the scope of their thoughts to questions like, “are genetics what defines an individual?” and “is a society where genetics can be chosen a better society?”, scientists can not only shape the nature of their research, but can also impact the direction of societal progress. No answer to these questions is implied here. Instead, these questions serve merely to demonstrate the magnitude of the discussions currently facing society that scientists are uniquely suited to mold. To do so, they must be willing to broaden their ethical thinking.

Meditative thinking is often about stepping back to obtain a broader view. Scientists are experts in their fields primarily due to their closeness to the subject. However, to steal from a cliché, this often means that they cannot see the forest due to the trees. Meditative thinking is about seeing the forest. Calculative reasoning may enable a researcher to use a rat brain to control a robot, but meditative thinking is what enables that scientist to ask what that says about the definition of consciousness.[75] Calculative thinking is what enables the scientific progress of humanity to push forward at an exponentially increasing rate, but meditative thinking is what allows a scientist to contemplate what dangers such an increase might hold. By stepping back and contemplating the nature and ramifications of scientific progress, those in STEM fields will be best able to shape society for the better.

Meditative thinking can be taught. Though some may think that scientists are naturally inclined toward a calculative style of reasoning and are therefore inherently

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[75] Upson, Sandra. "Rat Brain Robot Grows Up." *IEEE Spectrum: Technology, Engineering, and Science News*. IEEE, 05 Nov. 2010. Web. 13 Feb. 2017. <http://spectrum.ieee.org/automaton/biomedical/bionics/rat-brain-robot-grows-up>.

inept in meditative thought, in reality, meditative thinking is something that can be learned and practiced. Heidegger himself believed that the style of thinking was an acquired skill, and therefore wrote works such as *Discourse on Thinking* and *What is Thinking?* in order to train future thinkers. His writing style in those books forces the reader to adjust their thinking to a more meditative style in order to follow his reasoning. As Robert Mugerauer puts it, Hiedegger is "trying to teach us an art…. He recruits and trains the reader."[76] This concept is incredibly important because it means that ethical discussion need not be restricted to some sort of philosopher class of humans. Instead, scientists that have expertise in controversial fields can be trained to engage in discourse regarding ethics and thereby shape society. Teaching meditative thinking can form a new class of scientist, a renaissance scientist, who can raise the level of first-hand knowledge in the discussion of science related ethics, and thereby change the way that ethics are discussed in the public arena.

Conclusion

Though this chapter spends many pages on the life of Heidegger, his ideas are the center point. Heidegger hoped that his ideas would live longer than his name, and he would likely have hoped that readers would remember his thoughts rather than his story as this chapter concludes.

Modern humanity lives in a fascinating age, one defined by technology. As such, those in STEM fields have an opportunity to affect society's ethical discussion to a greater extent than at any other time in history. However, science risks throwing away

[76] Mugerauer, Robert. *Heidegger's Language and Thinking*. Atlantic Highlands, NJ: Humanities International, 1988. Print, 17.

this opportunity by training its researchers in only one style of thinking. By training scientists in both meditative and calculative thinking during their undergraduate education, universities have the ability to mold a new generation of scientists. This next generation would be able to allow meditative thoughts about the nature of science to guide their research, while simultaneously helping guide society through complex ethical discussions. A new renaissance could emerge, shaped by philosopher scientists.

CHAPTER THREE

Course Proposal

Introduction

The purpose of this thesis is, at its core, to lobby for increased ethics education for STEM students at the undergraduate level. Previous chapters have emphasized that a mere understanding of regulations that need to be met in order to not violate existing ethical standards is not a high enough goal for science students. Instead, science students should broaden their thinking to the moral and philosophical relevance of technological progress. This chapter provides a description of a potential course designed to meet this goal.

The first section of this chapter is a syllabus for a potential course entitled "Technology and Ethics". Syllabi are often altered from year to year, and each professor has their own preferences for teaching methods, so this syllabus is not intended to be a non-negotiable description of the only way to teach a science ethics course. The purpose of this syllabus is to provide the reader with an example of a course that meets the goals of this thesis, and to provide professors that desire to teach such a course with a good starting point for designing their own course.

The remainder of this chapter provides further description and analysis of the course. This chapter explains the reasoning behind different aspects of the course, and also analyzes the ways in which this course design meets the educational goals set forth in this thesis.

Syllabus

This section contains a syllabus for a potential course designed for science students to study ethics.

Technology and Ethics

Baylor University [Department…Course #]

Fall 2017

MWF [time]

Instructor Information:

Professor: [Professor Name]

Email: [Email_Address@baylor.edu]

Phone: [phone number]

Office: [Building and Room]

Office Hours: [Office Hours]

Graduate Assistant: [Name and Contact info if Applicable]

Required Texts:

Discourse on Thinking by Martin Heidegger (translated by Anderson and Freund)

Principles of Biomedical Ethics (7th Edition) by Beauchamp and Childress

The Ethics of Science: An Introduction by David B. Resnik

Choose one from: *Frankenstein, Brave New World,* or *I, Robot.* (Other science fiction books may be selected with instructor approval.

Additional readings will be provided.

Prerequisites:

Must be pursuing a Science or Engineering major or minor. Students not meeting this requirement must receive instructor approval.

Course Description:

This course is designed to introduce science students to the larger ethical issues surrounding the advance of technology. Ethical theories covered include deontological, utilitarian, principle, and virtue ethics. Students will discuss, debate, and write about controversial scientific advances.

Goals:

Students should leave the course with an understanding of the methods of thought used to consider philosophical and ethical issues, a greater ability to engage in discourse regarding scientific ethics, and knowledge of some of the primary scientific ethical issues currently faced by society.

Grading and Assignments:

Grading Scale:

A 92.5-100%

A- 89.5-92.49%

B+ 86.5-89.49%

B 82.5-86.49%

B- 79.5-82.49%

C+ 76.5-79.49%

C 72.5-76.49%

C- 69.5-72.49%

D+ 66.5-69.49%

D 62.5-66.49%

D- 59.5-62.49%

F 0-59.49%

Group Project: Debate 10%

During the second unit of the class, a new ethical issue related to the advance of science will be introduced each week. Each Friday, four students will participate in a debate about the topic for the week. Two students will be assigned one stance to defend against two other students who will be assigned the opposite position. The pairings and dates will be announced early in the semester. Before the first Friday, students must submit their top three date preferences (in order).

The debate format will allow each student to give a five-minute prepared speech defending their stance, and then will consist of a series of alternating three-minute responses.

Reading Quizzes 15%

In order to be able to effectively participate in class discussions, it is imperative that students complete assigned readings before class. To incentivize this, there will be 10-15 reading quizzes over the course of the semester. Quizzes will be unannounced. The quizzes are not designed to be difficult, and should be manageable if the student has completed the assigned reading. Each student's lowest two quiz scores will be dropped. Unexcused absences will be counted as zeros.

Exams 30%

There will be two exams during the semester. The midterm will follow Unit 1 and will be worth 15% of the overall grade. The Final exam will be cumulative and worth 15% of the overall grade. Exams will be a combination of multiple choice, short answer, and essay questions.

Essays 20%

There will be two essays during the course of the semester. Each paper will be a minimum of three full pages, double-spaced. Prompts will be given at least a week in advance of the papers' due dates. Each paper will be worth 10% of the overall grade.

Final Project 25%

The final project will consist of a research paper of at least five pages and a ten-minute presentation. The student will select a specific ethical dilemma raised by the progress of science and technology. The student may choose a topic discussed in class or one not addressed, but must move beyond the thoughts brought forth in class. Students may not choose the topic addressed in their in-class debate. The paper should introduce the ethical issue, explain the prominent opposing views on the dilemma, and then argue for the appropriate decisions for society and the scientific community to make regarding the issue. Sources must be cited and the student's thesis should be well-researched. The presentation will be a general overview of the topic, but should focus on defense of the student's stance. The presentation will be worth 10% of the overall course grade, and the paper will be worth 15% of the overall course grade.

Participation Bonus

This course will involve lectures, but is rooted in discussion. Because of this, student participation is a key part of the course. The participation grade is based on the student's involvement in class discussions, and also on the nature of the student's contribution (i.e. if the student's comments/questions/thoughts added to the class). Through stellar and consistent contribution, the student may add up to 2% to their final course grade.

Attendance:

Attendance has no direct impact on the student's grade in the course. However, extensive absences will likely impact the student's reading quiz grade and participation score. Students must attend 75% of the classes (no more than ten absences) in order to pass the course, as per the requirements of the College of Arts and Sciences.

Late Work:

Late work will be accepted. However, unless stated otherwise, the assignment score will drop one letter grade for every day. For example, an assignment turned in the following day can achieve a 90%, while an assignment turned in two days late can achieve a maximum grade of 80%.

Ethics:

High ethical standards are required of every student at Baylor University. It is your responsibility to foster an atmosphere of honesty and integrity. All exams and assignments must be the work of the individual student (unless otherwise instructed). Copying another's work or allowing another to copy your work are both considered cheating. Any violation of the Honor Code may be reported to the Honor Council and may result in failure of the course. For more information, see "Constitution of the Baylor University Honor System" in the Baylor Student Handbook.

Title IX Office:

If you or someone you know would like help related to an experience of sexual violence including sexual assault, harassment, domestic violence, dating violence, stalking or other type of non-consensual sexual conduct, please contact Kristan Tucker, the Title IX Coordinator at Baylor University, by email (Kristan_Tucker@baylor.edu) or phone (254-710-8454).

Course Calendar			
Week	Monday	Wednesday	Friday
1	Syllabus Day Aug. 21 Unit 1 Intro	Science and Ethics Aug. 23 **Read:** "Science and Ethics" http://embor.embopress.org/content/2/9/747	Meditative Thinking Aug. 25 **Due:** Debate Dates
2	Meditative ThinkingAug.28 **Read:**Memorial Address	Meditative Thinking Aug. 30 **Read:** Conversation on a Country Path about Thinking	Ethics Theories Sep. 1 **Read:** Ethics of Science pages 16-20
3	Sep. 4 **Labor Day**	Deontological Ethics Sep. 6 **Read:** Stanford Guide https://plato.stanford.edu/entries/ethics-deontological/	Deontology Sep. 8 **Read:** BBC Guide http://www.bbc.co.uk/ethics/introduction/duty_1.shtml
4	Consequentialism Sep11 **Read:** Stanford Guide https://plato.stanford.edu/entries/consequentialism/	Consequentialism Sep. 13 **Read:** BBC Guide http://www.bbc.co.uk/ethics/introduction/consequentialism_1.shtml	Consequentialism Sep. 15 **Read:** Utilitarianism https://plato.stanford.edu/entries/utilitarianism-history/#JohStuMil
5	Principle Ethics Sep. 18 **Read:** Biomedical Ethics Ch. 3	Principle Ethics Sep. 20 **Read:** Biomedical Ethics Ch. 4-5	Principle Ethics Sep. 22 **Read:** Biomedical Ethics Ch. 6
6	Virtue Ethics Sep. 25 **Read:** Stanford Guide https://plato.stanford.edu/entries/ethics-virtue/	Virtue Ethics Sep. 27 **Read:** IEP Virtue http://www.iep.utm.edu/virtue/	Virtue Ethics Sep. 29
7	Exam Review Oct. 2 **Due: Essay 1**	Oct. 4 **UNIT 1 EXAM**	Unit 2 Intro Oct. 6
8	AI Oct. 9 **Read:**Opposing Articles	AI Oct. 11 **Watch:** I, Robot or Transcendence	AI Debate Oct. 13
9	Cloning/Stem Cell Oct. 16 **Read:**Opposing Articles	Cloning/Stem Cell Oct. 18 **Read:** Opposing Articles	Cloning Debate Oct. 20
10	Cyborgization Oct. 23 **Read:**Opposing Articles	Cyborgization Oct. 25 **Watch:** Ghost in the Shell	Cyborg Debate Oct.27
11	Surveillance Oct. 30 **Read:**Opposing Articles **Due: Essay 2**	Surveillance Nov. 1 **Watch:** Eagle Eye or Citizen Four	Surveillance Debate Nov. 3
12	Genetic EGR Nov. 6 **Read:**Opposing Articles	Genetic Engineering Nov. 8 **Watch:** Gattaca	CRISPR Debate Nov. 10
13	Life Extension Nov. 13 **Read:**Opposing Articles	Life Extension Nov. 15 **Watch:** In Time	Life Ext. Debate Nov. 17
14	Ethical Science Nov. 20 **Read:** Ethics of Science pages 57-58	Nov. 22 **Thanksgiving Break**	Nov. 24 **Thanksgiving Break**
15	Presentations Nov. 27 **Due: Final Project Paper**	Presentations Nov. 29	Presentations Dec. 1
16	Presentations Dec. 4	**The Final Exam will be on [date] at [time]**	

Unit Summaries

Unit I has two primary goals: to give students an understanding of the importance of the course and to supply them with information about the primary theories that can be used to think about ethical questions. The unit will open by introducing the importance of scientists' involvement in ethics and by discussing Heidegger's ideas about thinking and science. Through the remainder of the unit, students will learn about deontological ethics, principlism, consequentialism, and virtue ethics. The first unit will be lecture-based, because there are a number of important concepts for the students to learn. However, the lectures will be designed to be interactive, so that the students can be involved in the discussion of ethical theories.

Unit 2 is designed provide students with an opportunity to practice wrestling with current scientific ethical issues, so that they will have experience with the process and knowledge of some of the main ethical issues currently at the forefront of scientific discovery. To meet this goal, the unit covers a new ethical issue each week, investigating both scholarly articles on the subjects and science fiction depictions of the issues. At the end of each week, four of the students will debate the topics. Debating teaches research and speaking skills, and also ensures that students dig deeper into a topic. In addition, at the end of the unit, students will be required to give a speech and write a paper on an ethical issue in science, thereby requiring in-depth investigation of a single topic.

Unit I Readings and Lectures

The course calendar provides an outline of the course schedule and the required readings, but does not discuss in depth the topics to be studied or provide an explanation of the reasoning behind the various assigned readings. This section addresses the

specifics of each topic, explains the order of the schedule, and summarizes the listed reading assignments. In addition, this section discusses the goals associated with the reading assignments. A professor teaching the course would have flexibility regarding the reading assignments in the second unit of the course, and likely would want to adjust the topics and readings each semester based on recent scientific developments. This section will address the topics in this proposed syllabus, but those topics are able to be altered by a professor teaching the course.

The first week opens with the "syllabus day." There is no required reading, and the class period covers the basic outline of the course and the requirements. For the second class day, students are required to read an article entitled "Science and Ethics." The thesis of the article states, "As research and technology are changing society and the way we live, scientists can no longer claim that science is neutral but must consider the ethical and social aspects of their work."[77] The author, Maurizio Iaccarino, discusses the idea that many of the primary ethical issues faced by society are heavily associated with the advance of science, and uses that fact as grounds for the argument that scientists need to be involved in ethical discourse. The article provides a good summary of motivation for the course, explaining to science students the reasons why taking the time from the busy STEM schedule to enroll in an ethics course is worthwhile. For the final day of the first week, students have no listed reading. During the Friday class, the professor would introduce Martin Heidegger and his ideas, thereby giving the students plenty of time to prepare for the discussion of *Discourse on Thinking* the following week.

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[77] Iaccarino, Maurizio. "Science and Ethics." *EMBO Reports*. EMBO Press, 01 Sept. 2001. Web. 28 Feb. 2017. <http://embor.embopress.org/content/2/9/747>

The second week of class focusses primarily on the writings of Martin Heidegger and his book *Discourse on Thinking.* The book is divided into two parts, the Memorial Address and the Conversation on a Country Path about Thinking. The syllabus requires that students read these sections by Monday and Wednesday respectively. Monday's lecture and discussion will continue the analysis of Heidegger's thoughts on thinking and on technology, but will focus on his discussion of those concepts in his Memorial Address specifically. Wednesday's lecture will shift the discussion more toward thinking, with less of a focus on the technological aspect, due to the focus of the Conversation portion of Heidegger's *Discourse on Thinking.* This class would also discuss the reasons that Heidegger used a conversation to convey his point, and emphasize the importance of being involved in philosophical and ethical conversations. The three-day discussion of Heidegger is designed to serve as motivation for the course, giving students an in-depth view into an influential philosopher and his thoughts on the importance of thinking meditatively about science.

The final day of the second week moves the focus away from Heidegger and toward the primary content of the first unit: the primary theories of ethics. This class would introduce the concepts of deontological ethics, consequentialism, principlism, and virtue ethics. This introduction would help to prepare the students for the readings and discussions in the following four weeks. The listed reading for this day comes from the *Ethics of Science*, which the students were required to purchase at the start of the semester. The reading summarizes the primary ethical theories and serves as an effective introduction to the following weeks of the course.

The length of the third week, which discusses Deontological Ethics, is limited by Labor Day. Wednesday of that week, students are required to read the section on Deontological Ethics in the Stanford Encyclopedia of Philosophy (SEP). The SEP provides an effective summary of most ethical theories, and is clear enough for the basics to be understood in a single day of reading. The Friday of the third week, students will read a similar summary published by the British Broadcasting Corporation (BBC). Between the two readings, students should leave the week with a solid understanding of the central tenets of deontology. The lectures in the week will discuss duty-based ethics and the advantages and drawbacks of the theory. Both the readings and the lectures will address the ideas of Kant, whose philosophy greatly influenced the idea of deontological ethics. The syllabus does not require students to read any first-hand writings of Kant, as such a reading would take longer than the time constraints in this class allow.

The fourth week of the course discusses consequentialism with a specific focus on utilitarianism. For Monday and Wednesday, students are required to read SEP and BBC summaries of consequentialism respectively. As with the readings of the previous week, these summaries provide enough detail for students to gain an understanding of the material and the philosophers associated with the theory without requiring them to read copious source material from individual philosophers. For Friday, students read a history of utilitarianism from the SEP. This reading addresses utilitarianism in more detail and will give the students a better understanding of the stances of important philosophers such as John Stuart Mill, who shaped the ethical theory. The lectures will discuss the tenets of consequentialism and the history of its development. The professor will also facilitate discussion of the advantages and disadvantages of the ethical theory.

The fifth week of the course addresses principle ethics. For Monday, the students will read the third chapter of *Principles of Biomedical Ethics*[78] which deals with one of the four principles of biomedical ethics: respect for autonomy. The lecture on Monday would introduce the basic concept of the ethical principles and their use, and would then address the reading about autonomy. The second class day lecture would address the next two biomedical ethics principles, beneficence and nonmaleficence. Essentially being inverse ideas of each other, these principles are covered in the fourth and fifth chapters of the text. Finally, completing the week, the students would read the sixth chapter covering the principle of justice. The Friday lecture would cover the last principle and then review the ideas from the week.

Week 6, the last week of Unit 1 content, would focus on the theory of virtue ethics. The readings for Monday and Wednesday are drawn from the SEP and Internet Encyclopedia of Philosophy (IEP) summaries of virtue ethics. Providing an effective description of the primary tenants of the theory and adequate summaries of the theory's founders (Plato, Aristotle, etc.), the readings give students the background required to converse coherently regarding the topic. In addition, the SEP and IEP discuss modern ideas regarding virtue ethics, which enables students to see the reasons behind recent resurgences of the theory and its application in modern times. The lectures for Monday and Wednesday would discuss the primary tenants of virtue ethics to cement the concept in students' minds, and would also lead discussion of the advantages and disadvantages to the application of the theory. The final day of the week has no assigned reading, giving

[78] Beauchamp, Tom L., and James F. Childress. *Principles of Biomedical Ethics*. 7th ed. New York: Oxford UP, 2009. Print.

the students additional time to work on their essay due the following week (discussed in Section V). The lecture will wrap up the discussion of virtue ethics.

The Unit will conclude on the first day of week seven with a review for the first test.

Unit II Readings and Lectures

The second unit follows a different pattern than the first. In the second unit, the first day of each week introduces the students to a new ethical question posed by science and the reading for the day presents students with two or more conflicting views on the topic. The first lecture will then cover important details of the topic and the professor will engage students in discussion of the various viewpoints. Students should leave each Monday class with an understanding of the root of the issue being debated and sufficient knowledge of the viewpoints to be able to competently discuss them. For the second day of class, the students will often be required to view a relevant science-fiction movie. The class will then be primarily a discussion of the week's topic, analyzing both the movie's portrayal of the issue and the real-world opinions that are currently prevalent. The last day of class will be devoted to a debate where two student teams will be assigned separate viewpoints and be required to defend them.

The goal of each Monday is to provide students with the background that they need in order effectively discuss the topic during the remainder of the week. Providing the students with two or more articles displaying conflicting views on the week's topic would enable students to learn some details of the issue at hand, and would give them a taste of some of the arguments currently being used regarding the controversy. The first class period of each week in Unit II would be lecture-based, enabling the professor to

solidify the information from the reading in the students' minds and also giving the professor the opportunity to cover any important details that he or she feels that the assigned readings did not cover. The professor would engage the students during class, facilitating discussion to maintain interest and enable students to voice their thoughts, but would spend most of the class period lecturing in order to ensure that the students have all the information that they need in order to contemplate the issue that week.

The goals of the second day of each week are to pique the students' interest in the subject and to provide the students with an opportunity to discuss the topic in a noncompetitive manner. The preparatory assignment for each Wednesday would typically be a science-fiction movie dealing with the ethical issue of the week. The movie assignment for the week is not intended to be difficult, but is instead designed to display the topic for the week while also maintaining the students' interest. Simply put, the assignment for the second day is meant to be fun. Studies show that students that find assignments entertaining and the material interesting are more likely to learn the subject.[79] In addition to being entertaining, science-fiction often probes deeply into ethical issues, making it an ideal teaching tool.[80] By being discussion-based, Wednesday class periods will provide the students with experience in conversing about ethical dilemmas in a noncompetitive environment. The professor would guide the discussion, giving the students a structured environment to wrestle with the ethical issue of the week. The class period would address the treatment of the recently watched movie of the

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[79] Renninger, K. Ann., Susanne Hidi, and Andreas Krapp. *Role of Interest in Learning and Development*. N.p.: Laurence Erlbaum Associates, 1992. Print.
[80] Paige, Anastasia. "TEACHING ETHICS WITH SCIENCE FICTION: A CASE STUDY SYLLABUS." (n.d.): n. pag. Union College, 2009. Web. https://www.uvu.edu/ethics/seac/Pease%20-%20Teaching%20Ethics%20with%20Science%20Fiction%20%20A%20Case%20Study%20Syllabus.pdf

subject as well as the opinions expressed in the articles read earlier by the students for their Monday reading.

Friday of each week would be devoted to a student debate. The format will be decided by the professor teaching the course, but the suggested format is as follows. Two teams, each consisting of two students, will debate the topic. Each speaker will have five minutes to give a prepared speech. A specific statement will be given to the teams at the beginning of the week that they must either affirm or negate. For example, "Human germline modification through CRISPR is morally and/or philosophically unacceptable in society and should not be allowed," or "human enhancement though cyborgization is a goal that humanity should strive towards." The first speaker will be from the Affirmative Team, arguing in favor of the statement (affirming it). The second speaker, from the Negative Team, will argue against the statement (negating it). The third speaker will be from the Affirmative team, and the fourth will be from the Negative team. All of the first four speeches will be prepared before the class. The second half of the debate will follow the same order of speakers as the first half of the debate, and each speech will be three minutes long. During this second round of speeches, the speakers will not have prepared rhetoric, but will instead be responding to the assertions of their opponents made during the first round of discussion. There will be no preparation time between speeches in the first round, but there will be one minute between each of the second round speeches. When transition time and preparation time are considered, this schedule of speeches will likely exhaust the vast majority of the time in a fifty minute class. However, any remaining time could be devoted to spectating students in the class asking questions of the speakers.

A debate has several advantages. The class is designed to equip students to enter into important and highly contested ethical issues in society, and debate gives the students experience in defending a viewpoint. The debate also ensures that students will dig deeply into one of the issues discussed in class. If a student wants to be successful in the debate, they require an in-depth understanding of the topic. Because students will know their topic during the first week of class, they are able to begin researching the issue early on, even if they do not know the specific statement they will need to defend. The debate trains students in two forms of oral presentation, prepared and impromptu, both of which are key types of discourse in society.

Assignment Specifics

The course syllabus supplied to the students has basic information regarding the class, but the specific essay prompts and test content may be announced during the course of the class. This section covers the specifics of the course that are not listed in the syllabus, and also discusses the reasoning behind each of the assignment designs.

Reading quizzes will be given throughout the course. These quizzes are not designed to be difficult for students that are up-to-date on assignments. Instead, these quizzes would consist of five multiple choice or fill-in-the-blank questions that would test knowledge of the basic concepts in the reading. For example, a reading quiz on *Discourse on Thinking* might ask, "According to Heidegger, which type of thinking requires 'slowing down'?" or "Heidegger says that 'man today is in flight from _____.'" Thus, the reading quizzes would incentivize students to read the assignments, which is key to a quality discussion in class, but would not pose a substantial threat to the grades of any student that is regularly reading for the course.

There are two essays during the semester. Due at the end of the first unit, the first essay is meant to make students think deeply and critically about the various ethical theories covered in the unit. The first prompt can be adjusted by the teaching professor as needed, but an assignment as follows would fulfill the goals of the essay well: "Which ethical theory (principlism, value ethics, consequentialism, or deontological ethics) best serves to answer the philosophical and moral questions regarding the advance of science and technology?" By requiring students to provide reasoning for why one ethical theory may be more useful in modern thinking, the prompt makes students review each of the theories and think more deeply about them. The first essay also provides the first opportunity in the course for students to formulate their own opinion regarding the course material, and thereby sets the tone for the second unit of the course. Thus, the first essay prompt will serve as a great transition from the first to second unit, making students review the material for the first test while simultaneously fostering the type of thinking that will be required in the second half of the course.

Soon after submission of the first essay, students will take Exam 1. The first exam will begin with a multiple choice section where students where students would demonstrate their understanding of the key facts about each of the ethical theories discussed in the first unit. For example, "Aristotle was an early proponent of which of the following ethical theories?" or "Which of the following is a tenet of utilitarianism?" or "Which of the following is not typically considered to be a principle of biomedical ethics?". The second part of the test would be a short essay prompt about Martin Heidegger's *Discourse on Thinking.* Such a prompt might be "Using Heidegger's thoughts in *Discourse on Thinking* and your own logic and experience, make a case for

increased meditative thinking amongst scientists." The essay prompt provides students with an opportunity to think critically, and also assesses their understanding of the motivation for the course.

The second essay will be due approximately halfway through the second unit. This essay will be about a science fiction novel that students may read at their own pace over the course of the semester. Near the beginning of the course, students may select a science fiction novel by either choosing one suggested in the syllabus or through professor approval of an alternate option. In this assignment, students must choose a scientific advancement that causes an ethical or philosophical dilemma in their novel, and write a three page essay about the book's stance on the ethical problem and how it relates to the student's opinion. The student would use the knowledge of various ethical theories gained during the first unit to discuss what they deemed to be the correct stance regarding the ethical issue discussed in their essay. This assignment would be designed to give students flexibility regarding their book choice and topic choice so that they would be able to invest their time in something that they found interesting. At the same time, the students would need professor approval for these choices, thereby ensuring that the students' books and topics addressed deep enough moral issues.

The Final Project, consisting of a ten-minute presentation and a five page research paper, would be a culmination of the ideas studied over the course of the semester. The goal of this assignment, like many of the others, is to give students an opportunity to wrestle with an ethical issue and practice defending their own viewpoint on the topic. After choosing an ethical question regarding the advance of science, either addressed in the course or approved by the professor, students would research the topic and then argue

in favor of a specific controversial stance on the issue. The varied nature of the assignment ensures that students will have practice defending their stance in both oral and written argument. The presentation and paper should both cover the same material, but the paper should possess greater detail. The presentations will be given as the last lectures of the semester, giving students an opportunity to spend time studying for final exams during the absence of reading assignments. After explaining the moral issue to the class, presenters would be expected to spend the majority of their speech defending their viewpoint. The final paper would be due the first day of presentations, thereby allowing the professor or teaching assistant time to grade the assignments and also requiring students to have their writing finalized before they present their ideas to the class. The deadline would not be insurmountable, even for procrastinating students, because there is very little assigned reading during the week prior to the due date. The goal of the course is to train scientists to think meditatively and engage in discussion with society regarding the ethics of scientific progress, and the Final Project is the culmination of that goal.

The final exam would be a combination of multiple choice questions and a few short essay questions. The multiple choice section would have a few repeated questions from the first exam, but would consist primarily of questions regarding the second unit. There would be one question from each of the student presentations at the end of the semester, in order to incentivize the students to attend the last class days. There would be a few additional multiple choice questions about the specific ethical dilemmas discussed in the class, (for example, "Which of the following is the current legal status of embryonic stem cell research in America…") but these questions would not be designed to be difficult or time-consuming for the students. The bulk of the time for the Final

Exam would be spent on two essay questions. Students would have the option to choose two out of four essay prompts to write two brief one-page essays. Addressing different weekly topics from the second unit, the essay prompts would ask students to use specific ethical theories to justify stances on scientific ethical issues. For example, "Use virtue ethics to argue for or against the use of CRISPR to alter DNA traits that could be passed to a patient's offspring." These essay prompts will test the student's ability to think through relevant issues using the frameworks taught in the course.

Conclusion

The listed goals of the Technology and Ethics course are threefold. Students should leave the course with an understanding of the methods of thought used to consider philosophical and ethical issues, a greater ability to engage in discourse regarding scientific ethics, and knowledge of some of the primary scientific ethical issues currently faced by society. However, the course has an additional goal not listed in the syllabus: students should leave the course more interested in ethical discourse than when they began. The purpose of the course is to train scientists that not only have the *ability* to engage in ethical discourse but also have the *desire.* This course can meet these goals.

The course attempts to create a desire to engage in ethical discussion through both content and medium. The semester begins with content emphasizing the importance of scientists' involvement in philosophical discussion. Heidegger and Iaccarino both express to readers that science and ethics are interwoven in the modern world, and that scientists can no longer be bystanders in the field of ethics. Later in the course, the engaging mediums used to teach the material (science fiction writings and movies, controversial articles, student debates, etc.) serve to display the fascinating and exciting nature of

technology ethics. Thus, by showing the both important and interesting nature of the subject, the course can help foster within science students a desire to engage in philosophical and ethical thought and discourse.

Meanwhile, the course also trains STEM students in the ability to effectively engage in ethical discussion. By equipping the students with knowledge of four of the primary ethical theories (deontology, principlism, consequentialism, and value ethics), the course enables students to draw on thoughts of previous great philosophers and ethicists when developing their own thoughts on important modern issues. Through Friday debates in the second unit, students gain practice in researching an ethical issue and defending a stance. In their essays, students gain further experience developing and defending a viewpoint about a controversial issue. Throughout the course, students are given opportunities to learn and practice meditative thinking, and opportunities to practice discussing important ethical issues both orally and in writing.

While no course can guarantee that its students emerge as brilliant philosopher scientists, by engaging the students, the course can ensure that science students are able to see ethics in a way that they have not before. By training students in the skills required and demonstrating the interesting and important nature of the subject, the Technology and Ethics course can teach a new generation of scientists that will have both an ability and a desire to use their scientific expertise to shape the fields of ethics and philosophy.

CHAPTER FOUR

The Renaissance Scientist

Introduction

Blaise Pascal was one of the greatest scientists of the renaissance. The breadth of his impact across diverse fields is matched by few. While innate intellect and inquisitive nature may have driven Pascal's success, his education played an indisputable role in his impact on society. Having studied philosophy, writing, and science, Pascal possessed a background that enabled him to shape a wide array of disciplines. Scientists today possess a depth of knowledge that rivals any time in history, but this targeted knowledge has come at the expense of breadth. Focused almost entirely on calculative thinking, STEM experts push forward the progress of science at an ever-increasing pace, rarely pausing to consider the implications of their progress. Philosophers and ethicists are thereby forced to shape their fields based on secondhand information regarding the nature of scientific discoveries. Lacking a full understanding of controversial technological advances, many possess unwarranted fears regarding scientific progress, hindering the development of ideal ethics policies. To remedy these issues, scientists must involve themselves in philosophical and ethical discussion. Society needs scientists like Blaise Pascal, who possess both the background and desire to engage in philosophical discourse regarding their fields. By training STEM students in ethics, undergraduate institutions have an opportunity to develop a new generation of renaissance scientist that can shape society.

Importance of Scientists in Ethics and Philosophy

The first chapter of this thesis delves into society's need for scientists in the fields of ethics and philosophy. The quantity and importance of ethical issues in society that are tied to STEM fields requires scientists' involvement in ethics for optimal discussion.

Many of the primary ethical issues facing society today are inextricably linked to the advance of science and technology. The discussion of online privacy, a prominent political dispute, is heavily shaped by the technology surrounding it. Those with expertise in computer systems and cyber processes should be pivotal players in society's policy decisions regarding privacy. Numerous other ethical dilemmas follow the same pattern. Stem cell research remains incredibly controversial, and a knowledge of the varying types of stem cells and the impact of current research is imperative to an informed discussion of the ethics. Cyborgization and genetic manipulation raise questions about the nature of personhood and the ethics of human enhancement. The possibility of life extension technology forces contemplation about the nature of life and death. Numerous incredible discoveries are tainted by the risk of their weaponized application. As Maurizio Iaccarino states, "We live in a world in which scientific knowledge and new technologies continuously challenge our values."[81] It is no longer an option for scientists to be bystanders in the discussion of ethics. Scientists have an obligation to further the conversation about the implications of their work, because they possess more information about the advances that create these ethical questions.

By lending their informed thoughts to the philosophical discussion surrounding their work, STEM experts can help ensure that the best decisions are made by society. As

[81] Iaccarino, Maurizio. "Science and Ethics." *EMBO Reports*. John Wiley & Sons, Ltd, 01 Sept. 2001. Web. 07 Apr. 2017. <http://onlinelibrary.wiley.com/doi/10.1093/embo-reports/kve191/full>.

stated in the first chapter, lack of understanding of an issue generates anxiety or fear. Subsequently, that fear can cloud objective decision-making. Thus, it is imperative that those with the greatest level of understanding of a technology be integrally involved in the discussion surrounding ethical implications. Through their input into ethical discourse, scientists can assist in making the best policy decisions about the ethics of various technologies.

Scientists can also improve the reputation of science through their participation in philosophical thought. Though modern society raises the STEM fields on a high pedestal, there are consistent negative stereotypes regarding scientists' disregard for ethics. Studies[82,83] show that the dangers associated with technological advancements are possibly the most prevalent fear in the United States, likely due to the perception that scientists are not giving thought to the implications of their actions. By merely making the effort to be involved in the discussion of ethics, scientists can aid in altering the perception of their fields.

In addition to enhancing society's view of scientists, having more scientists involved in ethics could also give philosophical thought greater credibility in the scientific community. Every profession has standards for credibility, and STEM fields are no exception. Scientists are more likely to read and heed another scientist's analysis of an ethical issue than they are a humanities professor for example. Through a career in science, one gains education, research, and other credentials that validate one's

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[82] Hartley, Catherine A., and Elizabeth A. Phelps. "Anxiety and Decision-Making." *Biological Psychiatry* 72.2 (2012): 113-18. Web. http://www.sciencedirect.com.ezproxy.baylor.edu/science/article/pii/S0006322312000091

[83] Miu, Andrei C., Renata M. Heilman, and Daniel Houser. "Anxiety Impairs Decision-making: Psychophysiological Evidence from an Iowa Gambling Task." *Biological Psychology* 77.3 (2008): 353-58. Web.http://www.sciencedirect.com.ezproxy.baylor.edu/science/article/pii/S0301051107001962

statements within the scientific community. In addition, throughout a career in science, one gains communication skills that can target the scientific community specifically, further enabling one to convince other scientists regarding philosophical thoughts. This increased ability to convince scientists not only helps to sway other STEM field members on ethical opinions, but also assists in normalizing the idea of a philosopher scientist. As mentioned in Chapter 1, one of the reasons for the lack of scientists engaged in ethical discourse is the lack of expectation that society places on the scientific community to further ethical discussion. By demonstrating a combination of scientific expertise and philosophical thought, an individual can both convince scientists of philosophical ideas and demonstrate the importance of scientists being involved in ethical discourse.

Thus, scientists' participation is now critical in society's discussion of philosophy and ethics. Lending their expertise in complex disciplines, scientists can provide insight that might otherwise be absent from important debates. In addition, scientists' understanding of various technological advances enables them to avoid the bias caused by apprehension of the unknown. Further, STEM experts' involvement alone can both alter the perception of their fields but also decrease society's uninformed anxiety regarding the ethical implications of technology. Scientists are able to provide society with increased comprehension of which ethical concerns should carry the most weight, and which concerns are less valid. In the modern era, scientists have an opportunity to shape the discussion of ethics for the better.

The Renaissance Scientist

Shaping both technological and ethical fields requires a unique type of individual, possessing characteristics modeled by Blaise Pascal. Practicing both calculative and meditative styles of thinking, such an individual would be able advance the development of technology while simultaneously contributing to the discussion of its implications. Expertise in a scientific discipline is a clear requirement, but training beyond STEM fields is key in order to provide the background necessary for a broader impact. This thesis calls such an individual the renaissance scientist.

The renaissance scientist in no way limits himself[84] to STEM interests, but a background in science is his most obvious required characteristic. What sets the renaissance scientist apart from other philosophers is his ability to draw upon his knowledge of technological concepts in order to form more fully developed thoughts on ethical implications. Though ethics and philosophy are some of his passions, he is a scientist first and foremost. The renaissance scientist blueprint, Blaise Pascal, demonstrates this quality well. Pascal is renowned in many fields, but few would dispute that his central focus was science. Despite his father's push towards the humanities, Pascal's natural desire for science could not be overcome, and he began studying STEM subjects on his own even before his teenage years. A scientist at heart, Pascal advanced the field of physics, and the SI unit for pressure now bears his name.

The renaissance scientist also possesses skill in communication. Without the ability to communicate ideas and ethical theories, a scientist can have little contribution to philosophical discourse. Pascal, though a scientist, penned some of the greatest

[84] Note: masculine pronouns are used to describe the renaissance scientist for simplicity only

writings of his era. His writings were not only profound, but were accessible and concise, and are even credited with beginning the modern style of French prose.[85] Through strength in communication, renaissance scientist are able to make their viewpoint clear, clarifying complex issues for society and summarizing the logic and information that back their viewpoint.

In addition, the renaissance scientist should have a working knowledge of key ethical theories. As with scientific knowledge, philosophical knowledge grows. Modern philosophers need not rediscover epiphanies had thousands of years ago. Instead, current ethicists and philosophical thinkers build on the thoughts of the past. Thus, the renaissance scientist requires an understanding of important ethical theories so that he may apply them to technological advance, rather than being required to recreate ideas that have already been thought through. This increases both credibility and effectiveness.

The renaissance scientist has a balanced style of thinking. While his STEM profession requires continual use of calculative thinking skills, the renaissance scientist understands that meditative thought possesses incalculable merit. Rather than being driven by calculation, he uses this more focused form of thought as a tool. The renaissance scientist employs calculative thought to solve complex scientific problems but meditative thought is what shapes his view of the world. He contemplates society and the technology within his field, and allows these thoughts to shape his scientific research. Meditation provides direction to the calculations of the renaissance scientist. Further, the renaissance scientist communicates with society regarding the ethical and philosophical

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[85] Orcibal, Jean, and Lucien Jerphagnon. "Blaise Pascal." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 30 Mar. 2016. Web. 12 Dec. 2016. <https://www.britannica.com/biography/Blaise-Pascal#ref365125>.

conclusions arrived upon during his meditative thinking. Blaise Pascal's diverse writings display the benefit to this varied style of thinking. Pascal penned both mathematical theorems and theological treatises. His influence in science was rivaled by his presence in philosophical discussion. Through both calculative and meditative thinking, Pascal portrayed the heart of the renaissance movement.

One of the most fundamental requirements of the renaissance scientist is a diverse set of interests. If an individual has the background and skillset required for a task, but no desire, then their other qualifications are wasted. Thus, even if an expert scientist has an understanding of ethical theories and knowledge of varied styles of thinking, without feeling that involvement in philosophical discourse is important, the scientists varied skills mean little. Pascal displayed his varied passions at all stages of his life. As a child, his father trained him in philosophy and the humanities, and forbid him to study STEM subjects. However, Blaise's desire for diverse knowledge drove him to study math and science on his own. As an adult, Pascal displayed the reverse. Though his career as a scientist lent itself towards calculative thinking, Blaise maintained his varied interests, writing important works in theological and philosophical fields. Blaise had more than varied knowledge. He possessed diverse passions.

The renaissance scientist does more than bridge the gap between scientists and ethicists; he weds the two roles through his expertise in both arenas. His background in science combined with skill in calculative thinking allow him to push the progress of technology further, but his meditative thought guides his actions and opinions. Through scientific knowledge and skill in communication, the renaissance scientist is able to shape society's conversation regarding cutting-edge technological advances. Meanwhile, his

varied passions spread to others, drawing more STEM experts into society's ethical discussions. The renaissance scientist is a key component of modern ethical discourse, and his presence can shape society for the better.

Training the Renaissance Scientist

One of the central goals of this thesis is to demonstrate the importance of educating a new generation of scientists that will be involved in ethical discourse and to show how to accomplish that goal at the undergraduate level. Blaise Pascal's father had the foresight to see the temptation of a scientist to neglect other areas of study, and therefore required his son to study various disciplines. In this way, Pascal's father helped to shape his son into one of the greatest thinkers of his time. This section is intended to demonstrate the ways that the course outlined in the third chapter can help to train modern renaissance scientists.

At the turn of the century, the United Nations Educational Scientific and Cultural Organization (UNESCO) and the International Council for Science (ICSU) held a conference where to discuss the role of science in society. One of the key discussions at the meetings was "ethics in science, engineering and technology (SET), and bridging the information gap between science and the public."[86] After discussing these topics, the member nations penned a statement saying that "The ethics and responsibility of science should be an integral part of the education and training of all scientists."[87] This principle

[86] UNESCO, and ICSU. "Harnessing Science to Society: Analytical Report to Governments and International Partners on the Follow-up to the World Conference on Science." *UNESCO*. N.p., 2002. Web. 29 Mar. 2017. <http://www.unesco.org/science/wcs/report_wcs.pdf>.
[87] UNESCO, and ICSU. "UNESCO - World Conference on Science - Science Agenda /Framework for Action." *UNESCO - World Conference on Science - Science Agenda /Framework for Action*. N.p., 1999. Web. 29 Mar. 2017. <http://www.unesco.org/science/wcs/eng/framework.htm#3_2>.

applies now more than ever, as science becomes ever-increasingly intertwined with ethical and philosophical debates. Scientists need to be present in the discussion in order to bridge the information gap, and in order to enter that discussion, scientists must be educated in ethics.

Perhaps the most essential requirement for ethical education of scientists is that it must expand their interests, and the course outlined in Chapter 3 meets this goal through its engaging design. The "reading" assignments of the course often involve science fiction movies, a genre that, at its best, enables the viewer to grapple with complex ethical issues raised by technology while simultaneously being entertained. Students will also be required to read a science fiction novel of their choice, further using the genre to allow the students to practice meditative thinking within a fun and exciting context. The students will be provided many opportunities during the course to customize their assignments, ranging from choosing their novel to choosing their project topics. These choices not only engage the students by enabling them to take ownership of their education, but also by ensuring that students are able to focus on what interests them the most. Discussion and debate are woven throughout the course so that students remain involved and interested. The content of the first part of the course enumerates reasons why the involvement of scientists in ethics is critical. Reading Heidegger and other authors, students learn the importance of varied styles of thinking and the importance of their involvement in the intertwined discussion of technology and philosophy. In essence, the setup of the course is meant to leave students with an understanding of the importance of ethics in science and of the engaging nature of philosophical discussion.

In order for the next generation of scientists to be effective in their involvement in ethical discourse, they must have an understanding of the ethical theories of the past, so the Technology and Ethics course covers the most important theories in its first unit. The course addresses several major ethical theories: consequentialism, principlism, virtues, utilitarianism, and deontological ethics. While there are other ethical theories that have been developed throughout history, those covered in the course are some of the primary ones used in consideration of modern philosophical and ethical dilemmas. The time constraints on a semester course clearly eliminate the ability to train students in all historical ethical thought, but the Technology and Ethics course material is sufficient for student to gain the necessary foundation to discuss effectively the ethical implications of technology.

The renaissance scientist requires an ability to use both calculative and meditative thinking skills. The design of the Technology and Ethics course makes the simple assumption that STEM students are being trained in calculative thinking in their science and engineering classes, and therefore focusses on teaching students meditative thinking. By opening with Heidegger's *Discourse on Thinking,* the course both emphasizes the importance of meditative thinking and explains the details of practicing it. As the course goes on, students are given countless opportunities to practice this skill, whether it be through their readings, discussions, or writings. The assignments are designed both explicitly and implicitly to encourage the students to think beyond the details of scientific advance and consider the philosophical implications. As Heidegger's *Discourse on Thinking* shows, conversation is a key component of meditative thinking, and therefore

the class is discussion-based throughout the semester and every student is given the opportunity to participate in a debate.

Finally, the renaissance scientist requires impressive communication ability in order to convince others of philosophical thoughts. Therefore, the course outlined in Chapter 3 trains students in both oral and written communication of ethics ideas. Students will have to write in both timed and untimed scenarios. They will practice researching for their papers, and also communicating their own thoughts. Training students in three different types of oral communication, the course requires students to participate in a formal debate, informal discussion, and a prepared presentation. Each of these three forms of speaking involve slightly different skillsets, and it is important for students to have practice in each one. Students should leave the course not only with increased knowledge, but with an enhanced ability to communicate that knowledge and their own ideas.

Conclusion

Blaise Pascal set an example of the broader thinking scientist that modern society needs and his life displays the key role of education in the formation of such a scientist. Involved in varied fields and disciplines, Pascal pushed forward the progress of science while simultaneously shaping philosophical and ethical discussion. Today more than ever, the involvement of scientists in ethical discourse is critical. Through their expertise in revolutionary developments, STEM field members can provide insight into philosophical conversations that no one else can. Scientists' involvement in ethics could help to eliminate unnecessary anxiety while simultaneously enabling society to wrestle more effectively with valid concerns. As someone with skill in both science and

philosophy, these individuals would have an increased ability to convince both scientists and ethicists regarding the moral implications of technology. Unfortunately, the vast majority of scientists enter the workforce with no formal training in meditative thinking or philosophical discussion. Universities should provide their STEM students with the opportunity to study the ethical implications of their fields. Following the guidelines set forth in the third chapter of this thesis, schools can create a course that would teach students a broader style of thinking. By educating students on the relationship between technology, ethics, and philosophy, undergraduate institutions have an opportunity to train a new generation of scientists that will shape the field of ethics for the better.

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