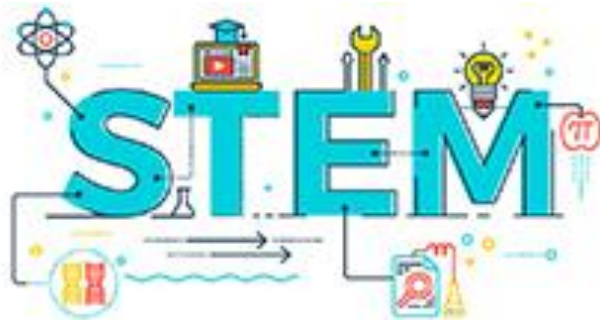




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# REDESIGN OF THE CRIMINAL JUSTICE COURSES WITH STEM TOOLS



ZHANG, YU  
DEPARTMENT OF CRIMINAL JUSTICE  
THE COLLEGE AT BROCKPORT  
STATE UNIVERSITY OF NEW YORK  
BROCKPORT, NEW YORK

Criminal justice study, a subcategory of social science, gathers information traditionally from three sources: survey research, government statistics, and one-off studies of particular people, places, and events (King 2013). However, the astonishing pace of technological advance has changed this pattern. In the next 50 years, the exponential increase of information sources will extremely affect both our research and practice in criminal justice. On the one hand, criminal justice courses need to handle problems created by high technology, such as the high-tech crimes, new technology applications in law enforcement and relevant criminal procedure issues. On the other hand, the high technology provides new tools for the crime control and the expanding of the discipline like the use of big data methods.

Criminal justice study is demanded to utilize high-tech assistance to explore various aspects of crime, the legal facts, and the justice system. The current chapter will focus on following two aspects and discuss the possible redesign of criminal justice courses adapted to new methods in Science, Technology, Engineering, and Mathematics (STEM). First, it will examine the weaknesses of traditional criminal justice course design. Second, it will discuss the relationship between criminal justice and STEM. Finally, the chapter will explore the redesign of traditional criminal justice courses using STEM tools.

Technology has transformed our lives, and it has influenced many disciplines. Studies on the combination of social science and technology have become a dynamic interdisciplinary field, as a result of the intersectional work by sociologists, historians, philosophers, anthropologists, and so on. It may be against some people's expectation that scientific facts are not objective because 1) those facts are obtained from investigations conducted in certain social conditions; 2) people who conduct these investigations are conditioned in certain social facts (Kuhn, 1962). As a result, technology is part of social facts and there is no clear segregation between natural science and social science. Technology can provide an enriched learning environment and equip learners with the skills, ideas and information which are necessary for them to become critical thinkers, collaborative peers and technology literates (Abdelraheem and Al-Rabane 2005; Angers and Matchmes 2006). Social scientists need to make efforts and explore scientific discoveries and applications that can be used in their research of social facts, legal development, public policy, and culture.

Compared to natural sciences, social science, including criminal justice, has been changing slowly in the past centuries. Criminal justice study, a subcategory of social science, gathers information traditionally from three sources: official statistics, survey research, and case studies (King 2013). With the technological advancements in recent years, the traditional criminal justice study has been challenged by many untraditional issues rising up in the field. Criminal justice professionals are facing up challenges from crimes using high technology. More and more crimes are committed by using technology to commit crimes, while some law enforcement agencies lack strategies against high-tech crimes. Moreover, some researchers are short of skills in using big data; legal policy is outdated without multidisciplinary approaches. Criminal justice or criminology, a discipline based on traditional sociological methodologies, encounters difficulties in solving new problems occurring in rapid social changes. Technology advances, which present challenges, provide useful tools to face these challenges and to reform the criminal justice discipline. The current paper will discuss new challenges and explore potential reforms in criminal justice courses.

## The weaknesses of traditional criminal justice courses

The founding of social science starts from the early nineteenth century, with an aim of pursuing the social justice and public benefit. Social scholars have tried to address the issue of whether there can be a science of society, modeled on scientific studies of the natural world (Salmon 2010). These early social scientists devoted to maintaining the independence of the social science studies by only focusing on social factors, and they tried hard to eliminate various extra-social factors, including technology, geography, meteorology, biology, etc. These efforts are important for the establishment of the social science as a separated discipline from natural science. However, it also creates a barrier for social scientists to explore the entire society, knowing very little about the social facts in the natural science field.

Hundreds of years later, along with the growing complexity of social development, the line between natural science and social science gradually becomes blurred. Technology, as a new driver, has entered the domain of social science. First, technology not only provides all basic facilities for the promotion and enhancement of education (Fawcett, Francisco, Paine-Andrews and Schultz 2000) but also present new methodologies. For example, the information technology has brought big data application into social science research. Second, our modern society has been tremendously changed by advances in science and technology, which generate critical public issues (Heath 1989). In criminal justice field, these issues can be found in hi-tech crime and cybercrime.

While issues related to technology keep rising, the criminal justice education has not changed much. The need of higher education in criminal justice was raised by the National Commission on Law Observance and Enforcement in 1931. After decades of growing, criminal justice programs have been built up in many colleges in the United States. Most of the U.S. criminal justice programs can be categorized into two types, one is more theoretically oriented or liberal-arts based, the other is more vocational, or skill-based (Verrill 2007). A curriculum is generally designed by using components from both theoretical and methodological perspectives, including courses of introduction to the criminal justice system, criminology, criminal justice organization, criminal justice ethics, juvenile justice, research methods, and statistics. These courses rarely discuss justice issues due to the advance of technology. For example, theories on cybercrime are not included in the curriculum. Criminal justice research also uses traditional social science research methods, such as sampling of particular people and/or places, without much adaptation of new technology.

Students of criminal justice program nowadays live in a world with web 2.0, spending time on the Internet and smartphones. In the near future, in a world full of high technology, they will confront science- and technology-related social issues because criminals also utilize these technologies. Criminal justice professionals need new tools to solve these issues and work for the system. Our courses should provide students with the capacity to inquire solution and help them make rational choices. But our current criminal justice curriculum cannot satisfy these needs.

First, technology components are limited in the current course curriculum. Technology now is applied in many criminal justice jobs, ranging from drug testing to robotic cameras to risk detection systems. Criminal justice students who are going to work in the field need to have both theories and practical knowledge about technology

applications in the field. But most textbooks now only generally talk about technology applications in criminal justice, without specific discussions on the conjunctions of technology, crime, society and solutions. Furthermore, the general technology content mostly focuses on law enforcement, much less on court and corrections. In addition, textbooks rarely discuss technology-related social issues in the system. For example, the legal and moral issues in assisted reproduction need to be included in the adjudication and family law course.

Second, there is a void of a multidisciplinary approach to criminal justice study. Criminal justice belongs to social science in the academy, and criminal justice major usually is included in the school of liberal arts in American universities. Criminal justice curriculum rarely adopts the natural science content. However, criminal justice professionals may encounter problems in the field which needs knowledge of natural science. For example, detectives face issues in evidence collection and need the knowledge of chemistry and biology; police officers who investigate cybercrime will need the knowledge of computer science. Our traditional curriculum rarely explores criminal justice issues with the considerations from other disciplines. Along with the blurred lines between social science and natural science nowadays, this has to be changed. In the modern era, it is necessary to address criminological and criminal justice problems from a multidisciplinary approach, using applied biology, chemistry, mathematics, computer science, and criminology. This can prepare students and future scholars in criminal justice for the changing subject matter in the field and face the emerging new aspects of crime.

Third, criminal justice research methods also need reform. It is argued that both the survey and the interview are outdated methods in research (Savage, and Burrows 2007, 885). The rapid development of online communications methods has produced big datasets for social behavior (Hooley, Wellens, and Marriott 2012). In addition, developments in administrative data also provide opportunities to study on population instead of samples (Boyle 2011). Unfortunately, our statistical courses in criminal justice major have not adopted big data applications. Classic statistical methods are incapable of dealing with the challenges from high dimensionality, increased instances of spurious correlations and ancillary homogeneity of data characterized by massive sample sizes, which have given rise to more computational methods (Bickel, Bächer, Otaduy, Matusik, Pfister and Gross 2009; Fan, Han and Liu, 2014). Classical statistical techniques applied to high-dimensional data have been found to be no better than a random guess as a result of noise accumulation (Hall, Pittelkow and Ghosh 2008).

In Web2.0 time, the Internet and social media afford broad opportunities to understand the peoples' social behavior from their habits to their favorites to their moods. Increasing challenges of terrorism and homeland security issues call for systematic monitoring through the national network and datasets. But a criminal justice student, trained with traditional statistical modeling, does not know how to collect and analyze these data. He/she does not know computational tools which offer increased capacity to organize and analyze the vast amounts of texts from the Internet and other sources. The weaknesses of our current criminal justice curriculum tend to have our students left behind for their professions. How to change this situation? Technology gives the answer.

### [The relation between criminal justice and STEM](#)

STEM knowledge has been applied in the criminal justice field. Examples include CompStat, inmate tracking software, crime mapping, GPS, DNA analysis, and other crime analysis tools. First, STEM provides advanced equipment to law enforcement agencies and promotes their capability to fulfill their function. For example, police officers are equipped with high-tech

weapons and devices to control crime, search criminals, and wear vests that can stop bullets. It's now possible to send in a robot to dangerous scenario instead of sending in an officer. Second, STEM enriches types and forms of law enforcing. For example, judges can order electronic monitoring with probation decision; prisons administer health care through telemedicine without moving prisoners. Flying robotic drones can be sent to a crime scene and get information; an electronic sensor system in high-crime areas can quickly detect gunshots and bomb; GPS/GIS can effectively map the crime and locate a suspect. Third, STEM can provide more ways to protect the public. For example, home surveyor system helps owners monitor home safety; people can use computerized crime maps and report a crime in seconds through their smartphone apps.

These changes in the field have induced relevant courses growing in criminal justice education, such as forensic courses, crime mapping courses, and cybercrime courses, etc. Some universities have created new majors or minors for students, e.g. Forensic science major/minor and/or information forensics major/minor. Other universities even created dual major of computer-criminology degree programs. This dual major has two aspects: one is to facilitate students with new methodologies and data techniques for crime analysis; the other is to educate students with new trends of crime and delinquency through technology application (Valentine, Hay, Beaver and Blomberg 2013).

Technology joins higher education field and improves teaching methods with online teaching and virtual learning. Most schools now provide online courses or online degree programs. These courses or programs have either lecture videos and/or course materials posted on websites. Students do not need to go to the campus and can finish courses or programs while staying home. Accordingly, the curriculum needs certain modifications to meet online program's requirement. An online criminal justice course needs to install more practical content with multimedia formats.

In addition, STEM knowledge directs a criminal justice curriculum shift from disciplinary to interdisciplinary style. In the criminal justice program, particularly, students not only learn discipline-based courses, but also need to learn technology courses which help with crime analysis. For instance, with GIS and statistical software, students can look into crime patterns more closely with mapping and modeling. Technology also brings a curriculum change from formative to vocational approach. Reduced funding for higher education has accelerated such a change. More and more schools want to have more courses to build up professional skills of students. Curriculum with STEM components can satisfy such needs. In sum, the relationship between STEM and criminal justice is getting closer, and it is a time to conceive potential changes in our curriculum in criminal justice.

### How to reform

It is not easy to conduct curriculum reform in any disciplines, especially for using STEM tools to reform a social science discipline. I will discuss the three parts of the reform: content, methods, and assessment.

#### Curriculum content reform

Knowledge and skills from Science, Technology, Engineering, and Mathematics (STEM) have helped criminal justice professionals ensure public safety, prevent and control crime, and ensure the fair and impartial administration of criminal justice in the

United States. These disciplines also provide opportunities for the criminal justice curriculum redesign. One type of design is to adopt STEM components into course content. The second type of redesign is to create new courses. The first type is relatively easy to work on and fits in different course redesigns. The second type requires more institutional efforts and multidisciplinary collaboration in doing a systematic curriculum redesign. It is realistic to start with the first type and continue with the second type when the opportunities are available.

### *Technology component adoption of older courses*

Most criminal justice required courses can adopt technology components because technology advances nowadays exist in all criminal justice job fields. I have two examples in the course redesign. One is the “Introduction to criminal justice” course, and three chapters of technology application can be added to the course content. The other is “Policing and society” course, and two chapters can be added.

### *Introduction to criminal justice course*

I add technology application to three parts of the criminal justice system: policing, court and corrections, including material technology and information technology. For each part, one class session is used to discuss new technology application in the system. For example, in the police session, I first explore how police now use technology to improve crime control, including DNA testing, robot officer, GIS system, etc. Second, I discuss how technology can help improve the police-public relationship. For instance, the police officers wear body cameras during their work and the public can inspect officers by recording their work. Lectures will use case studies, videos and guest speeches.

Another class session is used to discuss challenges and opportunities produced by technology in the system. For example, how the Internet evidence can be adopted in court for the *alibi*. Because this introductory course is to give the freshmen general guidelines about the criminal justice system for their future study, the discussion of technology components does not need to go very deep and technological jargon should be avoided. This course redesign can inform the importance of technology in criminal justice and encourage students to learn more technical courses for better job opportunities.

### *Policing and society*

Policing and society course is a class which deeply explores the relationship between policing and social development, including the origin of policing, policing theory, police work, and social change, policing reform, etc. Two chapters about technology can be added to the course. One chapter is how technology changes policing in modern society: technology can help improve crime control and discipline police officers. A historical development of technology used in policing is discussed: from the car, telephone to robots, robotic cameras, and flying drones, from gunshot detection system (GDS), GPS and GIS systems to Automatic License Plate Recognition (ALPR). The advantages and issues of these technology applications are also discussed.

Another chapter explores policing in an information era: digital policing, policing on social media and information forensics. When social life has expanded to the Internet, online policing is needed to ensure public safety. More and more criminals use the Internet as a tool to commit crimes, from stealing private information to financial fraud, from the money laundering to the terrorism. Police have to utilize the Internet to fight against crime, from using social media to pursue criminals to detecting crime leads through security software. At the same time, discussion on the balance between digital policing and citizens’ rights is included.



This course gives students a deep understanding of police work and technology, and it will inform students with future police jobs. Real stories from the news and the field are used to show the prevalence of cybercrime, and the importance of online policing. These two chapters are welcomed by students and they express their interest in learning more in online policing. Some students have claimed that they would like to work as the Internet police officers to do online crime control. Some decide to take the information science courses and get prepared for the new careers.

### *Create new courses*

For colleges which have the capacity, new courses can be created to meet technological advances in the criminal justice field. The new domain includes, but are not limited to forensic science and computational criminology. In order to design new courses, faculty in criminal justice and in natural science need to collaborate.

### *Forensic science*

For forensic science courses, students need to take various science courses, including biology, chemistry, pathology, and psychology, etc. One new course can be created to inform students with the knowledge of criminal justice, and it is called Forensic analysis, including content from science, psychology, and criminology. This course needs the collaboration of faculty from different disciplines, including biology, chemistry, criminology, psychology. Lab devices and experiments are needed to complement the classroom teaching.

An easy way to start this new course is to reform the existing course. For example, many criminal justice programs already have crime investigation course which discusses crime scene walkthrough, documentation, and evidence finding etc. The new course of Forensic analysis can be built up based on crime scene investigation and expand to forensic photography, hair and DNA testing, firearms testing, fingerprints etc. The course can be divided into two or three levels in order for students to choose based on their career needs. Level I course covers the basic crime scene investigation. Level II and III will focus on evidence testing and analysis. The course should be assisted with crime scenes and lab activities. If conditions allow, students can go to a local police department and have field trips with the crime scene team. Students will be encouraged to take more training and prepare for the International Association for Identification (IAI) level 1 crime scene certification test. Because forensic science courses require special expertise, schools usually need to recruit professors with forensic science Ph.D. The forensic science courses provide students with new opportunities in the job market and increase competitive capacity of criminal justice programs.

### *Computational criminology*

Besides forensic science, computational criminology has been growing fast in recent years. This new discipline uses mathematical and computational methods to train students with the necessary skills to deal with crime issues in cyberspace. Different from forensic science which usually needs to hire new professors, computational criminology can be built up through collaborations between departments of criminal justice and department of computer science in universities. It may change our traditional criminal justice academy in the near future. As I discussed before, the traditional statistical modeling cannot handle computational algorithms because of the changes in data structures and software. The impact of computing will create new criminological models

with calculated algorithms, and explore dynamics of crime within the spatial and temporal domain by computational modeling.

New courses will be created based on both the knowledge of computing and criminology. One new course is computational crime modeling, which will use algorithms to model and simulate crime patterns and trends. This course will include the content of crime mapping, theoretical crime modeling, algorithm analysis, calculation, and analysis, etc. Students will learn how to transfer traditional crime theoretical model into algorithms, and then use algorithms to calculate crime patterns and trends with computational methods. Another new course is cybercrime and web security which will study on strategy against cybercrime and protect public security in the Internet era. This is an in-demand course nowadays when we are facing serious threats from cybercrime and terrorism. This course will include the content of cybercrime pattern, theory, web security software, the Internet security practice, etc. Students will learn how to use web security software to protect the Internet and detect cybercrime. All computational criminology courses require a lot of experiments and practices in the computer labs. These courses need faculty members from both criminal justice department and computer science department.

### Teaching methods reform

Besides using the STEM to reform criminal justice curriculum directly, STEM tools also can be used to reform the teaching methods of criminal justice courses. For a long time, most social science courses, including criminal justice courses, take the form of lecturing, with or without PowerPoint (statistics courses may have additional lab sessions). Although we professors use different ways to make lectures more interesting, the traditional lecture formats are limited in attractiveness to the generation in the Web2.0 era. Our pretty PowerPoint slides cannot compete with smartphones and Facebook. Some schools have tried to forbid the use of smartphones in classrooms, but it is usually in vain. It is more efficient to embrace the change brought by the technology and utilize it for our teaching. More and more professors now use various course websites (e.g. Blackboard) to help students learn. Social media, such as blogs, microblogs, and social networking sites can also be used for students to interact with peers and share their learning experience. A popular way is to create a course blog to post relevant documents, stories, and assignments for students to review and discuss. I discuss two types of methods reform below.

### *Learning experience enhanced with technology*

The first way is to immerse students in learning with technology. It is well known that learning is conducted by three styles: auditory, visual and tactile. Technology can enhance the learning experience for learners of different styles. As a type of auditory learning, lecturing has been used for thousands of years and gradually loses its advantage in the Web2.0 era. One alternate way is to change long lecturing into short podcasts. You can create podcasts by yourself or search online. There are thousands of relevant podcasts available on the Web (e.g. Department of justice website, NIJ website, Federal Law Enforcement Training Centers website). When I teach the policing part in the “Introduction to criminal justice” course, I use several podcasts to explain the police work. The first podcast is from several police chiefs speaking about their work and how to strike a balance between crime control and protecting citizens’ rights. The second podcast is the execution of a search warrant training episode, specifically talking about the procedures. The third podcast is about community policing from community members and police officers. While listening to these podcasts, students need to write down notes and turn in a one-page reflection. These podcasts include stories from different speakers and can enrich the



auditory experience in the classroom. I also provide students with links to podcasts for them to download and review after class. Students can access the information whenever they want. For some students, listening is much more convenient for learning.

Visual learning is also a good way for many students and can be combined with auditory learning. A popular way is to play videos. There are many criminal justice videos which can be used for teaching. For the police work class, I played a YouTube video at the beginning of class, and it is called “A day of a police officer” which records a real work day of a police officer in the New York City. In addition, I also played another video of a police officer in a small county for students to see the different work environment of police.

My favorite learning style is tactile learning which means learning by physical movements, such as touching and doing. It is not easy to teach the social science courses by tactile approach because physical movements are not required for most social science courses. However, it is beneficial for learners to have “hands-on” experience which not only helps to learn but also bridges classroom and future careers. We can use auditory and visual tools to simulate tactile learning. We can ask students to create podcasts, video or take photos themselves. This can create an environment of touching and doing what they learn from textbooks. For example, I ask students to write down an outline of a book chapter and then create a podcast based on the outline. Students need to speak what they have learned from that chapter and record it. They then upload these podcasts on the Blackboard and everyone can get information for review. When I teach criminology, I ask students to use art to explain different theories. For social disorganization theory, students take pictures of communities and tell stories of their neighborhood. For social learning theory, they find criminal stories and make slides or videos to show the learning into crime. The key to tactile learning is to make students move, build, or draw what they learn instead of sitting still on their chairs. Although most social science courses lack practical content compared to natural science courses, technology can help us simulate those practical experiences.

### *Learning becomes an experiment*

If there are possibilities, professors can combine their research and teaching together in classrooms to help students learn. This approach is very similar to tactile learning, but it is more dynamic and needs more efforts. Usually, professors should obtain IRB approval before starting the experiments.

I apply this learning approach in my research methods course. I have a research on the intra-racial bias which has obtained IRB approval. All students in my research methods class have joined this research and use this research as a tool to study on research methods. I have students choose what kind of methods we can use for this research. After reading books and discussion, we agreed that multiple methods should be used: experiments, surveys, and physiological testing. Because all students want to participate, we use the pre-test and post-test methods instead of dividing students into groups. Students first took implicit bias test online and record their results, then they took a survey. In addition, students went to the lab to take a physiological test on the racial bias issue. Students learn how to use BioPak device to measure skin conductance levels through electrodermal activity to obtain physiological responses towards arousal information. After taking three weeks racial issue competence training, all students took the online test and survey again. After collecting all data, students need to enter data into

SPSS and run analyses. The whole research took place during all class sessions. For each step of the research, I usually took one class session (one hour) to teach relevant methodological knowledge and let students have discussions after each research step. Because this research project is multidisciplinary, I also invited professors from biology, physiology, and psychology departments to teach relevant content. The result of this teaching method is very successful and students all claimed that the learning through experiments was full of fun.

#### Learning assessment methods' reform

Traditional assessment tools include exam, homework, presentation, term paper, etc. When STEM content and tools are used in the courses, assessment tools should be updated accordingly. Traditional assessments focus on writing, e.g. Essay exam and paper specifically test students with writing. Even for presentation, students put too many words into slides and neglect the essence of "presenting" their ideas. Actually, the oral expression is a very good way to test how well the students understand the content. I have tried auditory assignments for one year in my criminal law class and found that a good articulation signals good understanding. For all my classes, I assign each student with a chapter and they need to clearly articulate all the concepts and ideas of that chapter. Students record their outline articulation into podcasts and submit to Blackboard. Besides recording podcasts, students are required to create an E-book in which they find news stories and case laws for concepts and ideas in textbooks. By the end of the semester, students have both an auditory book and an E-book which show their understanding of the course. These can become part of the final grade. In addition, students can use these two books for exam preparation and future reference. My students feel these tools are very useful. They may sell textbooks after the semester ends but they can keep and check these E-books forever.

In conclusion, the quick advances of technology in modern society have produced an increasing gap between social science and natural science. Such a gap has become a big barrier to further research and education in the criminal justice. There are fewer resources available in the social sciences to minimize it. However, STEM actually provides great tools for studying social behavior while very few people from social science dare to challenge themselves and to learn these tools which may transform the whole field. In this article, I discuss the three parts of the curriculum reform: content, methods, and assessment. STEM content can be adapted to old courses or combined to create new courses in the criminal justice. Technology can refresh auditory, visual and tactile learning style and teaching methods. Accordingly, assessment tools should be reformed with technology to evaluate students' learning in the Web 2.0 century.

Yu Zhang  
Assistant Professor  
Department of Criminal Justice  
The College at Brockport  
State University of New York  
350 New Campus Drive  
Brockport, NY 14420

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