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# Reflective Practice Series: The Age of Synthetic Instruction

Martin W. Sivula

*Johnson & Wales University - Providence*, [martin.sivula@jwu.edu](mailto:martin.sivula@jwu.edu)

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The Age of Synthetic Instruction

Martin W. Sivula

Johnson & Wales University

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Reflective Practice Series

## Introduction

Methods of teaching, instruction, and training have been transformed due to advances Information Technology and Communication (ICT). People from all over the globe via ICT can learn just about anything, anytime, and anywhere provided they have basic linguistic knowledge and skills in their native language and an Internet connection. Using these ICT methods, one could question whether deep knowledge, comprehension, and understanding of a given content domain has occurred? More importantly, does instructor personality and their teaching traits make a difference to students in this modality? Quite possibly, the new learner's ultimate outcome might be: the most convenient and cost effective instructional method which "best fits" their life style. The ICT and on-line education movement continues to grow and is displacing some of the more traditional forms of education. The ideas presented here offer are no concrete reasons or answers for these phenomena, but offer a dialogue of issues for further exploration.

## Synthetic Instruction

Merriam Webster Dictionary (2017) states that **synthetic** "produced artificially *synthetic drugs synthetic silk* (2): of or relating to a synfuel **b**: devised, arranged, or fabricated for special situations to imitate or replace usual realities." For centuries, human teachers have taught human students, one to one, one to many, small groups receiving information through the five human senses while interacting with a textbook(s). These functions were performed in a physical space, a real environment... possibly a self-contained classroom in some type of institution dedicated to education and training. For many of us this is the *usual reality of schools, colleges, and universities* (at least a few decades ago). Data from observations, informal interviews, and electronic sources provide evidence of a transformation of the instructional process at all levels. This usual reality is being transformed into an artificial reality for instruction or what I coin "synthetic instruction."

Are we now producing in some areas of education a “substitute” or “artificial” or “synthetic” form of instruction with the use of the Internet, Learning Management Systems, and all types of connective electronic devices? And if this is true, will there be adverse consequences yet to be discovered or researched? Are all these synthetic forms of instruction producing the same or better educational outcomes? The last two decades of sparse research suggests that they might be equal, but who knows for certain? Business looks towards technology as a tool which might produce “better, faster, and cheaper” products, services, and results. This paper raises these questions and maybe sheds some light upon them as well.

Do not confuse *synthetic instruction* with synthetic biology, synthetic phonics, or synthetic geometry which all have different meanings. A working definition of *synthetic instruction* is: delivered by using computers, (with or without human intervention) tablets, Smartphones with Information and Communication Technologies (ICT) and possibly Learning Management Systems (LMS) which produce *learning* for the end user (student, employee, trainee). There may not be any teacher, trainer, or moderator present... the recipient merely interacts with the hardware, software, electronics, audio, video, tactile, etc. through their senses and electronic devices of choice. Instant messaging and/or text messaging (SMS) also contributes to this phenomenon as well. In fact, it is quite possible to go through grade K all the way to a doctorate degree with limited human to human, physical, social interaction in a classroom.

#### Historical Movement: Flesh, Bones, and Blood Traditional Teaching

For much of the 20<sup>th</sup> century not much changed in the self-contained teacher-student classroom. One of the major differences was instead of having bolted down desks and chairs to the floor, portable chairs and desks (and tables) became available and allowed for greater flexibility within the self-contained classroom (groups, one to one, stations by task, etc.). Some technology creped in however, such as 16mm films, overhead transparencies, filmstrips,

tape recordings, microphone use, and loud speakers to name a few. They enhanced the educational process, and provided variation for students and teachers within the bounds of the topic/unit/lesson. In the best sense of the word they were “tools” and those teachers who used these “tools” were truly craftsmen. History classes became alive with films, teachers could write on an overhead transparency with a grease pencil, and you could listen to speeches that were taped recorded (or the students could be taped), etc.

The 1960s primed many new thoughts, ideas, and concepts. Perhaps it was the era itself which in many ways was revolutionary in society and sometimes even radical. Rather than giving an historical account of the decade, I will share some thoughts of technology and education. Technology was showing tremendous advances such as placing man on the moon, LEDs, chip technology and RAM cells, lasers and bar codes, and lastly, the operating system UNIX. These are only some of the examples. However, in the U.S. Texas Instruments (TI) introduced the first scientific calculator, the SR-10 in 1972 which was known as the “electronic slide rule” calculator. The second version was introduced in 1973 had the name SR-10. So now the pocket and hand held calculator could be used by anyone, and at any time. TI has marketed the education area over the decades meeting some resistance from instructors in that students would not acquire basic arithmetic and computational knowledge and skills if they used a calculator. However, the National Council of Teachers of Mathematics has promoted the use of calculators K-high school. In some sectors, education in the late 1960s and early 1970s was attempting the break away from the traditional model of the self-contained, one teacher many student models. Individualizing instruction could better meet the needs of the student. One teacher-one student instruction, with all types of instructional tools that were available, film strips, recordings, books, self-contained instructional packets and so forth. Theoretically, each student would proceed at their own rate through a curriculum, “Topics-Units-Lessons” in a course of study. Programmed instructional textbooks became popular to meet this need.

“Open” high schools appeared, schools without walls, etc. These arrangements were certainly radical contrasts from the traditional self-contained classroom. The movement was embraced by some educational leaders and some did not move from tradition. Cost, time, resources, and training for teachers were all real issues and in some cases major barriers to these types of instructional deliveries.

### Liberation and the New Movement

In the late 1970s there was a freedom movement from the mainframe and minicomputer systems to the recently invented (and on the market) the *personal computer*. “Three machines, the Apple II, PET 2001 and TRS-80 were all released in 1977, “eventually selling millions of machines. *Byte* magazine later referred to their launch as the "1977 Trinity" (History of Personal Computers, 2017). There it started... the liberation from the slavery of the mainframe and mini-computer systems (cable connections) to on the desktop independence. Persons programmed in computer languages to get the machine to do what they wanted it to do, it was the “hay day” of personal computing, the new frontier. And it was even possible to upload and download to the mainframes and mini-systems using very slow magnetic tape drives. Apple Computer allowed the “networking” of its Apple II C computers. Instead of every machine having its own software, data and programs could be “shared” through the network. Commercial software development spread rapidly to do standard business functions, print, account, and so on. The “game” electronic environment also became popular on the same of the personal computers. However, in 1983 the “Atari shock” was starting to occur after a peak of about 3.2 billion dollars in 1983, it fell to 100 million in 1985, almost a 97% crash. (North American Video Game Crash of 1983, 2017). Later in 1985 Nintendo Company revitalized the industry with its eight-bit gaming console. Not everyone was capable or wants to program personal computers or learn a computer programming language. So, the software development companies created pre-programmed software in which the end user merely used. This application software development provided for tasks, processes, and functions needed by the end user on their own personal computers. For example, Lotus 1-2-3 was a

highly successful spreadsheet program designed to run on the IBM PCs during the 1980s. Still, you had to learn the software and how it operated before you could do anything meaningful in the world of work.

### Internet and WWW

The Internet is a *network of networks* that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries an extensive range of information resources and services. Before web browsers, there were hyperlinked applications going back to the 1980s. " Tim Berners-Lee is credited with inventing the World Wide Web in 1989 and developing in 1990 both the first web server, and the first web browser, called Worldwide Web (no spaces) and later renamed Nexus. Many others were soon developed, with Marc Andreessen's 1993 Mosaic (later Netscape),<sup>1</sup> being particularly easy to use and install, and often credited with sparking the internet boom of the 1990s" (Internet, 2017). Here lies the vehicle for the transmission of data and information throughout the globe. More importantly it is also the carrier of knowledge and learning throughout the world in the 21<sup>st</sup> century. The Internet and the WWW have revolutionized electronic transmission of data, information, and knowledge creating a "superhighway" for the users across the globe.

### Automated Teller Machines (ATM) and Online Education

I would argue that increased use of the ATM machines (since its invention in 1969) and the growth of online banking has influenced the movement in online education. Instead of waiting in banks with long lines and consumers dealing with restrictive hours, customers could now either go directly to an ATM at a convenient geographic location to carry out simple banking. Progressively, online banking now (through the Internet and the WWW) allows just about every banking and financial function from your home or office, from a personal computer, laptop, Smartphone, etc.

Convenience, 24 hours a day, seven days a week, ease of use, and comfort all contribute to the “online movement in education.” For the do it yourself adult who wants to get more education, training, and/or certificates and degrees when they want, where they want, and how they want “online” is very appealing. It integrates quite nicely into a complex lifestyle of which so many adults have in the twenty-first century... go, go, go, global, mobile, and social! Just as with the ATM and the online banking industry, education on the go is rapidly gaining momentum. When the ATM became more common place I said to a friend, “Maybe someday we will have Automatic Teaching Machines.” And perhaps to some degree we are already there. Many “online” courses have very limited instructor led instructional interventions: for example, they use “canned” software, streaming video, e-books to provide the content for instruction. Please note these are totally asynchronous courses meaning that there is no real time or synchronous contact between the instructor and the students. The general form of these courses:

Topic/Content to be Studied

Learning Objectives

Learning Activities

Assignments and Assessments

Evaluation (grades, narratives, pass, fail, etc.)

There are paid content experts and instructional designers that work together to develop these types of courses. Now if the content expert was a master teacher and/or professor in the subject or discipline, working with instructional designers to create the highest quality course, great! This does happen, but it takes time and possibly it is not very cost effective. One alternative is to temporarily hire content experts or even instructional designers to capture the “language” of the course (as above) and create a product sustainable for a time and able to be

replicated. No long-term employment or contracts or paying benefit packages, they would be independent contractors. Once completed, the organization owns the learning package and might also have rights to modify it as needed. This is cost effective and has very low overhead; and might be done virtually, meaning that the content experts and the instructional designers work totally “online.”

Correspondence courses are now offered at many universities where the students earn credits, learn new knowledge and skills without physically ever being on campus. Correspondence is primarily done through email systems and Learning Management Systems (What are Correspondence Courses?, 2017). Some schools still use the printed mediums (books, reports, papers,) to correspond through a land mail system. Correspondence courses date back to the 1840s in England where one-way communication to an instructor was delivered by students living in rural communities taking advantage of a new “rural free delivery” mail (land) system. Since that time, we have had radio, television, fax, audiocassettes in the mix and around 1985 computers and networks got into the mix. So, in some regards the technologies have got more sophisticated, but the general principles of “learning at a distance” have not changed drastically.

If we examine online education from a product or Self-Service Technologies model, such as automated hotel check in-out, Smartphone banking, and/or boarding on airplanes, etc. it becomes apparent that the asynchronous, online education instructional model has followed similar suit. The *product* is the successful completion of a course, or maybe leading to a degree or a certificate program in a highly-specialized area, etc. Replication, once the course is “canned” then it can be executed repeatedly by different instructors, etc. sort of a “standardized” course. If you add automated or automatic assessments (no instructor intervention) then the whole course is automated, (such as the use of Respondus <sup>TM</sup>)

assessments. One student recently commented: “those are courses without soul.” Can we put the soul and instructor personality into online courses?

#### Human(s) to Human(s) Teaching-Learning in a Classroom

There are many persons that want the human to human, on the ground interactive classroom environment. And as you read this, reflect on one of your great instructors and think about what made them special and why you were so anxious to go to class! What makes up the human to human on the ground, great teachers or what attributes do they possess? Thompson, Greer, and Greer ( 2004) conducted research on what characteristics a human teacher in a classroom possess that make them a “great teacher” and also highly qualified and successful. They came up with twelve themes, but as they state: “the ... *theme of caring*, all twelve of the characteristics in some way epitomize this essential human trait.” The twelve other characteristics are as follows: fairness, positive attitude, preparedness, personal touch, sense of humor, creativity, willingness to admit mistakes, forgiving, respect, high expectations, compassion, and sense of belonging. They go on to state that these are characteristics of effective teachers and *have proven to increase student achievement* (Thompson, Greer, & Greer, 2004). Perhaps the students achieved at higher levels because they sensed the teacher truly “cared” about them as an individual.

#### Health and Medical Service Influencing e-Learning

Over the last several years there have changes to health and medical services and the providers of such. Many pharmacists can now deliver certain type of shots (some immunizations), whereas a few years ago, this was unheard of. Minute clinics and urgent care allow nurse practitioners to diagnose and prescribe patients on some medical and health related issues. Physician assistants also perform some of the duties only reserved for Medical Doctors (MDs) a few years back. Appendix A gives an overview of this phenomena.

I believe the same thing is happening in education especially with college, adult, and continuing education. I hate to say it, but I think cost and benefits are the key drivers, along with convenience for the learner. Another way to put it, it is the course of least resistance. Why pay earned doctorates in various fields and disciplines to assess papers, reports, and written scholarship, when you can cut costs by having lesser degreed professionals do the same tasks? Traditionally, many of these tasks have been performed by teaching assistants, and graduate assistants. On a more permanent level, why not hire master's degree persons in the field or discipline? The key questions are there high standards and high quality of the assessments done by non-doctorates? Is it cheaper and better, it might be cost effective, but is quality lost in the process? From the trends in health and medical services it seems a very logical course of action, but maybe it will be slower in development in education.

#### Discussion

As an instructor in 1972, the educational innovations were somewhat revolutionary and maybe even radical in my learning environment. Open classrooms, schools without walls, Individualized Instruction, Programmed Learning textbooks, and Learning Activity packages (LAPs) were components of my educational system. In the same year, (Moore, Learner autonomy: The second dimension of independent learning., 1972) came out with a theory of independent learning and learner autonomy which after several decades became the *Theory of Transactional Distance* (Moore, Theoretical Principles of Distance Education, 1993). In education there was a trend to escape out of the "traditional boundaries of the self-contained classroom." In 1972 we had limited "technology" and unless you were on a mainframe computer very little, if any computer assisted instruction. My point is Moore's (1972) original work and research did not focus on technology but the "distance" between the learner and the instructor which promoted greater understanding of content material. Classic educational theorist John Dewey stated that transactional distance was "the distance in understanding

between the teacher and learner” (Dewey, 1938). So with or without technology whether synchronous or asynchronous there is a “distance” between learner and teacher. One might say that when the distance is minimal between teacher and learner there is greater learning and understanding for the student. This concept should be able to be applied to any educational system.

### Critical Mass

“In social dynamics, **critical mass** is a sufficient number of adopters of an innovation in a social system so that the rate of adoption becomes self-sustaining and creates further growth” (Critical mass (social dynamics), 2017). As with the banking, financial, health, pharmaceuticals, medical, and other industries will the critical mass of new online (asynchronous and synchronous) learners be large enough for sustainability and further growth for e-learning? The short answer... to some degree it already has. Computer-assisted home schooling, virtual K-12 schools (some of which are free) are very attractive for learning in some families. Some of the virtual schools are full time online (K-12). Connections Academy™ reported that there was an 80% increase from 2010-2014 in students taking online or blended learning courses, from 1.5 million to 2.7 million students (Infographic: Growth of K-12 Digital Learning, 2017). If the growth rates continue it would seem the e-learning systems would become stable and better over the next decade. Legacy schools and universities will continue to be populated for those learners who want on the ground, traditional self-contained classrooms, but will that trend decline sharply over the next few decades?

The theory of **Diffusion of innovations** seeks to explain how, why, and at what rate new ideas and technology spread. Everett Roger’s latest work (2003) proposes that four main elements influence the spread of a new idea: the innovation itself, communication channels, time, and a social system (Diffusion of Innovations, 2017). This process relies heavily on human capital. The innovation must be widely adopted (68% between early and late majority adopters) *to self-sustain and reach a critical mass*, but where is that point? Roger’s adoption rate follows much like the normal curve where

the population (68%) majority would be  $\pm$  one standard deviation from the mean value. Critical mass might be estimated with statistics, however, the timeline for the adopters would seem to be problematic in that where is the starting point, how is it operationally defined, and why that point, the rationale for it?

### Assessment

Tests, quizzes, exams, and other forms of assessment are very traditional in education. The “online” environment has provided various software tools to automate the pencil, paper, and proctoring processes. Publishing companies of textbooks produce various test banks to accompany the various software testing products. These “tests” could be administered to a large group in a computer laboratory, and proctored by a human. Or, might be done online through the Internet anytime, anywhere one test-one student, maybe with a lockdown browser. Each student in a class might receive a different test over the same content test bank with a random block function. Or if an essay response is desirable, there are software packages that will check the entire document for spelling, grammar, plagiarism, and issuing a “grade” to the paper. Quite surprisingly, if you chose the correct software “apps” for the assessment task(s), all these assessments can be done without human intervention (or very little). You can program the Learning Management System (LMS) to receive the software inputs from the various assessments and the LMS will produce an average and a grade for each student.

As the world has become smaller with global communication through the Internet, more standardized assessments will be needed to move across, cultures, languages, and countries. Software development and engineering have made great strides to facilitate such assessments with translation tools and voice-to-text speech recognition. Along with assessments and assessing are the issues of academic dishonesty. This is always an issue whether on the ground in a classroom or online. We can never eradicate crime and/or criminals, the same goes for academic dishonestly. Here are some recommendations: Controls are needed for it, there needs to be deterrents, and clear consequences of any dishonest actions. In certain disciplines and major fields of study, pass-fail might be considered over an entire range of assessments

done by qualified “experts” in the field. Using video conferencing software, instructors might give an oral exam face to face and know within a reasonable confidence that the person answering is the student in the course. There could also be a range of assessments that would be formatively evaluated along the way, with human subjective feedback, and then a final subjective summative feedback at the end of the course.

### Tentative Conclusions

In Dew’s (2010) article on the college of tomorrow, he indicates it will be (and is now): “Global, Mobile, Virtual, and Social.” He states there will be more globalization of education and standards will be needed to be set for such global education. Instructional designers will have more of a role than classroom teachers, while much of the content will be digitized. Of course, new advances in technology will change very rapidly how all this is done. Many faculty will diminish their roles as classroom (self-contained) teachers. Many colleges and universities will hire scholar-practitioners as adjunct professors. Full-time faculty will be guardians of knowledge and spend more time researching and publishing in their disciplines. Most of all changing students (maybe as customers) determining their academic courses and schedules to fit with their lifestyles, preferences, and work schedules. Convenience, flexibility, and “best fit” for lifestyles will be the norm. Even traditionally large universities which great traditions in academics and athletics might see decreasing traditional in the classroom enrollment over the next few decades. “Moreover, many institutions will use their residential campus as an organizational glue to hold the institution together (like a corporate headquarters) and as a place to gather a critical mass of full time faculty and administrators” (Dew, 2010). So instead of the human to human, teacher to student, we are in a transformative and new evolutionary age. Synthetic may not be the best descriptor, perhaps the whole world is now in an augmented reality where we have a technology “image” across the whole world providing a new reality?

If you define a *totally automated course of instruction* (no human instructor intervention) we are in the “Innovators or Early Adopters” stage (Diffusion of Innovations, 2017). Ease of use of the software, convenience, cost, choice, flexibility, and learning styles differentiation are among favorable attributes for the automated course. All in all, I believe especially with adult learners it becomes a possible “best fit” for a given lifestyle. In the United States, there are advertisements now which say something to the affect, “let the university or college come to you rather than you going to it.” Can software, hardware, and machines exhibit and imitate “caring” like the most successful teachers? I think not. Even Artificial Intelligence (AI) does not possess cognitive functions or affective domains in their inference engines to perform like a human instructor...yet. With human intervention discourse and commentary with learner can be performed with email and SMS (text messaging). The question becomes can these modalities exhibit “caring” through the written words and sentences or the latent content convey a deeper message of “caring”?

However, momentum is increasing for totally automated courses of instruction. In the United States many people are obsessed with the Smartphone technology, social media, and messaging. Transfer these obsessions to a cost effective, convenient, and social learning online environment and you’ve got a possible critical mass of learners. Self-directed learning for these mature individuals will continue gain momentum in society. Samsung and T-Mobile have announced that around 2019-2020 there will be 5G Mobile available. Specific details are sketchy at this point, but T-Mobile reportedly spent 8 billion dollars to become a major competitor (Kastrenakes, 2017). Early reports state that the 5G Mobile will be 200 times faster than 4G LTE with other advanced functions (such as holographic imaging). So, teachers and instructors might come into one’s personal learning environment as a recorded (or real time) holographic images.

## References

- Critical mass (social dynamics)*. (2017, August 14). Retrieved from Wikipedia:  
[https://en.wikipedia.org/wiki/Critical\\_mass\\_\(sociodynamics\)](https://en.wikipedia.org/wiki/Critical_mass_(sociodynamics))
- Dew, J. (2010, March-April). Global, Mobile, Virtual, and Social: The College Campus of Tomorrow. *The Futurist*, pp. 46-50.
- Dewey, J. (1938). *Experience and Education*. New York: Collier MacMillan .
- Diffusion of Innovations*. (2017, August 14). Retrieved from Wikipedia:  
[https://en.wikipedia.org/wiki/Diffusion\\_of\\_innovations](https://en.wikipedia.org/wiki/Diffusion_of_innovations)
- History of Personal Computers*. (2017, July 13). Retrieved from Wikipedia:  
[https://en.wikipedia.org/wiki/History\\_of\\_personal\\_computers](https://en.wikipedia.org/wiki/History_of_personal_computers)
- Infographic: Growth of K-12 Digital Learning*. (2017, August 14). Retrieved from Connections Academy:  
<http://www.connectionsacademy.com/news/growth-of-k-12-online-education-infographic>
- Internet*. (2017, July 25). Retrieved from Wikipedia: <https://en.wikipedia.org/wiki/Internet>
- Kastrenakes, J. (2017, April 13). *T-Mobile just spent nearly \$8 billion to finally put its network on par with Verizon and AT&T*. Retrieved from The Verge:  
<https://www.theverge.com/2017/4/13/15291496/tmobile-fcc-incentive-auction-results-8-billion-airwaves-lte>
- Moore, M. (1972). Learner autonomy: The second dimension of independent learning. *Convergence*, 76-88.
- Moore, M. (1993). *Theoretical Principles of Distance Education*. (D. Keegan, Ed.) New York: Routledge.
- North American Video Game Crash of 1983*. (2017, July 13). Retrieved from wikipedia:  
[https://en.wikipedia.org/wiki/North\\_American\\_video\\_game\\_crash\\_of\\_1983](https://en.wikipedia.org/wiki/North_American_video_game_crash_of_1983)
- Synthetic*. (2017, June 22). Retrieved from Merriam Webster Dictionary: <https://www.merriam-webster.com/dictionary/synthetic>
- Technology*. (2017, June 22). Retrieved from Wikipedia: <https://en.wikipedia.org/wiki/Technology>
- Thompson, S., Greer, J. G., & Greer, B. B. (2004). Highly Qualified for Successful Teaching : Characteristics Every Teacher Should Possess.
- What are Correspondence Courses?* (2017, August 15). Retrieved from Learn.org:  
[http://learn.org/articles/What\\_are\\_Correspondence\\_Courses.html](http://learn.org/articles/What_are_Correspondence_Courses.html)

Appendix A

Physician Assistant vs. Nurse Practitioner vs. Medical Doctor

Category	Medical Assistant	Nurse (RN, BSN)	Nurse Practitioner	Physician Assistant	Physician (Family Practice)
Prerequisite Education	None	None	Bachelor Degree in Nursing and clinical hours	Bachelor Degree and clinical hours	Bachelor Degree
Learning Model	-	Medical-Nursing	Medical-Nursing	Medical-Physician	Medical-Physician
Time in Classroom	134 hrs	varies greatly by program	500 hrs	1000 hrs	2 years
Time in Clinic	160 hours	varies by program	500-700 hrs	2000 hrs	2 years
Total Post High School Education	1-2 years	2-4 years	6-8 years	6-7 years	8 years
Residency	None	None	None	Optional 1-2 years	3-8 years
Degree or Certificate Awarded	Certificate or Associate Degree	Associate or Bachelor Degree	Master's Degree planned transition to Doctorate	Master's Degree PA-C	Doctor of Medicine (M.D.) or Osteopathy (D.O.)
Recertification	60 education points or exam every 5 years	1000 hours practicing in area of certification or exam every 5 years	1000 professional practice hours and 12 CE credits per year OR exam every 5 years	100 education hours every 2 years and exam every 10 years	MD: 50 education hours/year and ABMS certification recommended
Base Salary U.S	\$29,708	\$66,220 (varies greatly by state)	\$97,990	\$97,280	\$185,151
Independent Practitioner			18 states allow NPs to practice independently		Yes
Complicated or High Risk Cases			Varies	Varies	Yes
Perform Surgery			Assist	Assist	Yes
Deliver babies			Yes	Varies by State	Yes
Write Prescriptions			Yes	Yes	Yes
Prescribe Controlled Substances			Varies by State	Varies by State	Yes
Conduct Physical Exams		Assist	Yes	Yes	Yes
Diagnose			Yes	Yes	Yes
Treat Illness		Yes	Yes	Yes	Yes
Order and Interpret Tests		Assist	Yes	Yes	Yes
Patient Counseling		Yes	Yes	Yes	Yes

*Figure 1.* Source: <https://www.thepalife.com/wp-content/uploads/2012/02/Physician-Assistant-vs.-Nurse-Practitioner-vs.-Medical-Doctor-vs.-Nurse-vs.-Medical-Assistant.jpg>