

A Synthesis of Literature Pertaining to Complexity Theory and Instructional Pedagogies:

Applying Complexity to Promote Successful Classrooms

Ashleigh Meckle

4/12/2016

OVERVIEW

As 21st century schools fall under great scrutiny both from within and from without, there are many influences which impact students' learning. School districts, government officials, family members, and teachers all impact how students learn and grow. While all sources of influence will see brief exploration throughout this review, the review will begin with an evaluation of classrooms as learning systems. It will be argued that classrooms can be classified under this definition since they are intended to be interactive, dynamic communities in which the knowledge of the collective may exceed the learning of individual students. This review will then seek to draw parallels between well-renown work of educational psychologists and philosophers and the collective or emergent behaviors discussed by viewing classrooms as learning system. This portion will focus on the work of highly regarded educational researchers with a specific emphasis on Lev Vygotsky. An exploration of the specific philosophy of constructivism will ensue wherein the role of the teacher will be explained to be a successful facilitator in alignment with complexity thinking. Following an overview of how such educational philosophies may be implemented in the classroom, this review will analyze the goals and applications of the Minnesota Standards of Effective Practices and the content standards set forth by Common Core to determine which portions may or may not be successful in allowing educators to encourage complex interactions in their classroom. Finally, this review will analyze the trends in American education and professional development that have, in some ways, recently allowed for more teacher autonomy and small movements toward the deconstruction of rigid educational hierarchies.

All of this information will be presented through the lens of the growing study of Complexity Theory and its application across many fields of study. The field of complexity theory as it applies to education has thus far been rather limited in its explorations of how to precipitate the conditions to create emergent phenomenon in the classroom. Perhaps this is due to the notion that such instances are infinitely diverse due to the different social patterns and unique conditions of each school. However, this review will seek to synthesize a broad view of effective practices and identify proven theories which may lead to a rise in enriching education with an ultimate focus on empowering students and applying classroom knowledge to the world beyond.

I. CLASSROOMS AS LEARNING SYSTEMS

I.i Section Overview

This section will initially provide clear definitions of learning systems, emergence, and complexity theory. It will then explore the idea that the interacting structures of classrooms, schools, districts, and states impact classrooms in different ways. However, this portion is designed to explore how classrooms themselves create unique opportunities for students to learn communally. The overall will begin with a focus on the students who are the main priority of the education system.

I.ii An Introduction to Complexity in Classrooms

In order to understand how emergent learning facilitates student growth and development, it is essential to begin with an understanding of the basic vocabulary associated with the discussion of complexity theory. The transdisciplinary analysis of the new science of complexity theory focuses on many aspects, and complexity itself is still in many ways an emerging and nebulous subject (Davis & Sumara, 2006). The theory behind this emerging field focuses on the operation of self-organizing organic systems, which often applies to studies of economics, artificial intelligence, and an extensive variety of interactive models which may yield a variety of results (Waldrop, 1992). However, this discussion and application of complexity theory will focus on three main elements. The first will discuss the interactions amongst many smaller, varied agents to create diverse possibilities and interactive systems (Davis & Sumara, 2006). Such agents will largely be viewed as students as they interact with peers and educators in the American education system. The complexity of this element relates to the notion that each student will have a unique classroom experience based on an infinite

multitude of interactions between classmates, educators, and external sources such as familial involvement. The second tenet of complexity theory that will be analyzed will be referred to as emergence, with a particular focus on emergent learning. Emergence is characterized by the unification of various agents to create an ordered system out of potentially infinite and chaotic outcomes (Waldrop, 1992). The following section (Vygotsky, Emergence, and Collective behavior), will seek to respond to the phenomenon of emergence in the classroom. The third key idea associated with this analysis of complexity theory and education will describe how learning systems can develop within the classroom. The premise of a learning system is based on the self-organizing emergence of a unique system that adapts to its surroundings in order to respond to non-linear problems and the intrigue of patterns within an open system (Murphy, 2011). However, exactly the same non-linear characteristics that are fundamental to complexity theory are also the characteristics which disallow broad, sweeping theories to be canonical to educational discourse. Since complexity theory is inherently unique in every system to which it is applied, it must be understood that complexity theory is not a universalizing theory of everything (Davis & Sumara, 2006). Therefore, this review will make its argument based on the foundations that complexity theory is a useful tool to understand the inner workings of classroom education, and it is a lens through which modern pedagogies may seek to improve student learning and application of instructed materials.

The primary focus of the American education system is to further student learning and enrich the minds of those enrolled in K-12 programs. One basic problem with exploring complex phenomena in education derives from the specific structure of

the American education system. There is difficulty in determining what constitutes a learning community that can be analyzed for evidence of such complex or emergent occurrences. Based on previously described definitions, nearly all bureaucratic levels of education may be deemed to have the potential to be complex learning systems.

However, the importance of self-organization is often left out of such definitions, and therefore grades of students that are predetermined by age, schools where students are divided into classrooms with little interaction with those beyond, and districts which are geographically and demographically determined all embody an element of external organization which disqualify them from becoming the hub for true learning systems to occur. Therefore, in order to understand how the lens of complexity theory may be used to encourage productive outcomes, classrooms must first be viewed as the key learning system through which student development takes place.

I.ii Complex Interactions Seen Commonly in the American Education System

In some ways, the perspective of the classroom through the lens of complexity theory and through the eyes of the traditional educational structure are parallel: both views demonstrate the impact of direct interaction between students and teachers, and both acknowledge the importance of creating individual opportunity within this system. For example, traditional views of the classroom are in fact trending toward a reduction in the student to teacher ratio in order to provide more individual support to students, and the lens of complexity theory acknowledges the value of each student or agent in their ability to influence the system around them. Furthermore, classrooms are the main unit which can be used to analyze a regularly interacting group of agents with the

opportunity to create unique learning systems. Self-organization, risk taking, and trust building are three key factors whose presence (or lack thereof) directly impacts the ability or inability of a student to learn (Williams, Mackness & Gumtau, 2012).

Classroom disruptions and the ability of students to self-correct also play key roles in determining how much students will learn and how many opportunities there are to extend the knowledge of the students beyond the classroom (Williams, Mackness & Gumtau, 2012).

Since there are many factors at play in the development of a safe classroom and educational community, it is essential for educators to embrace classroom management strategies which allow students to engage in risk-taking behavior or to allow opportunities for self-organization. In classrooms, student self-organization may take many forms, particularly in social spheres. Experiences through the adolescent years have a great impact on how students perceive themselves and their future ability to succeed academically (Jonassen, 2014). Although the way students interact with one another may at times seem foreign or illogical to educators and on looking adults, their behavior is actually quite simple. They are individual units following a prescribed set of rules: be smart, but never be too smart; be wealthy, but not stuck up; be kind, but not a sycophant, etc. These “rules” often determine the way students group up based on socioeconomic status, and students derive their identities through their place in this system and through their related psychosocial interactions (Sokol, 2009). This form of self-organization parallels Waldrop’s description of boids: each agent acts simply and logically alone, but the group behavior appears complex and difficult to imitate (1992).

Elements of educational psychology and philosophy will further be analyzed in the following section (Vygotsky, Emergence, and Collective Behavior).

These social spheres clearly impact the willingness of students to learn based on the unwritten rules established by classes and peers rather than by educators. However, teachers may use this to their advantage while prescribing group work. There are nearly infinite combinations of how to group students, and their place within groups may affect their performance and the overall classroom environment. The finer pedagogical points of group work to accomplish emergent learning and critical thought are discussed below in the section titled Constructivism and the Philosophy of Education. However, the impact of social groups on the learning system is directly linked to creating a successful classroom climate where students display trust, respect, and a desire to accept challenges and risks. Therefore, it is essential to set a standard of uncertainty within the lesson planning process. An added element of uncertainty through open-ended questions, think pair share activities, group work, etc. allows the establishment of an open discourse between students and with teachers to create trust and respect (Roshe & Anderson, 2006). Based on the establishment of an open classroom environment, educators must lead by example and continue to learn alongside students in order to incorporate themselves into the unique learning system.

II. VYGOTSKY, EMERGENCE & COLLECTIVE BEHAVIOR

II.i Section Overview

This section will provide further examples of how collective behavior and emergent learning impact student experiences. Furthermore, this section will additionally focus on how previously recognized developments in educational research may, at times, parallel the ideals of creating complex learning communities. With its focus on Vygotsky's work, this section will focus on how Zones of Proximal development work to create cognitive dissonance and "aha moments," which may be examples of emergent learning in disguise.

II.ii Constructivism and Complexity Theory Differentiated

The basis of complexity theory requires that nearly unlimited, unpredictable results may rise from any change within unique, nonlinear, dynamic systems (Waldrop, 1992). In this case, it is nearly impossible to use complexity theory from a purist perspective in order to inform instruction. However, each classroom is in fact its own unique organic system with teachers and students acting as specialized agents who may unpredictably change the environment. Therefore, simply applying the broad idea of complexity theory may not specifically guide rational decision making on behalf of the educator. Some of the key elements of the theory state that development and alteration of the system can only occur if changes take place. Each teacher's goal is to allow student habit, interactions, and learning to evolve over the course of the school year in order to meet various social, emotional, and legally binding educational goals.

The main ideas behind constructivism and the work of Vygotsky as well as other renowned educational philosophers and practitioners provide insight into how to make the right changes. While every classroom may be unique and ultimately unpredictable, the scaffolding described by Vygotsky seeks to allow each student to reach their zone of proximal development at a cognitively appropriate time (Knight, 2013). Scaffolding as described by Vygotsky allows a loose structure to be put into place in order to allow students to make progress toward a legally mandated, standardized goal while allowing enough flexibility for each student to make their own jumps (Knight, 2013). This fundamental element of educational philosophy has led to a constructivist revolution in education in which teachers serve as guides to students who ultimately put the pieces together in order to create these “aha” moments of emergent learning. While complexity theory would generally state that anything can happen at any moment within a dynamic system, when this theory is paired with the interactionist philosophy of constructivism, educators receive a more practical insight on how to apply the “anything goes” idea to make the right changes to their classroom systems to ultimately achieve the learning and behavioral goals to which they are legally bound.

II.iii Fundamental Pedagogical Ties to Complexity Theory

With natural and built-in opportunities for complex systems of interactions to develop, the question of what actually emerges from an academic standpoint still remains. As previously discussed, emergence is the idea that the abilities or characteristics of the collective is great than the sum of its parts. This can be seen in the example of how differentiated seating plans or activity groups give rise to new dynamics

and communities within the classroom. Overall, students must be able to take their learning beyond a single subject area and connect it with other areas of study or with examples from their own lives. Therefore, what would ideally emerge is embodied by a non-traditional classroom dynamic, which is the dream of any constructivist seeking students to take building blocks and make them into something greater. Students must be allowed to have choices in their education, be trusted with responsibilities, and have control over their own learning environments.

The requirements of creating an emergence-friendly learning system in the classroom shockingly parallel what educational philosophers have known all along: students learn when they can self-regulate and adapt their views in a non-standardized system. Maria Montessori recognized many years ago that students are oftentimes more capable and competent than educators often give them credit for. Regularly allowing students to take initiative and interact with one another promotes engagement, which is fundamental to creating a complex exchange of ideas. Although such allowances of freedom are obviously beneficial and are becoming more prominent from a pedagogical standpoint, contrary legislative trends (such as No Child Left Behind or Race to the Top) continue incentivizing standardization, which is counterproductive from a complex/emergent standpoint.

However, the educator's burden once again arises as they are called by the American education system to regulate such opportunities for student control and academic discourse. To most educators, this regulation is simply called classroom management. Waldrop reiterates throughout his writing that the functioning of the whole is dependent on the simple behaviors of the cooperative agents operating on a

smaller level (1992). Likewise, the cooperation amongst students is essential to creating a safe, positive environment where students can take risks, and the class can function as a greater learning system. Through incorporating the details and rituals which promote student engagement, oftentimes the classroom and coursework are not centered on the teacher. Student learning and organization of concepts must be initiated by the teacher, responsibility for learning must be assumed by students, and the teacher must serve as a guide and final checkpoint to allow students the liberty to interact with the material in a way that can be applied to their own worldview (Doolittle, 2014). In this respect, the educator's responsibility is to turn over as much learning to students as possible while still teaching within the legislated standards and continue to guide the class. This responsibility, however, is not fulfilled without difficulty.

To revisit the key issue with applying complexity theory to education, it must be recognized that the closed American school system offers little opportunity for such emergent learning to take place. Opportunities must be deliberately implanted by educators, and this can be done in a variety of ways on a small scale with hopes of producing a classroom dynamic which is entirely nontraditional. Students will each be able to bring different pieces of the puzzle which can contribute to the overall learning of the class.

III. CONSTRUCTIVISM AND PHILOSOPHY OF EDUCATION

III.i Section Overview

This section will focus on specific educational philosophies, and argues that constructivism largely parallels the ideal outcomes that have been described as characteristic of complexity implementation. This section also allows for a discussion of the appropriate role of the teacher in systems which are student-centered. The role of the teacher will also help to explain tasks and measures educators can take in order to facilitate productive learning environments. There will also be a brief discussion in the role of families and communication between guardians and educators. It will stress that family interaction is yet another variable in the equation of school success, but it will postulate that parents may serve as an effective periphery community.

III.ii Small-Scale Applications and Environment of Complexity

At times instructional and institutional framework provided to teachers may seem rather discouraging, but there are still smaller scale applications of fostering complex interactions, which may pay great dividends. Coupled with constructivist pedagogies as detailed by Doolittle (2014), complexity theory can still wiggle its way into daily functions of the classroom. Constructivism, in its essence, is focused on allowing students to take “pieces of the puzzle” and construct their own meanings in order to apply and master their learning. This educational philosophy allows the teacher to act as a guide and a facilitator to student learning. Such a methodology allows students to use their teachers as resources in order to master knowledge and interpret it in the context

of their individual lives. Constructivism has its parallel in the world of complexity in a term known as emergent learning:

Emergent learning is likely to occur when many selforganising agents interact frequently and openly, with considerable degrees of freedom, but within specific constraints; no individual can see the whole picture; and agents and system co-evolve. ... Why is it important? Emergent learning is open and flexible, so it is responsive to context and can adapt rapidly. [...However] emergence is not a panacea, it is an option ... it has to be integrated within an overall, inclusive learning ecology, along with prescribed learning. (Williams, Karousou, & Mackness, 2011)

This definition of emergent learning focuses on the deliberate integration of complex pedagogies. Students must be intentionally given the opportunity to explore creative and nontraditional intellectual pathways which may be out of alignment with instructional standards, and which may often lead to figurative dead ends.

Since the nature of complex and constructive pedagogies are contrary to many aspects of the hierarchical system of education, incorporation of such learning opportunities must be deliberate and varied. As any seasoned educator will know, the most fundamental element to effective instruction is flexibility and an ability to differentiate instruction based on the needs of specific students. Differentiation is an essential consideration to all lesson plans, and it often is a criterion present on observation forms and professional development plans.

According to Davis and Sumara, the hierarchical structure of the education system further highlights yet another issue in apply complexity theory to education: much of what is written about complexity theory is written in a descriptive way with little focus on how to *bring about* complex behaviors (2006). However, there are some basic, simple actions educators can take and evaluate as far as creating a workshop for complex, emergent learning to occur. To begin with, students must be able to interact with their environment as well as the students and educators around them. Interactions can be promoted through something as simple as placing desks and chairs in group-work-facilitating patterns such as circles, teams, or tables. Allowing students to collaborate with peers and teachers typically offers the greatest opportunity for student growth and in turn the greatest opportunity for emergent learning (Jonassen 2014). Changes made to seating charts and learning groups can also have complex consequences as student relationships and interactions evolve to adapt. In some respects, the effects of differentiated physical arrangements of the classroom are in themselves an example of classroom emergence where the sum is greater than the whole of its parts. On the surface, configurations of 25 desks are arbitrary. There are 25 desks in the room, regardless of their specific orientation, and there is exactly one for each student. However, the location of the desks, the pairings of the students, and the following interactions work to build a cooperative, or uncooperative classroom environment.

In addition to the physical arrangement of the classroom, establishing classroom rituals is a great way to allow students to adapt to their environment, but such rituals must not hinder the higher-level functioning of the classroom. For example, students

may be in the ritual of taking out their folder, reading book, and a pencil in order to prepare them for class. This ritual would be helpful since it is allowing students to have the tools they need to engage in class without disruption. However, a repeated pattern of note-taking, reading, and quiet work time throughout the class period could become a hindrance if it were implemented daily (Knight, 2013). When routines encourage preparing students to feel comfortable or to take initiative, they are beneficial; when they are detrimental to student interest or motivation, they accomplish the exact opposite goals of emergent learning.

III.iii Classroom Behaviors

Furthermore, many outside factors also have complex influences on classroom behaviors. Perhaps the most notable contributor to classroom behavior and dynamics apart from the school is familial involvement. A student's home life has an acute impact on their motivation level, attitude, and dedication in school, which in turn affects the behaviors of students around them. In an anecdote described by complexity and education researchers Davis and Sumara, parents who read school books along with their students are able to have meaningful conversations on the topic, which can translate to classroom success (2006). Such discussions allow students to evaluate alternative viewpoints provided by their parents, and they are able to understand the material in ways that their peers could not present to them. In finding ways to foster familial involvement, and transitively emergent learning, the burden once again rests on the shoulders of the educator. To an extent, parent-teacher conferences have been a long-standing tradition to encourage this exact same communication. However, a simple meeting once per grading period is not sufficient to engage those outside of the

classroom when they so highly impact student learning. Some teaching tools that are helpful in promoting such interactions include the creation of a class newsletter or webpage to keep families informed. Communication through email may also be an advantageous manner of engaging students and their relatives beyond the classroom.

IV. STANDARDS OF EFFECTIVE PRACTICE & CONTENT STANDARDS

IV.i Section Overview

This section will provides of survey of evaluating whether or not the Minnesota Standards of Effective Practice, Common Core standards, and state-adopted standards ultimately help or hinder the development of good teaching through the lens of emergence and complexity. It will look to identify the specific aims of each set of standards and compare them with the aims of constructivism and previously defined “good teaching.” This section will also use specific examples of these standards to demonstrate that in some cases standards may be beneficial, but generally speaking offer a variety of adherence to an educational frame work based on complexity theory. The standards discussed in this portion are heavily centered on Minnesota-specific information. Finally, this section will briefly analyze opportunities for integrating complexity theory into professional development. This portion will further identify the critical points of teaching with complexity theory that may be beneficial to implement in teacher education programs.

IV.ii Standards and Complexity Theory Alignment

Common Core may be one of the most discussed elements of modern education, and there is often little understanding about the true nature of these standards. Common Core is a set of standards developed by leading content experts and pedagogical experts throughout the American education system. They are not a compulsory element of American education. Since education is considered to be a state-by-state system, federal interference and compulsory mandates are illegal. Although Common Core is not federally mandated, at its peak, the standards were adopted in full

or in part by 47 states and the District of Columbia (Karge & Moore, 2015). According to information provided by the Association for Supervision and Curriculum Development and data collected from announcements based on state departments of education, a small handful of states have reconsidered their adoption of the Common Core Standards and are no longer participating (ASCD, 2016). Minnesota is one of the few states who has only partially adopted the Common Core standards, and the state has accepted them for only English/Language Arts (ASCD, 2016). However a state chooses to adopt the Common Core standards, if at all, it is unavoidable that these standards influence all of American education. They often serve as a baseline for state standards to be created in order to help pull out the important ideas, in a manner of speaking. The Minnesota content standards are affected in this way for all content areas, excluding English/Language Arts. They often serve as a foundation and are reworded to fit the specific aims of each affected state department of education.

While the standards themselves largely serve to provide a curricular framework which identifies key content and skills that are essential to mastery of a given content area, oftentimes, the benchmarks are the true culprits of limiting instruction. An example of this within a state-adopted standard can be seen within Minnesota's Social Studies Standard 6.2.1.1:

People make informed economic choices by identifying their goals, interpreting and applying data, considering the short- and long-run costs and benefits of alternative choices and revising their goals based on their analysis.

Benchmark 6.2.1.1.1 Create a budget based on a given monthly income, real-world expenses, and personal preferences, including enough savings to meet an identified future savings goal.

In this example, provided by the Minnesota Department of Education in their most recent content standard update from 2013, the standard is seen within the first excerpted paragraph. This standard includes a description of what content the student must master. However, the benchmark (6.2.1.1.1) provided as an additional element of standard 6.2.1.1 gives educators a specific task which must be completed in order to assess whether students are meeting this given. To contrast with this style of standard the Common Core Standards for all states are simply *literacy* standards in all content areas, with the primary exception being English/Language Arts. Therefore, an example of a Common Core Social Studies literacy standard for the same 6th grade level would read, “Integrate visual information (e.g., in charts, graphs, photographs, videos, or maps) with other information in print and digital texts” (Common Core State Standards Initiative, 2016). As is evident through the specificity of a secondary Common Core standard compared to a parallel state content standard for the same age student in the same subject, this is an instance where Common Core often takes the fall for being more limiting than it truly is. Therefore, in addition to the common core literacy standards for each subject area, many states also take on specific content standards with specific tasks.

With all of the standards and mandates put into place, are teachers really being allowed the flexibility to create opportunities for divergent thinking and emergence?

Davis and Sumara use this nearly unanswerable question as a basis for exploration

throughout their work. They make the argument that “If one seriously considers the range of theories and philosophies invoked in current discussions of education, it is obvious that there is little agreement on what formal education is doing, much less on what it is intended to do” (2006). As is a recurring theme with the consistency of this formal education, the only real answer is “it depends”. In a previous section, Small-Scale Applications and Environment of Complexity, good teaching was described to be highly differentiated, not only to encourage a variety of open-ended responses, but also to meet the needs of students who perform at different skill levels. While the content standards and benchmarks may specifically limit what is casually called “teachable content,” they only partially limit instructional styles. Based on the previous example of a 6th grade content standard and benchmark, it would seem that creating a budget is a singular task with a singular end: use the given criteria to end up with a personal budget that can be assessed. However, some advocates of standards implementation advocate for a multifaceted approach. Teaching Optimum Topic Exploration (TOTE) is the ultimate goal of the standards; this theoretical approach seeks to explore as many topics as possible and provide breadth to the content area (Karge & Moore, 2015). This theory also implies that there are ways for complexity and unique collective experiences to slip in the cracks left unfilled by a simple cycle through standards in coursework.

The “bottom-up” element of complex systems is trademarked by a collective result being greater than the sum of its parts. For example, in such a budgeting activity, it would be possible for the teacher to group students together with other students who have different life experiences. By giving a group of three or four students a total sum of money that they must divide amongst their needs as they see fit, this invites

opportunities for students to engage in unique behaviors. They will have to account for a variety of personal needs, and each group will likely yield a variety of unexpected results. Furthermore, students must engage in discourse on philosophical and subjective questions such as: what does it mean to be fair? Is equality necessarily the fairest thing? How do you know if what is best for you is what is best for the group? and so on. These questions allow natural differentiation of content and skill based on the unique grouping of students, they are inherent in the negotiating process and therefore provide a foundation for building skills that extend beyond the classroom, they require thought processes at higher levels of Bloom's cognitive domains, and (perhaps essentially) still allow students to meet the standards with a product that can be objectively assessed by the teacher.

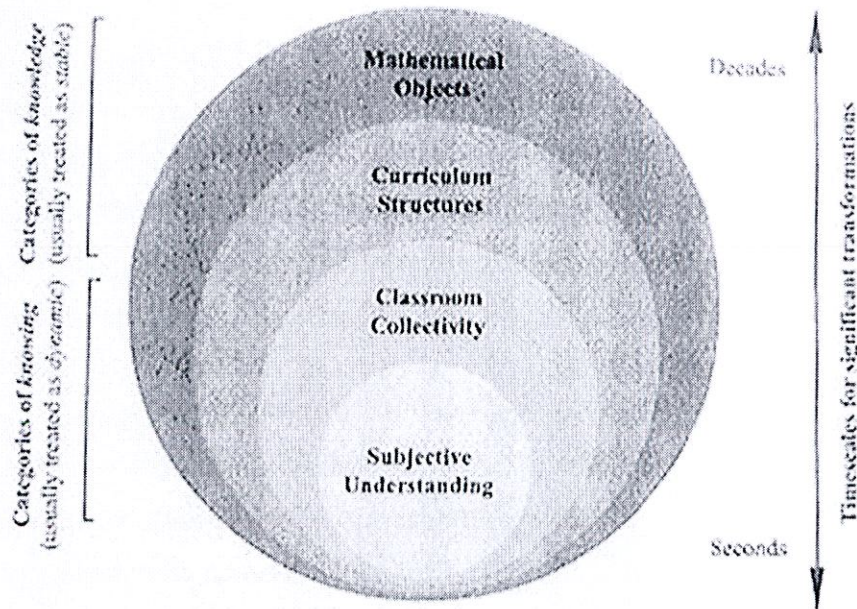
IV.iii Minnesota Standards of Effective Practice

Since a large part of the success of a complexity-gearred education relies on the teacher rather than the content, it can be argued the Standards of Effective Practice are much better indicators of an educator's ability to encourage opportunities unique, applicable, and divergent thinking. While Common Core falsely takes the fall for all content standards created in all states at all grade levels in many mainstream discussions of the American education system, it has been shown that there is still room for excellent, well-differentiated teaching within these rather linear constructs. Such measures do take more time, creativity, and mastery to implement. In other words, educators must be more *effective*. The Standards of Effective Practice are essentially reminders, guidelines, and mandates that must be fulfilled by every teacher throughout their career. Minnesota is unique in the state establishment of these standards, and they

are adopted by the Minnesota Department of Education as a requirement for all teacher candidates to fulfill (Office of Revisor of Statutes, 2016). These standards in themselves encourage the fundamentals of good teaching, and states without a conscious attention to their ideals throughout teacher training programs may not have such reflective and intentional young teachers.

There is an extensive amount of literature available to teachers and students in teacher preparation programs about what is considered “effective instruction”. From design to execution to external influence, what is deemed effective is largely subjective based on the evaluator (Morrison, Ross, Kemp & Kalman, 2010). However, in Minnesota, there are clearly provided definitions. Before being recommended for licensure, each student in a teacher education program must provide written accounts of how they meet each of the 125 competencies (Minnesota Department of Education, 2016). These competencies seek to ensure that emerging teachers are creative, thoughtful professionals. Many of these principles encourage the same tenets encouraged by complexity theory’s application to create thriving classrooms. For example, standard 2 reads as follows: A teacher must understand how students learn and develop and must provide learning opportunities that support a student's intellectual, social, and personal development (Office of Revisor of Statutes, 2016). Such

a



1: Nested Structure of Schools

standard recognizes the necessity of educating the whole child, including the external forces at play when students come to the classroom. The nested structures of schools also indicate the natural complexity of school systems which is often overlooked. This diagram based on the research of Davis and Simmt (2003) demonstrates how the small world of a math classroom fits into the larger forces at play within a school system.

With standards and teachers held largely accountable on an individual basis, this diagram serves as a reminder that those notions should largely be undermined. Many facets of school systems and research in content areas require long, arduous reformation processes. While standards of effective practice serve as wonderful teacher preparation tools, meeting each individual competency will still not guarantee classroom success. Content standards and Common Core Standards often suggest linearity, which can be an impediment to young teacher seeking to allow opportunities for emergence. However,

there is no denial of the inherent complexity and creativity it takes for any educator to successfully integrate a variety of teaching methods into such a multi-faceted system.

V. A MOVEMENT TOWARD COMPLEXITY?

V.i Section Overview

This section will explore modern trends in professional development and seek to identify parallels between what information is given to teachers and what the main tenets of complexity theory would recommend. This final portion will also explore the trend of web- and technology-based learning communities and their growing potential to encourage emergence and complex systems of interaction from afar.

V.ii Professional Development

With Standards of Effective Practice in place in Minnesota, some teachers are receiving key help during the largest professional development opportunity of their career: the teacher preparation program. However, even in states with similar licensure requirements, many young teachers still miss the mark. The fundamental question to find the remedy from a lens of complexity standpoint is “How do we teach teachers about how to encourage divergent learning, paralleling complexity?” With nearly a 50% turnover rate in the first five years, young educators are facing more challenges and setbacks than ever before (Monroe & Blackwell, 2010). However, when teachers learn to deviate from the suggested linearity of standards, legislation, and standardized testing, classroom management takes on its own life. As previously mentioned, the direct

interactions between students and teachers play a large role in creating a cooperative learning environment, which is fundamental for developing a safe place to take risks and engage in abstract thought. Monroe and Blackwell see the development of classroom management skills as a collaborative effort between schools, communities, and teacher preparation programs.

When new teachers enter their student teaching and their first years of teaching, they face a daily “do or die” scenario (Green, 2006). This is perhaps the most difficult and overwhelming point of the teaching career; this scenario takes place immediately, and it often results in premature abandonment of the profession (Johnson, Rice, Edgington, & Williams, 2005). One solution to this increasing problem is to provide students in teacher preparation programs with a skillset in structured questioning (Green, 2006).

Green claims “Teachers must make a variety of decisions, which include: clarifying outcomes, determining content, designing curriculum, devising learning activities, creating meaningful assessments, accounting for students’ different learning styles and needs, and fashioning a climate conducive to learning” (2006). In order to remedy the stress and overwhelming nature of this cornucopia of daily decisions, is to engage in a recursive reflective pattern. Through daily reflection on successes and struggles, adaptations will be made to slowly encourage an evolution of ineffective teaching practices into more practical, effective actions (Green, 2006). Structured questioning is one of the most effective strategies to engage both the student and teacher, and it can be developed based off of an analytical, reflective approach. The idea is largely to ask students low-risk questions that they already have the ability to access a correct answer to. These could be questions based off of personal experience or previously learned

content. Slowly, the teacher can ask more open-ended questions to seek a variety of responses. It also encourages the student-centered model of learning and educating as described in a previous section on constructivism and complexity.

V.iii Online Learning and Opportunities for Emergent Learning

In modern education systems, perhaps a teacher's most marketable attribute is directly linked to their ability to quickly adapt to and adopt a variety of online learning tools to supplement their work in the classroom. The quick adoption of many technological tools and resources has caused much excitement in the educational community. Such a rapid adoption pace requires teachers to be willing to take risks and pursue a growth mindset in a way similar to what teachers often ask students to do. (Kim, Mims & Holmes, 2006). However exciting these new online opportunities may be, teachers must also work to caution their students against a type of false online emergent learning. Citing the example of how 50 million Americans "learned" that Barack Obama is a Muslim, several educational researchers have identified a group think gone wrong scenario (Williams, Karousou & Mackness, 2011). This specific incident provides a strong example of the dangers of not fact-checking online information. However, by the same token, educators can take advantage of online forums to encourage this phenomenon, if they provide and require accurate sourcing (Jansen, 2015). Online forums allow students to privately take positions on critical issues, and have discussions that may not happen in classrooms due to social pressures discussed previously. Suddenly, these opportunities allow students to self-organize into ideologically similar

groups rather than groups based on social class or race. Although media literacy and safety education often take the forefront on discourse concerning technological integration into the classroom, young teachers have a unique opportunity to grow alongside these new innovations to encourage positive forms of emergence from afar.

SUMMARY

In understanding how the ideals of complexity theory can be applied to the American education system and experience, it is essential to not perceive the ideals as a theory at all. Since self-organization of nonlinear, organic systems is inherently unpredictable, it is nearly impossible to establish a theory which clearly dictates under which conditions emergent learning and phenomena present themselves. While at times the nested structures and hierarchical curriculum structures of schools may serve as confining tools while seeking the emergence of self-organizing systems, oftentimes, emergent learning and bottom-up emergence of learning systems may still occur on a small scale.

Many opportunities for complex forms of learning to occur within a single classroom are not dependent on the presence of content or Common Core standards. Oftentimes, these opportunities are based on the individual's aptitude to differentiate instruction and provide increased opportunities for student interactions. However, young teachers must seek to develop these tools early on in their professional development experiences, and early integration into a classroom environment during a teacher preparation program may possibly help hone these skills early on. The ultimate goal of the education system is to teach students how to learn how to learn. When

students experience their “aha” moments as teachers access their zones of proximal development, that ultimate goal is met in a way that reflects complexity’s ideals in the school. While broad, sweeping system reforms may be unattainable in the short term, it is certain that educators can take steps every day to implement these perspectives and get students learning.

Works Cited

- Association for Supervision and Curriculum Development. (2016). Common Core Standards Adoption by State. Retrieved April 7, 2016, from <http://www.ascd.org/common-core-state-standards/common-core-state-standards-adoption-map.aspx>
- Common Core State Standards Initiative. (2016). History/Social Studies Standards Grades 6-8. Retrieved April 7, 2016, from <http://www.corestandards.org/ELA-Literacy/RH/6-8/>
- Davis, B., E. Simmt. (2003) Understanding learning systems: mathematics teaching and complexity science. *Journal for research in Mathematics Education*. 34(2).137-167.
- Davis, B., Sumara, D. (2006). *Complexity and Education*. New York, NY: Routledge
- Doolittle, P. (2014). Complex constructivism: A theoretical model of complexity and cognition. *International Journal of Teaching and Learning in Higher Education*, 26(3). Retrieved From <http://files.eric.ed.gov/fulltext/EJ1060852.pdf>

- Green, K. (2006, Spring). No novice teacher left behind: guiding novice teachers to improve decision-making through structured questioning. *Penn GSE Perspectives on Urban Education*, 4(1).
- Jansen, C. (2015). Teaching practice in the 21st century: emerging trends, challenges, and opportunities. *Universal Journal of Educational Research*, 3(3), 190-199.
- Johnson, D. D., Rice, M. P., Edgington, W., & Williams, P. (2005, Fall). For the uninitiated: how to succeed in classroom management. *Kappa Delta Pi Record*, 42(1), 28-32.
- Jonassen, D. (2014). *Theoretical Foundations of Learning Environments*. New York, NY: Routledge.
- Karge, B., & Moore, R. (2015). Common Core: Teaching Optimum Topic Exploration (TOTE). *Contemporary Issues in Education Research (CIER)*, 8(1), 45-48.
doi:<http://dx.doi.org/10.19030/cier.v8i1.9089>
- Kim, S. H., Mims, C., & Holmes, K. P. (2006). An introduction to current trends and benefits of mobile wireless technology use in higher education. *AACE journal*, 14(1), 77-100.
- Knight, J. (2013). *High-Impact instruction: A framework for great teaching*. Thousand Oaks, CA: Corwin.
- Minnesota Department of Education. (2011). 2011 Social Studies State Standards [PDF]. MDE.

Monroe, A., Blackwell, S., & Pepper, S. (2010, Fall). Strengthening professional development partnerships while bridging classroom management instruction and practice. *Professional Educator*, 34(2).

Morrison, G. R., Ross, S. M., Kemp, J. E., & Kalman, H. (2010). *Designing effective instruction*. John Wiley & Sons.

Murphy, D. (2011, November). "Chaos Rules" Revisited. *International Review of Research in Open and Distance Learning*, 12(7), 116-134.

Office of the Revisor of Statutes. (2016). *Minnesota Administrative Rules*. Retrieved March 20, 2016, from <https://www.revisor.leg.state.mn.us/rules/?id=8710.2000>

Roshe, S., & Anderson, T. (2006). Design patterns for complex learning. *Journal of Learning Design*, 1(3), 82-91.

Sokol, Justin T. (2009). "Identity Development Throughout the Lifetime: An Examination of Eriksonian Theory," *Graduate Journal of Counseling Psychology*. 1(2).

Waldrop, M.M. (1992). *Complexity: The emerging science at the edge of order and chaos*. New York, NY: Simon and Schuster.

Williams, R., Mackness, J., & Gumtau, S. (2012, October). Footprints of emergence. *International Review of Research in Open and Distance Learning*, 13(4), 49-90.