

A Perspective on Exploring the Terrain of the Middle Level

G. Nathan Carnes, Ph.D.

University of South Carolina

Primary Intention

One of the primary purposes of colleges and schools of education is to prepare teacher candidates who will make contributions students' learning in significant and impactful ways. To this end, the National Science Teachers Association ([NSTA], 2012) makes several recommendations preparing teacher candidates that include the following:

- understanding and articulation of knowledge in practices of contemporary science;
- understanding of how students learn and develop scientific knowledge with particular emphasis on scientific inquiry to develop this knowledge for all students;
- ability to plan in a way that engages all students in the learning process by setting appropriate goals which are consistent with how those students learn science and in a way that is consistent with state and national standards;
- ability to collect, organize, analyze, and reflect on a variety of assessments to demonstrate positive impact on science learning; and practices associated with professional development, leading to increased knowledge and understanding of constant changes with regard to content and pedagogical matters.

For the most part, it appears that there are a sufficient number of resources that enable science teacher educators to reach these NSTA goals. At the same time, there are opportunities to incorporate middle level education scholarship to further understanding of preparing science teacher candidates to impact young adolescent learners. The purpose of this short position paper seeks to review some middle level philosophical principles that have implications to this end.

The success of impacting middle level teacher candidates' knowledge and abilities to teach science relies significantly on a knowledge and application of middle level education research. Middle level proponents argue that middle school students are unique in the way they

develop and learn. Specifically, these young adolescents undergo significant changes during this point in their lives with regard to physical, intellectual, emotional, psychological, and moral developments (Association of Middle Level Education [AMLE], 2010). The number and extent of these transformations and are only second to those that children ages birth- four undergo (AMLE, 2010, Davis Powell, 2015). However, infants and toddlers are not as aware of their development, as are young adolescents (AMLE, 2010). At the same time, middle schools are staffed with classroom teachers who have little or no knowledge of young adolescents or of other factors that lead to effective education at this level. Judging from the scant attention that the science education community gives to middle level philosophy and a focus on the unique characteristics and needs of students in this age range, there is a need for deeper inquiries into innovations and challenges that educators and the education community face. Therefore, a more thorough understanding of the middle school concept is important to science teacher educators and researchers alike. Additionally, a deeper understanding of middle level philosophy opens new frontiers to science education research.

My Vexation

Mertens, Flowers, & Mulhall (2005) and White, Dever, & Jones (2013) indicated a paucity of research on how middle level teacher graduates implement middle school tenets exists. A search of the ERIC Academic Search databases suggest that attention to middle level ideals with regard to science education is even less. For example, a search for Journal of Science Teacher Education articles yielded 71 hits as compared to 27,506 hits generated by a search for “middle level”. For at least one reason, the relatively small number of contributions is understandable; the science education focus is much more narrow. As described later in the

paper, the relatively small number of research is not really the main issue; it is the limited treatment that middle level nuances and issues receive in consideration of science education.

Within the first consolidated review of science education research (Gabel, 1994), Helgeson (1994) provided an overview of problem solving, as it related to science education in middle school learning environments. Throughout his chapter, he uses “middle school” and “junior high school” interchangeably. A review of science education studies that briefly highlight participation of middle school students and/or teachers suggest that he is not alone in this practice. Based on the work of William Alexander (a middle school pioneer) and other contributors, the use of these designations is an oversight and perpetuates a myth that the two institutions are synonymous (Davis Powell, 2015; Manning, 2000). Drawing from the original *Turning Points* (Carnegie Council on Adolescent Development, 1989), there are significant differences between the junior high and middle schools. For example, junior high schools are subject-centered while middle schools are designed to focus on developing the whole being of students. Junior high schools organize teachers into subject- based departments while middle schools organize teacher and students into interdisciplinary teams. Part of the day within a junior high includes a “study hall” or “homeroom period”. In contrast, the middle school schedule provides time for an “advisory” that promotes opportunities during which teachers and school staff provide guidance to students and foster advisee/advisor relationships.

Appleton (2007), synthesized studies related to teaching science in elementary school and extended his review to middle schools, institutions who served learners aged 10- 15. In doing so, he acknowledged that much of the research on science teaching and learning was conducted in middle school contexts. To name a few, contributions by Bulunuz, Bulunuz, & Peker, (2014); O'Neill, Yamagata, Yamagata, , & Togioka (2012); Segedy, Biswas, & Sulcer, (2014); and

Yager, & Akcay (2008) confirm his point; but fail to provide much insight into what characterizes the school, student, and/or teachers as middle school. This is not to criticize the quality of their studies and point out technical flaws. To the contrary, these scholars have contributed to science teacher education in meaningful ways. At the same time, there is richness and a deeper understanding of how science education fits within middle level learning environments and why certain innovations or interventions fare well while others do not.

This vexation is further magnified by the many instances in which preparation to teach middle level science is blended within an elementary/middle or a middle/high school science methods course. Judging from science methods texts, it appears that the major education components of an effective middle level program is diluted or skirted. I will revisit this argument later in this paper, also. Sun Tzu, a Chinese warlord, stated, "if you know the enemy and know yourself, your victory will not stand in doubt..." (Sun Tzu & Clavell, 1983). The application of these words of wisdom is not intended to characterize our teacher candidates or their future students as enemies. Instead, the analogy speaks to the depth to which we know our candidates and their future students, the academic successes for which we strive will be certainly attainable. If we know our students and our ability to reach them, there is no doubt that we will be successful in our endeavors.

A Glimpse at Middle Level Philosophy

Although an appreciable amount of science research has been situated in middle school environments, it is important to consider the philosophy that those institutions might embrace. It is possible that the "Middle School" distinction is no more than the name posted above the door. The AMLE promotes views and strategies that draw from a research a broad experience base that substantiates what is developmentally responsive for this group of learners. In doing so, this

professional organization acknowledges that every young adolescent learner may not be ready to master specific concepts or content within a specific time period. Yet the belief that the development of an education program that offers diverse and meaningful experiences is attainable (AMLE, 2010).

While NSTA recommendations and science education research contributions are consistent with the Association for Middle Level ([AMLE], 2012) teacher preparation standards, middle schools encompass much more than a specific grade and/or age range. Middle level philosophy is grounded in an understanding of the unique nature of young adolescent development, how educators respond to those needs, and the many ways in which they interact with their students in ways that are not necessarily quantifiable (Jackson & Davis, 2000; National Middle School Association, 2010; Powell, 2015). Furthermore, young adolescent learners undergo an unprecedented multiplicity of changes.

Middle level proponents argue that middle school students are unique in the way they develop and learn and that schools are staffed with classroom teachers who have little or no knowledge of young adolescents or of other factors that lead to effective education at this level. Teacher preparation programs, state departments of certification, and the education profession must share the blame for this dilemma (Swaim & Stefanich, 1996). Therefore, a deeper understanding of the middle school terrain is important to science teacher educators and researchers alike.

Recently, the Association for Middle Level Education (AMLE) revised its teacher preparation standards around five (5) major tenets:

- Standard 1: Young Adolescent Development- an understanding of major concepts, principles, theories, and research connected to young adolescent development and an ability to support students' development and learning.
- Standard 2: Middle Level Curriculum- an understanding and use of central concepts, tools of inquiry, standards, research, and content knowledge to plan and implement curricular material that develops students' competence in the subject matter.
- Standard 3: Middle Level Philosophy and School Organization- an understanding of major concepts, principles, theories, and research that underlie philosophical foundations of developmentally responsive middle level programs and schools; and an ability to work within these organizational components.
- Standard 4: Middle Level Instruction and Assessment- understanding, use and reflection on major concepts, principles, theories, and research related to data-informed instruction and assessment; inclusive of the use of a variety of developmentally appropriate practices for meeting diverse students' needs.
- Standard 5: Middle Level Professional Roles- understanding the complexity of teaching young adolescents and engagement in practices and behaviors that develop professional competence (AMLE 2012; Davis Powell, 2015).

For each of these standards, there are two to four elements that illuminates the scope of the expectation, an explanation, scholarly references that form the basis for the expectations, and a scoring rubric that can be used to determine levels of competence. For example, Standard 4, Middle Level Instruction and Assessment consists of the following four elements:

- Element a. Content Pedagogy: a knowledge of instruction and assessment strategies that are especially effective in the subjects taught.

- Element b. Middle Level Instructional Strategies: employment of a wide variety of effective teaching, learning, and assessment strategies that include technologies to encourage exploration, creativity, and information literacy skills (e.g., critical thinking, problem solving, evaluation of information gained) in a way that actively engages young adolescents in their learning in culturally and personally relevant ways.
- Element c. Middle Level Assessment and Data-informed Instruction: development and administration of a variety of assessments (i.e. diagnostic, formative, and summative) to create meaningful learning experiences and adjust instruction based on the knowledge gained.
- Element d. Young Adolescent Motivation: demonstration of the ability to motivate all young adolescents and facilitate their learning through a wide variety of developmentally responsive materials and resources (e.g., technology, manipulative materials, information literacy skills, contemporary media).

A Brief Consideration of Science Methods Texts

For the past several years, my teaching responsibilities have included a middle level science methods course (not blended with elementary or high school science). In my search of a textbook that seemed most useful to my middle school preservice teachers, I sought out a resource that was well aligned with the AMLE standards and incorporated the NSTA major tenets. Among several texts that were available for adoption, there were promising prospects with specific strengths. For example, Carin, Bass, & Contant (2004) provided a very simple overview of the history of science education and emphasize questioning skills associated with critical thinking. As this text was written for elementary and middle level teacher candidates, the its content seems very useful for supporting the development of middle level preservice teachers’

competence with regard to middle level instruction and assessment. Bentley, Ebert, & Ebert (2000) synthesize instructional practices that enhance conceptual learning and provide a thoughtful presentation on how teachers might use interviews to gain insight into elementary and middle school students' misconceptions. Howe (2002) presents a variety of teaching and assessment methods to engage elementary students as active learners. Koch (2009) drew upon the premise that there is a "childhood scientist" in everyone, touching on several practical ways to engage elementary and middle level learners in science education. Kracjik & Czerniak (2007) offered a project-based approach to science teaching and learning that coincides with the flavor throughout the Next Generation Science Standards (Achieve, 2013). Gallagher (2007) weaves content knowledge throughout his discussion of practical ways to make science learning relevant to middle level and high school learners, as do Chiapetta & Koballa (2009). Settlage & Southerland (2012) share a combination of content and pedagogical knowledge to help teacher candidates understand ways to reach a diverse group of students, particularly in light of language diversity.

As these texts were written for elementary and middle level or middle level and secondary teacher candidates, the content of each text seems very useful for supporting the development of middle level preservice teachers' competence with regard to middle level instruction and assessment. There is no specific mention of major concepts, principles, theories related to young adolescent development or middle level curriculum, With that said, most of the elementary/middle level texts do address interdisciplinary or integrated curriculum issues and strategies. On the other hand, Davis Powell (2012) does provide a thorough overview of the middle level curriculum and a very brief glance at science standards within one chapter. Instruction and assessment strategies that are generic to all content areas are presented in two

other chapters. To some degree, there is an overlap between these chapters and those that appear in the science methods texts.

My Venture

Most recently, I have adopted the practice of using the NSTA Learning Center that provides me with flexibility to expose middle level teacher candidates to best science teaching practices and science content knowledge in a way that builds upon a foundation laid in a previous middle level course that addressed middle level philosophy and behavior management competencies. My teaching experiences and interaction with middle level teacher candidates have served as the impetus for this proposed position paper. As the candidates gain experiences with middle level students and increased exposure to science standards that dictate what they must teach, they raise questions about how to engage young adolescent learners in meaningful ways, particularly those who have a strong dislike for school and/or science content. Some of their questions have included the following:

- “How do I teach my students about the relationship between era, epoch, and period in a way that is relevant to them?”
- “How can I motivate my students to learn about the difference between mixtures and solutions without lecturing to them about it? My coaching teacher lectures to them a lot and they tell me how boring it is to listen to her.”
- “I’m still trying to get ready for the lesson I have to teach tomorrow. I talked yesterday with my science coaching teacher, and I think I’m just more confused now. Are you by any chance in your office still? If not, I completely understand. This is super last minute!”

My experiences with creating a resource for a science methods class is limited to assembling a custom text that consists of chapters drawn from existing texts. The fact that there are circumstances and conditions associated with authoring or editing a text is readily apparent. Besides, there would be no need for multiple texts if one resource contained all that a teacher candidate would need to know. At the same time, science teacher educators can improve their support of middle level teachers' preparation by familiarizing themselves with the AMLE teacher preparation standards. The implications include, but not limited to:

- provision of opportunities in which candidates connect planning activities to a thorough knowledge of intellectual, physical, social, emotional, and moral characteristics, needs, and interests of young adolescents
- implementation of curriculum and instruction that is responsive to young adolescents' personal histories, language/dialects, and individual identities (e.g., race, ethnicity, culture, age, appearance, ability, sexual orientation, socioeconomic status, family composition)
- application of a knowledge of young adolescent in creating and maintaining developmentally responsive learning environments that support science learning with attention to effective middle level school organizational practices such as interdisciplinary team organization and advisory programs.

Final Remarks

The intent of this position paper is to draw the attention of science teacher educators who are interested about the preparation of middle school science teachers to the AMLE teacher preparation standards. Young adolescent students are unique to elementary and high school students with regard to developmental issues that they face. Although they are very curious about

the world around them and the people within their lives, they are not necessarily interested in the content that they are required to learn. It is incumbent upon science teacher educators to help teacher candidates develop awareness of the nuances associated with this age group and to competencies through which they might have a positive impact on these students. As stated earlier, "if you know the enemy and know yourself, your victory will not stand in doubt..." (Clavell, 1983). In the context of middle level science teacher preparation, the application of these words of wisdom challenges us to know our teacher candidates and the middle level education terrain upon which they must navigate.

References

- Achieve Inc. 2013. *Next generation science standards*. Washington, DC: National Academies Press.
- Association for Middle Level Education (AMLE). 2010. *This we believe: Keys to educating young adolescents*. Westerville, OH: Author.
- Appleton, K. (2007). Research on cultural diversity in the classroom. In S. Abell & N. Lederman, (Eds.), *Handbook of research on science education*, (pp. 558-576).
- Bentley, M. L., Ebert, C., & Ebert, E. S. (2000). *The natural investigator: A constructivist approach to teaching elementary and middle school science*. New York: Wadsworth Publishing Company.
- Bulunuz, N., Bulunuz, M., & Peker, H. (2014). Effects of formative assessment probes integrated in extracurricular hands-on science: Middle school students' understanding. *Journal of Baltic Science Education*, 13(2), 243-258.
- Carin, A. A., Bass, Contant. (2001). *Teaching science through discovery* (10th ed.). New York: MacMillan Publishing Company Education, 75(1), 9-21.
- Carnegie Council on Adolescent Development. (1989). *Turning points: Preparing American youth for the 21st century*. Washington, D.C.: Author.
- Chiapetta, E. L. & Koballa, T. R. (2009). *Science instruction in the middle and secondary schools: developing fundamental knowledge and skills* (7th edition). Upper saddle River, New Jersey: Pearson Prentice Hall.
- Davis Powell, S. (2015). *Introduction to middle level education* (3rd edition). Boston: Pearson Education Inc.

- Gabel, D. L. (1994). *Handbook of research on science teaching and learning*. New York: MacMillan Publishing Company.
- Gallagher, J.J. (2007). *Teaching science for understanding: A practical guide for middle and high school teachers*. Columbus, OH: Merrill/Prentice Hall.
- Helgeson, S. L. (1994). Research on problem solving: Middle school. In D. L. Gabel, (Ed.), *Handbook of research on science teaching and learning*, (pp. 248-268).
- Howe, A. C. (2002). *Engaging children in science* (3rd ed). Upper Saddle River, NJ: Prentice Hall.
- Jackson, A. W., & Davis, G. A. (2000). *Turning points 2000: Educating adolescents in the 21st century*. New York, NY & Westerville, OH: Teacher College Press & National Middle School Association.
- Koch, J. (2009). *Science stories: Science methods for elementary and middle school teachers*. Belmont, CA: Wadsworth Cengage Learning.
- Kracjik, J. & Czerniak, C. (2007). *Teaching science in elementary and middle school: A project-based approach* (3rd ed.). New York: Lawrence Erlbaum Associates.
- Manning, M.L. (2000). A brief history of the middle school. *The Clearing House*, 73(4), pp. 158-160.
- Mertens, S., Flowers, N, & Mulhall, P. (2005). How does middle grade teacher certification affect teacher practices and student learning? *Middle School Journal*, 36(5), 56-61.
- National Middle School Association. (2010). *This we believe: Keys to educating young adolescents*. Westerville, OH: Author.

- National Science Teachers Association. (2002). *An NSTA position statement: Elementary school science*. Accessed on June 12, 2007 at <http://www.nsta.org/about/positions/elementary.aspx>.
- O'Neill, T., Yamagata, L., Yamagata, J., & Togioka, S. (2012). Teaching STEM means teacher learning. *Phi Delta Kappan*, 94(1), 36-40.
- Segedy, J. R., Biswas, G., & Sulcer, B. (2014). A Model-Based Behavior Analysis Approach for Open-Ended Environments. *Journal of Educational Technology & Society*, 17(1), 272-282.
- Settlage, J. & Southerland, S. A. (2007). *Teaching science to every child: Using culture as a starting point*. New York: Routledge.
- State Department of Education, 2014 (entry disguised and truncated to facilitate blind review).
- Sun Tzu & Clavell, J. (1983). *The art of war*. New York: Delacorte Press.
- Swaim, J. H., & Stefanich, G. P. (1996). *Meeting the standards: Middle level teacher education*. Columbus, OH: National Middle School Association.
- White, P. M., Ross, D., Miller, J., Dever, R., & Jones, K. A. (2013). Ohio's Middle Childhood Licensure Study. *Research In Middle Level Education Online*, 37(1), 1-22.
- Yager, R. E., & Akcay, H. (2008). Comparison of Student Learning Outcomes in Middle School Science Classes with an STS Approach and a Typical Textbook Dominated Approach. *Research In Middle Level Education Online*, 31(7), 1-16.