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Journal of College Science Teaching

- Preparing future faculty to use active learning approaches
- Improving the science self-efficacy of preservice teachers
- Using clickers for deliberate practice in large science courses

NSTA National Science Teachers Association

Journal of College Science Teaching

...a Peer-Reviewed Journal Published by the National Science Teachers Association

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Read the study on page 7 that examines the effectiveness of a curriculum on preservice teachers' attitudes and knowledge of evolution and the legalities of teaching it. Are you working to integrate case studies into your classroom? If so, you won't want to miss the article in the Case Study column on page 37 by a veteran case study teacher that provides a tool kit with 10 "tools" for managing a case study classroom effectively. Despite overwhelming scientific consensus, certain controversial scientific conclusions are often rejected by nonscientists. On page 46, see the article that explores the connection between student identity and the acceptance of certain scientific conclusions.

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FEATURES

DEPARTMENTS

ALSO IN THIS ISSUE

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Preparing Preservice K–8 Teachers for the Public School: Improving Evolution Attitudes, Misconceptions, and Legal Confusion

By Ashley R. Vaughn and Jennifer R. Robbins

Evolutionary theory is a central tenet of biological science, and it is essential for all science teachers, early childhood through secondary, to have a clear understanding of not only the science behind evolution, but also the legal precedents for teaching evolution in the classroom. This study examines the effectiveness of a curriculum on preservice teachers' attitudes and knowledge of evolution and legalities of teaching it. We used a curriculum designed to encourage conceptual change with two cohorts of preservice teachers. The second cohort was also assigned a research paper on legal issues surrounding evolution in the classroom. Our analysis supports the effectiveness of this curriculum in fighting misconceptions and improving attitudes, with a further boost from the assigned paper. These findings support prior work showing direct confrontation of misconceptions is effective in generating change. It is important for teachers to have not only a firm grasp on the content they will teach, but also a clear understanding of the laws regarding the teaching of this content. Our findings support the need for direct instruction for preservice teachers on the legality surrounding "controversial" educational topics.

Although science teachers have a responsibility to educate students on evolutionary theory, current research has indicated that many teachers do not value evolutionary theory, do not understand the role of evolution within the curriculum, and in some cases do not believe evolution should be taught in school (Losh & Nzekwe, 2011; Nadelson & Nadelson, 2010). Preservice teacher (PST) beliefs toward pseudoscience and evolution approximately align with the general public (Losh & Nzekwe, 2011). In 2014, over 40% of Americans believed humans were created in their present form (creationism), 31% believed humans evolved with guidance from God (intelligent design), and only 19% believed humans evolved without God (Newport, 2014). Encouragingly, acceptance of evolutionary theory increased 10% in the past 2 decades (Newport, 2014); however, widespread misconceptions remain (Losh & Nzekwe, 2011). Schools and teachers have a significant role in correcting these misconceptions, yet specific knowledge, attitudes, and beliefs of K–8 PST about evolution have not been well reported.

K–8 and special education PST may not expect to teach evolutionary theory; however, as more states adopt the *Next Generation Science Standards* (*NGSS*; NGSS Lead States, 2013), pressure increases to introduce these concepts in an age-appropriate manner. Evolutionary theory serves as a *NGSS* Disciplinary Core Idea (DCI) beginning in 2nd grade (2-LS4 Biological Evolution: Unity and Diversity; NGSS Lead States, 2013). DCI are themes or ideas central to science disciplines, serve as organizing concepts and tools for understanding key ideas and solving problems closely related to societal concerns, and can be taught to a wide range of grades and depths.

Nadelson and Southerland (2010) discussed the need for increased education on macroevolution to further knowledge, acceptance, and belief, having demonstrated that acceptance of evolution and understanding of macroevolution are significantly correlated. Prior research has indicated a significant correlation between biology majors' microevolution knowledge and evolution acceptance (Nadelson & Southerland, 2010; Southerland & Sinatra, 2005). Others have effectively used inquiry-based instruction to foster significant gains in acceptance and knowledge of evolution among undergraduate nonscience majors (Robbins & Roy, 2007).

All citizens benefit from increased science understanding, but public school teachers have an additional responsibility: communication of science in a religiously neutral way. Procreationist groups have promoted standards and lesson plans to "Teach the Controversy," encouraging the public to see creationism and evolution as equally valid choices in a menu of possible scientific explanations for diversity of life (Meyer, 2002; Mitchell, 2012). Although teaching

creationism is illegal in U.S. public schools, many teachers still include creationism or "evidence" that evolution is incorrect in their curricula (Moore, 2004, 2008). Moore (2004) found four factors influencing teachers' evolutionary theory instruction: pressure to teach creationism or avoid evolution; teachers' acceptance of creationism and rejection of evolution; teachers' lack of knowledge about the law; and teachers' religious beliefs. Almost 30% of biology teachers think there are places in the United States where teaching evolution is a crime. Twenty-eight percent believe both evolution and creationism can be taught in the classroom if students, parents, and administrators desire (Moore, 2004). Explicit legal instruction for education majors would seem to be merited.

We contend it is essential for science teachers not only to be fully prepared for grade-level appropriate evolutionary theory content, but also to have a clear understanding of both legal and ethical issues surrounding teaching evolution in the classroom. Here we analyze misconceptions, attitudes, and beliefs of preservice K–8 and special education teachers enrolled in a college life sciences class restricted to education majors. We describe a transformative curriculum geared toward conceptual change and assess its effects on evolutionary thinking. Finally, we report on PST opinions, before and after course, about the place of evolution, creationism, and intelligent design in the classroom.

Method

We used a nonequivalent control group quasi-experimental design (Creswell, 2014). We chose this design because our study was a classroom-based intervention conducted over two cohorts. As a requirement for their degree, PST took the course in sequence with overall major course load and could not be randomly assigned to control (fall 2012) and experimental (fall 2013) groups.

Participants

Participants included two cohorts of PST enrolled in an Introductory Biology course specifically created for early and middle childhood PST. More than 90% of the PST in each cohort were majoring in early childhood, middle childhood, Montessori, or special education. More than 90% were female students ages 18 to 22. The 2012 cohort (n = 26) had one more participant than 2013 (n = 25).

Setting

The setting for this study provides an important context for both curricular need as well as pedagogical approach. As a small, Midwestern Jesuit institution, Xavier University encourages faculty to teach within the Ignatian tradition. Ignatian pedagogy encourages educators to facilitate student understanding in a personally relevant manner, incorporate interreligious understanding, explore the interface between faith and culture, focus on comprehensive liberal arts education, integrate knowledge across disciplines, and encourage critical and analytical problem solving (Xavier University, 2017).

Curriculum

Building on growing recognition that targeted analysis of misconceptions (including religious misconceptions) is necessary for understanding and acceptance of evolution (Heddy & Nadelson, 2013; Manwaring, Jensen, Gill, & Bybee, 2015; Nadelson & Southerland, 2010; Robbins & Roy, 2007), we developed a curriculum that directly confronted creationism and intelligent design while teaching the evidence and mechanisms behind the science (Table 1). Developed on the basis of the Ohio Science Standards (Ohio Department of Education, 2003) and prior evolution inquiry curriculum (Robbins & Roy, 2007) the curriculum required an hour of segmented preclass video lectures and homework questions daily. K–8 science texts were available for reference, reinforcing relevance. Other resources included the BBC series *Planet Earth*, PBS documentaries *Intelligent Design on Trial* and *Guns, Germs and Steel,* and text of Supreme Court cases.

In 2012, the curriculum was deployed as described in Table 1. A 280-page workbook created by the second author was used instead of a textbook. In the second year (2013 cohort), PST were additionally required to write a 3- to 5-page paper about the legal and philosophical basis of teaching evolution in public-school classrooms. This assignment required students to summarize legal and scientific reasoning behind:

- why evolution is a required topic in K–12 academic standards;
- why creationism, ID, or other such ideas can't be taught in public school science classes;
- why evolution can't be singled out as particularly doubtful among other scientific theories; and
- at least one more issue about evolution and teaching (student choice).

To do this they read multiple Supreme Court decisions (*Epperson v. Arkansas*, 1968; *McLean v. Arkansas Board of Education*, 1982; *Edwards v. Aguillard*, 1987; *Peloza v. Capistrano School District*, 1994; *Kitzmiller et al. v. Dover*, 2005), as well as other reputable sources, such as major news outlets, published books, peer-reviewed papers, and websites or journals of reputable scientific, religious, or educational associations.

PST were taught central tenets of biology, using inquiry and evolution throughout (Table 1). Before learning the evidence and mechanisms of evolution, PST read and discussed statements from religious organizations endorsing evolution and from religious scientists discussing how they reconcile their beliefs (Sinclair & Pendarvis, 1997). They also heard guest lecturers from theology (2012)

TABLE 1

Curriculum for a one-semester, evolution-intensive life sciences course for K–8 education majors.

Day(s)	Topics	Activities
Unit 1. Basic Biology and Scientific Inquiry		
1	Inquiry and the scientific method	G: Tree of Life (pre; lesson = '20 questions' is easier with tree-thinking) I: Is it Alive?
2	Guesses, hypotheses, theories, laws	
3	Matter and energy	A: Judge the Science Fair A: Food Web Explorers A: Biome in a Bottle
4	Classification of living things	
5	DNA, protein, and reproduction	A: Popbead Mitosis I: Cells in Action I: What's in an Onion Root? G: The Bear Facts (coin-flip/elimination game on simulating natural selection)
6	Evolution: The conflict that isn't (confronting preexisting misconceptions)	
Unit 2. Evolution		
7	Understanding phylogenies	I: The Dawn Horse I: Animalicules A: How Many is a Billion?
8	Exam 1	
9	Anatomical and geographical evidence	F: Natural History Museum
10	Fossil evidence	
11	Mechanisms of selection	I: Whales in the Making F: Local Fossil Bed
12	Mechanisms of speciation	
Unit 3. Nonanimal diversity		
13	Unicellular life	I: The Resistance Movement I: Observing Unicellular Life
14	Exam 2	
15–19	Plant Diversity, Plant Organs, Fungi	Many mapping metabolic and reproductive structures onto basic cladograms, walkabouts.
Unit 4. Animal diversity		
20–25	Invertebrate diversity, invertebrate organs, vertebrate diversity, vertebrate organs, Exam 3	See above, plus dissections
Unit 5. Integration		
27	Primate and human evolution	
28	Impacts on human society	G: Commodities Trading A: Tree of Life (post)
29	Our changing planet	A: Nutrient Cycling Through the Ages I: Biome in a Bottle wrap-up

Note. Developed based on 2003 Ohio Science Standards and prior evolution inquiry curriculum (Robbins & Roy, 2007). Each day required ~1 hour of segmented preclass video lectures and ~1 hour of homework questions. Alternating 3- and 1-hour classes opened with an individual quiz the team then took again, followed by discussion questions and activities for the teams. Diverse K–8 science texts were kept on hand for preschool teachers to refer to, reinforcing relevance. Other resources included the BBC series Planet Earth; the PBS documentaries Intelligent Design on Trial and Guns, Germs and Steel; and the text of multiple Supreme Court Cases. Key: A = activity; G = game; F = field trip; I = inquiry.

and philosophy (2013) speak about different benefits and purposes of myth and science, truth, and fact. Throughout, a respectful attitude toward religion was maintained in the classroom.

Surveys

We adapted an instrument designed to measure attitudes toward science in PST (Norby, 2003; Weinberg, 1998). On the first and last day of class, we administered a Likert-scaled survey (Table 2; 1 = *strongly agree*, 5 = *strongly disagree*) asking PST to indicate levels of agreement with statements concerning science and evolution. Participation was voluntary and anonymous. Independent and paired samples *t*-tests were used to compare survey item scales. Although Likert items are ordinal, scales of Likert items are not (Carifio & Perla, 2008); further, Norman (2010) and de Winter and Dodou (2010) previously established that the use of parametric procedures are no more likely to have Type I error in Likert scales than nonparametric procedures.

Results

Preconceptions about evolution

We found, on average, PST in both years held slightly positive attitudes about evolution (2012 $M = 2.61$; 2013 $M = 2.49$), and independent samples *t*-test results were not significantly different between years (Table 2, Figure 1A, $p > .05$). Among misconceptions identified as key to educators (Understanding Evolution, available at http://evolution.berkeley.edu), most common were: evolution is inadequate, most of what we know comes from Darwin, individuals adapt, and "only the strongest survive," consistent with prior research (Robbins & Roy, 2007; Rutledge & Mitchell, 2002). PST overall had slightly positive attitudes toward evolution. However, 31% of PST agreed and 25% disagreed with a statement of relativistic fallacy ("It doesn't matter whether one thinks evolution is correct; it's just an opinion either way").

When asked about their beliefs, 28% agreed with the statement "Evolution is almost certainly correct," whereas 14% agreed "Evolutionary theory is almost certainly wrong." However, PST did not indicate much support for "alternative" explanations either: Only a few PST agreed with statements supporting young-Earth creationism (one student), old-Earth creationism (three students), or intelligent design (four students).

Twenty-nine percent of PST said evolution was not included in their high school biology class. However, these PST were no more likely to hold misconceptions about evolution than the 62% who said it was ($p = .88$). There was no effect of self-reported past instruction on acceptance of evolution ($p = .73$). There was no significant difference in misconceptions, attitudes, or beliefs based on planned grade level or special education; however, sample sizes of those preparing to teach middle school science were too small to assess.

Effects of curricula on evolution knowledge, attitudes, and beliefs

A paired samples *t*-test was used to compare pre- and posttest scales within each year. In both years, PST showed a large effect size and significant decrease in misconceptions (2012 $d = 1.96$, $p < .00$; 2013 $d = 2.5$, $p < .00$) and negative attitudes about evolution (2012 $d = 1.51$, 2013 $d = 2.2$; Figure 1A, Table 2). Misconceptions decreased significantly more for PST who wrote the paper (2013; by independent sample *t*-test; $p < .05$). It is important to note that 65% (2012) and 76% (2013) now rejected the relativistic fallacy. Further, although seven PST (across both years) initially *agreed* or *strongly agreed* that "my religious faith forbids me from accepting evolution," only one agreed with this statement in postclass surveys.

Beliefs of PST about evolution were also significantly affected (Figure 1A, Table 2). Agreement with the statement "Evolution is almost certainly correct" went from 15% to 54% in 2012 and from 35% to 70% in 2013. Meanwhile, only one in each year now agreed "Evolution is almost certainly wrong." Disagreement with that statement went from 54% in the presurvey to 86% in the postsurvey. Disagreement with creationism and intelligent design increased significantly, more so in 2013 (Figure 1A, Table 2).

In comparing pre- and postanswers of individual PST, 58% indicated an increase in evolution acceptance, whereas 14% indicated decreased acceptance. Unsurprisingly, acceptance and misconceptions were inversely correlated (linear $R^2 = 0.39$)—but only after the course (Figure 2), which aligns with current literature about correlation between belief, acceptance, and misconceptions (Nadelson & Southerland, 2010). In the precourse survey, there was no correlation between these aggregate Likert scores.

Evolution's place in the public school classroom

Surprisingly, the science curriculum alone (with discussions about religion) had little effect on PST beliefs about what should be taught (Table 3). Before the course, 61% of 2012 PST agreed evolution should be taught; afterward, 76% did. Support for teaching creationism in public schools went from 34% to 27%. The only statistically significant change (2012 presurvey $M = 2.44$; 2012 postsurvey $M = 1.88$; $p = .048$) was an increase in disagreement that schools should teach nothing about evolution, creationism, or intelligent design (Table 3).

However, when the PST were required to read and write about relevant Supreme Court cases, their opinions shifted significantly (Table 3). In 2013, support for teaching evolution went from 58% to 100% (2013 presurvey $M = 3.58$; 2014 postsurvey $M = 4.44$; $p = .008$). Support for teaching creationism and intelligent design declined from 26% to 11.5%. We aggregated these opinions into a

TABLE 2

Preservice teachers' understanding of, attitudes toward, and beliefs about evolution (Likert Scale, 5 = *strongly agree*).

	2012 Pre	2013 Pre	2012 Post	2013 Post
Misconceptions				
The major point of evolutionary theory is that man evolved from monkeys.	2.88	2.88	2.00*	1.76*
Most of what we know about evolution comes from Darwin.	3.38	3.72	2.42*	2.68*
Evolution says the universe was created in a Big Bang.	2.65†	3.36†	2.31	2.32*
Evolutionary theory says that "only the strongest survive."	3.35	3.40	3.04	2.76*
Evolution says that organisms adapt to their environment, meaning that if an animal living in a cave needs big eyes, it will grow big eyes.	3.35	3.56	2.31*	2.04*
Many biologists disagree with evolutionary theory.	3.00	2.64	2.44	1.56*,†
Evolution is just an idea, there isn't much evidence for it.	2.64	2.64	1.80*	1.40*
Evolution is inadequate to explain the living world.	3.56	3.68	2.88*	2.48*
There exists abundant evidence that contradicts evolution.	3.04	3.12	2.32*	1.56*,†
Scale	**27.86**	**29.0**	**21.52***	**18.56***
Attitudes				
The word "evolution" causes me to feel distaste.	2.50	2.72	2.35	2.20
Doesn't matter: it's just an opinion either way.	2.96	3.08	2.31*	1.72*
My religion forbids accepting evolution.	2.38	2.42	1.92*	1.68*
Can't be religious and still accept evolution.	3.35	2.04	1.77	1.48*
Evolution negatively influences society.	2.52	2.56	2.08	1.92*
Evolution makes people behave in immoral ways.	1.96	2.13	1.72	1.56*
Scale	**15.67**	**14.95**	**12.14***	**10.56***
People who reject evolution are ignorant about science.	2.46	2.46	2.48	3.08*,†
Beliefs				
Creationism/ID: Support				
• Abundant evidence supports creationism	2.58	2.84	2.08*	2.08*
• All life was created in present form <10kya	2.35	2.48	1.88*	1.48*
• All life was created in present form long ago	2.35	2.60	1.96	1.52*
• Intelligent designer intervened to create life	2.65	2.52	2.00*	1.68*
• Evolutionary theory is almost certainly wrong	2.50	2.64	1.88*	1.56*
Scale	**12.42**	**13.08**	**9.81***	**8.32***
Evolution: Support				
• Abundant evidence supports evolution	3.4	3.32	3.88*	4.28*
• Evolutionary theory is almost certainly correct	2.92	2.96	3.40	3.84*
Scale	**6.16**	**3.28**	**7.28***	**8.12***
Theistic Evolution: Evolution is the mechanism by which God created life	3.04	2.88	2.92	2.72
I have no opinion about whether evolutionary theory is correct	3.36	2.96	2.52*	2.48

Note. Preservice teachers (n = 26 [2012] or 25 [2013]) took a written survey on the first and last days of class. Symbols indicate statistically different responses (* = pre to post; † = 2012 vs. 2013) using student's t-test ($p < .05$).

single value by inverting Likert value for questions that did not support evolution, creating a scale sum and an opinion index about evolution in the classroom (Figure 1B; Table 3). The inclusion of the writing assignment caused PST to align more significantly with National Science Teachers Association (NSTA; 2013) and *NGSS* guidelines ($p = .003$, $d = 1.8$).

Attitudes toward science

We found no significant impact of the curriculum on PST attitudes toward science in either cohort, nor were the cohorts significantly different from one another. In general, PST had a slightly positive attitude toward science before and after the course (as indicated by a 3 or above on the Likert scale). However, PST who indicated in the presurvey that the word *evolution* made them feel distaste had significantly less favorable attitudes toward science generally ($p = .03$). The only survey item the curriculum affected was agreement with the statement "I notice myself thinking about science and things I've learned in science class when I'm going through an ordinary day" (average 2.45 pre to average 3.49 post; $p < .002$).

Discussion

We found this population of PST initially reflected the general U.S. population in their understanding, attitudes, and beliefs about evolution, regardless of whether they had received instruction on the subject in high school, which is consistent with previous literature (Losh & Nzekwe, 2011; Rutledge & Mitchell, 2002). As found previously (Nadelson & Southerland, 2010; Robbins & Roy, 2007), a semester of biology instruction through an evolutionary lens, including direct and open conversations about religion, caused PST views to align much more with those of scientific organizations. However, the curriculum alone did not cause PST to significantly change their views about the inclusion of evolution in public school classrooms. Only when assigned a paper including reading and analysis of specific classroom challenges did a large majority

FIGURE 1

Summary of knowledge, attitudes, and beliefs toward evolution and evolution in the classroom before (hatched) and after (solid) course. All preservice teachers (PST; orange and blue) received evolution-intensive instruction on basic life sciences. PST in 2013 (blue) were additionally required to complete a research paper on evolution in the classroom, including the reading of major Supreme Court decisions. (a) Misconceptions, negative attitudes, and procreationist viewpoints decreased, whereas evolution acceptance increased across both years, with the paper assignment producing additional gains. (b) Similarly, writing the paper significantly increased favorability of PST toward including evolution (and not literalist religious "alternatives" in the classroom). The index was calculated from Likert scores (see Table 2). Identical lowercase letters indicate statistically similar samples by an independent-samples *t*-test ($p < .05$).

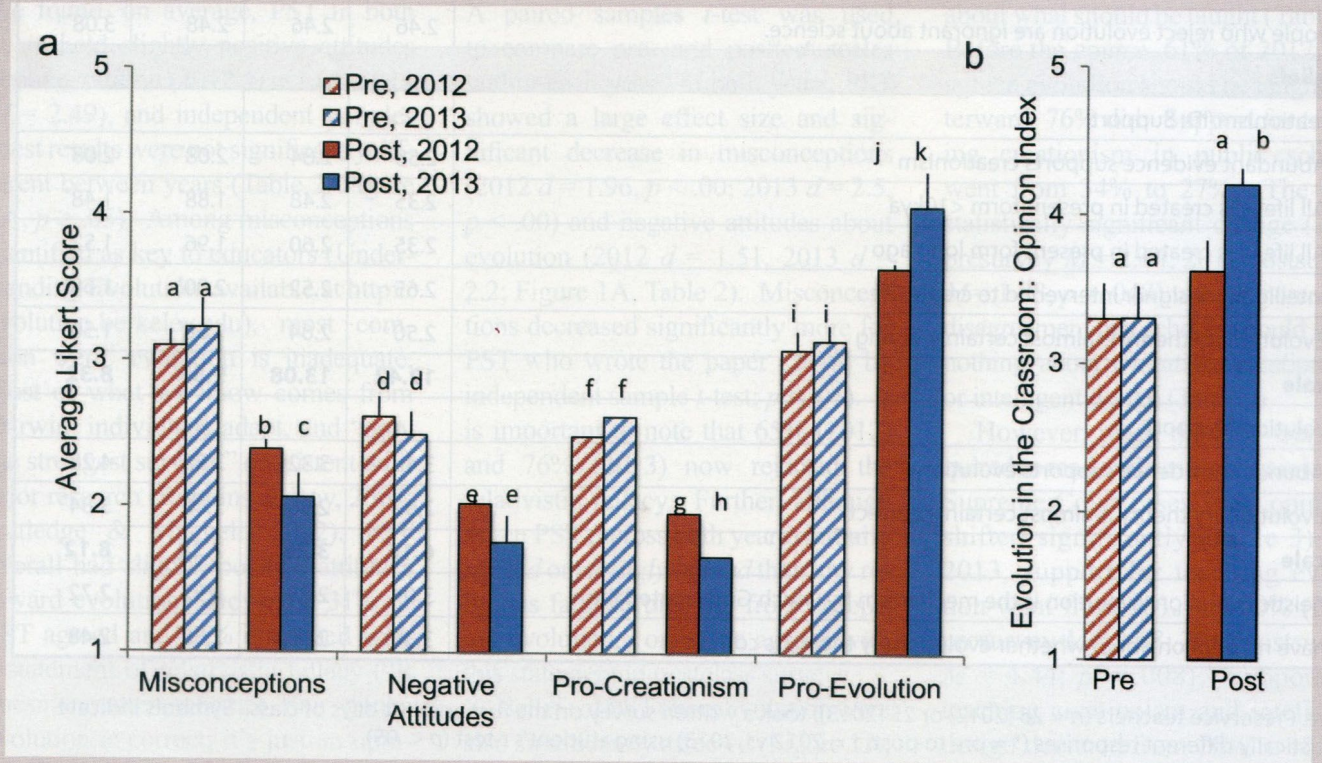
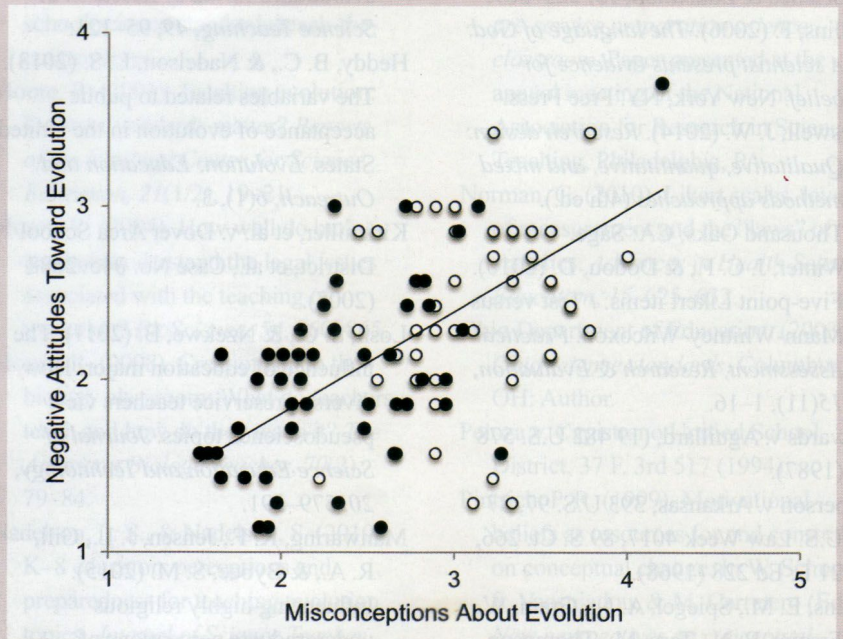


FIGURE 2

Misconceptions about evolution and acceptance of evolution are inversely correlated after, but not before, instruction. Open circles show average results of acceptance and misconception questions before the class; closed circles represent after-class results. The trendline shows linear regression through postclass results ($R^2 = 0.39$). There was no correlation in preclass results ($R^2 = 0.01$).



support teaching of evolution and reject presentation of literalist religious alternatives.

The link between understanding and acceptance

Our findings agree with others (Manwaring et al., 2015; Nadelson & Southerland, 2010) showing PST who understand macroevolution are more likely to accept it. Others disagreed (Rutledge & Warden, 1999). However, Wagler and Wagler (2013) found the Measure of Acceptance of the Theory of Evolution (MATE; Rutledge & Warden, 1999) is not valid among all populations. Thus, this inconsistency may be a result of population differences or acceptance measurement used. Future research should examine the consistency between various evolution measures, such as MATE, I-SEA (Nadelson & Southerland, 2012), and our measure (Norby, 2003; Robbins & Roy, 2007; Weinberg, 1998). Other variables that may influence differences among these studies are participant epistemology and reasoning (Evans et al., 2010; Ha, Haury, & Nehm, 2012), religion/religiosity (Allmon, 2011; Ha et al., 2012; Heddy & Nadelson, 2013), level of education (Ha et al., 2012; Heddy & Nadelson, 2013), and political/social influences (Allmon, 2011).

Addressing attitudes

In response to Smith and Siegel (2004), Cobern (2004), advocated for "a more open cultural/historical approach to science teaching" (p. 588). This sentiment is echoed by Nadelson and Southerland (2010), who implored us to bear in mind PST beliefs and lives beyond the classroom. Other well-supported theories of learning (Gregoire, 2003; Sinatra, 2005; Sinatra & Seyranian, 2015) have also demonstrated that cognition and knowledge are intimately tied to underlying psychological attitudes. Directly acknowledging PST beliefs and identity may help mitigate backfire effect (Trevors, Muis, Pekrun, Sinatra, & Winne, 2016). Our results support the theory that explicit instruction targeted at both content knowledge and attitudes can help decrease misconceptions and negative feelings surrounding evolutionary theory. Furthermore, it is often assumed religion and evolution are at odds (Collins, 2006; Miller, 1999; Moore, 2008). However, our results agree with others: Directly confronting these assumptions and providing evidence to the contrary helps (Robbins & Roy, 2007; Manwaring et al., 2015; Moore, 2008).

Preparing teachers

We found PST were initially open to inclusion of sectarian materials in the classroom (usually alongside evolution). Interestingly, the curriculum alone was sufficient to increase their acceptance of evolution but had no impact on what they believed should be taught in public schools. Only after reading and writing about problems arising from including religious material did PST views change. The relevant Supreme Court decisions are themselves a useful tool for learning about the philosophy of science and may help prepare PST to confront other issues of pseudoscience.

We were unable to follow these PST over time and verify if perceptions about evolution were durable. A longitudinal study would be important for assessing the durability of misconception correction (Pintrich, 1999; Pintrich & Sinatra, 2003; Sinatra, 2005) and assessing the extent to which these PST use these ideas in their classrooms.

Conclusion

As of February 2016, 18 states, plus the District of Columbia, have fully adopted *NGSS* and a further 11 states have begun the adoption process (NSTA, 2013; NGSS Lead States, 2013). Even those states choosing not to adopt the *NGSS* have still incorpo-

rated evolution into their standards (Moore, 2001; National Research Council, 1996). This overwhelming support by national science organizations and within state standards makes it especially important for all teachers of science, including grade school teachers, to be adequately prepared to teach evolutionary theory and improve scientific literacy.

Although PST have a similar understanding of basic science as the general public, they undoubtedly have a greater impact on the understanding of the very same topics, including evolution (Losh & Nzekwe, 2011). It is essential for teacher education programs to ensure graduates have not only a strong content knowledge, but also a clear understanding of legal and ethical issues surrounding their classroom, including the teaching of evolution (Moore, 2004). We recognize that many universities do not offer science classes specifically for education majors. The inclusion of similar approaches in a teaching methods or ethics class might produce positive results as well. ■

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TABLE 3

Preservice teachers' attitudes toward teaching evolution in the classroom (Likert Scale, 5 = *strongly agree*).

	2012 Pre	2013 Pre	2012 Post	2013 Post
It is important for children to learn about evolution.	3.81	3.71	4.04	4.32*
Public schools should teach evolutionary theory.	3.69	3.58	4.00	4.44*,†
Public schools should teach Biblical creationism.	2.96	2.88	2.77	2.04*,†
Public schools should teach intelligent design theory.	3.35	3.29	2.73	1.88*,†
Public schools should not teach anything about evolution *or* creationism *or* intelligent design.	2.44	2.38	1.88*	1.54*
Public schools should teach kids that evolution is scientifically controversial.	3.67	3.58	3.32	2.32*,†
Public school teachers should have the right to teach whatever they believe is correct.	2.00	2.04	2.00	1.56
Scale total	**23.08**	**23.13**	**25.33**	**29.42*,†**

Note. Preservice teachers (n = 26 [2012] or 25 [2013]) took a written survey on the first and last days of class. Questions were administered with an anonymous, user-generated code to identify participants. Symbols indicate statistically different responses (* = pre to post; † = 2012 vs. 2013; $p < .05$) using a paired samples t-test (pre to post) or an independent samples t-test (2012 to 2013).

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