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Social media: How the next generation can practice argumentation

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ABSTRACT

In this article the authors share how social media, paired with gaming and in-class supports, can facilitate the practice of scientific argumentation and report data that show how students can learn and practice argumentation through these highly interactive and engaging mediums. Social media will continue to evolve and fluctuate in popularity, but no matter the service or software, there will continue to be online spaces for communication, collaboration, learning, and future career growth. Since the role of education is to prepare students to be college and career ready, the use of social media as a component of schooling should be explored. This work has parsed out specific strategies and methods to support higher order thinking through gaming and social media.

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Introduction

Over the last 10 years, the National Science Foundation (NSF) has funded projects at the University of Kansas Center for Research on Learning to explore and develop solutions to help students and teachers practice argumentation. With the release of the Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS), making arguments from evidence through writing and speaking has become an important way for students to show what they know. During the first project, the Argumentation and Evaluation Routine (AER) was developed (Bulgren & Ellis, 2012, 2015a; Bulgren, Ellis, & Marquis, 2014). This routine was effective in teaching the practice of argumentation to high school students. Teachers, however, reported a lack of time to implement the instruction. Furthermore, although students in groups representing diverse academic and achievement abilities learned components of argumentation associated with evidence, reasoning, and making conclusions, they could benefit from more instruction to support their abilities to generalize the use of argumentation to other areas. This finding led to a second

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project that resulted in the development of a web-based, multi-player game called Reason Racer. This game achieved the objective of not only teaching and practicing the components of argumentation, but doing it in a highly engaging way (Craig-Hare & Ault, 2011). Indeed, the final task in the game required students to pass judgment on a claim and defend their views in an online chat environment with their peers. This led the research team to a third project that explored ways to support online discourse, particularly using the world of social media where students are highly engaged.

The purpose of this manuscript is to share how social media, paired with gaming and in-class supports, can support the practice of scientific argumentation and report data that show how students can learn and practice argumentation through these highly interactive and engaging mediums.

Argumentation

Of the many higher order thinking challenges found in the NGSS, argumentation has a prominent role. In general, an argument is a sequence of statements that present evidence to support a claim (a statement about the natural world based on scientific observation intended to persuade another person) (Achieve, 2013). In addition, an argument involves reasoning (the process of using logical thinking to evaluate and explain how the evidence and methodology support or refute the claim) followed by why the claim should be accepted based on the evidence (Toulmin, 2003).

Next generation argumentation through social media

In order to explore how social media can facilitate the practice of argumentation, a team of four teacher-researchers and university faculty developed a four-week biology unit on Inheritance and Variation of Traits that was augmented with interactive technologies. The unit utilized games and social media to progressively move high school biology students through learning the practice of argumentation. Students were introduced to the vocabulary of argumentation through the AER and the Reason Racer game was used to refresh the students' understanding of the concepts and practice throughout the year. During the final year of the three-year grant, a pilot study was conducted to determine if a unit that had students practice scientific argumentation through gaming and social media helped increase student understanding of argumentation.

Theoretical framework

Research on scientific argumentation, social media, gaming, and computer-supported discourse, as well as the NGSS and associated practices helped to guide this study.

Argumentation and evaluation guide

In the initial project funded by NSF (Grant #0554414) an instructional procedure, the AER, was developed to assist secondary science teachers in teaching the knowledge and skills related to scientific argumentation. The components of the AER include a visual organizer, the Argumentation and Evaluation Guide (AEG), an embedded Argumentation and Evaluation Strategy (AES), and the instructional procedures in the AER (Bulgren & Ellis, 2015a, 2015b; Bulgren et al., 2014). Results of this study produced both quantitative data on students and teachers (Bulgren et al., 2014) and qualitative reports of teacher thinking (Bulgren & Ellis, 2012).

This study was important because it demonstrated that teachers could implement the AEG with fidelity. In addition, it indicated that student groups representing diversity academic and achievement abilities could benefit from teacher use of the routine. Significant differences were found in favor of the students in the experimental condition when assessed for total scores, and for subscores related to evidence, reasoning, and making conclusions. Statistically significant results were found between the experimental and comparison groups in favor of the students with learning disabilities and those identified as gifted. Follow-up analyzes showed that the treatment group had higher scores than the comparison group, regardless of gender or grade level.

Other findings laid the foundation for the two subsequent studies: Reason Racer and Social Media. One finding suggested that students scored lower on the ability to generalize argumentation to other areas, such as news articles, outside of school learning. It was determined that students may need more instructional support to learn and generalize the argumentation strategy to real-world issues. Another finding was that teachers reported challenges with finding the time to use the entire routine frequently enough that students could master the procedure and generalize its use. Therefore, more instructional time or more ways for students to practice higher order reasoning were needed. Gaming and eventually social media were used to see if these technologies could support student's learning the components of argumentation.

Gaming

Reason Racer is an online multiplayer arcade-style game developed through the second project supported by NSF (Grant #1019842). The game contains four parts, each designed to engage players in building skills and knowledge specific to scientific argumentation. Teachers choose from 40 different scenarios covering topics in physical science; life science; earth and space science; and engineering, technology and the application of science to assign to their students during game play. The scenarios were developed to be interesting to middle school students and populate the content of the game's challenges. During one session, a single game scenario is used for students to play the game with their peers. Areas of argumentation addressed in the game include understanding a claim, judging

evidence about a claim based on type (fact, opinion, data, or theory) and quality, determining the reasoning (authority, theory, or logic), considering counterarguments and rebuttals, and making judgments, based on Toulmin's model (Toulmin, 2003; Toulmin, Rieke, & Janik, 1984). Reason Racer has been shown to increase argumentation skills and judgment when students played the game using various scenarios at least 10 times throughout a two-month period (Ault, Craig-Hare, Frey, Ellis, & Bulgren, 2015).

The last part of the game involves players interacting with the other team members in a peer-scored discourse environment. As each player finishes racing through the Pit Stops in the Reason Racer game, they are presented with the decision to accept, reject, or withhold judgment about a claim from a passage of text related to the scenario they just played through. Their justification for their decision feeds into the chat episode. A chat episode further develops when a player selects another player's justification statement and posts an additional comment to the author of the justification. Practicing argumentation discourse through this type of online interaction has the potential to further engage players through a game-based format. Online games have a history of providing a rich and compelling environment for discourse (Brown & Bell, 2006; McEwan, Gutwin, Mandryk, & Nacke, 2012). Studying the components of discourse within the context of online games, Gee (1992, 1996, 1999) suggested that this type of online environment constitutes a rich space in which discourse emerges and allows for integrating language with the use of symbols and slang.

Reason Racer was used during class to allow students to review and practice of the components of argumentation. Specifically, teachers had students play Reason Racer as a way to tap into their previous knowledge and remind students of the various parts of a quality argument so that when they were preparing to make claims they considered the quality of the evidence and reasoning, as well as questioned the claims and evidence of their peers. One scenario, in particular, was used to prepare for a Socratic Seminar discussing epigenetics. Students played the "Energy Drinks? Don't waste your energy!" scenario where they explored the controversial topic of the health benefits and risks of popular energy drinks. This "warm-up" helped remind students of the components necessary to practice scientific argumentation and "speak the language" when engaging in peer-to-peer discourse.

Multi-player games, such as Reason Racer, provide an opportunity for discourse that is persistent, player-produced and useful; generally focusing on solving problems or making sense of the content. Because online chat environments provide an opportunity to engage game players in discourse, researchers have recognized game-based chat as a suitable space for the development of scientific argumentation skills and discourse (Squire & Jan, 2007; Steinkuehler & Chmiel, 2006). This lead the research team to further explore online chat environments such as social media spaces as additional suitable spaces for the development of scientific argumentation skills and discourse.

Social media

The third project involved a group of educators, high school teachers, and university researchers in a three-year study of if and how social media supports the practice of scientific argumentation for high school Biology teachers and students. The team, funded by NSF (Grant #1316799), chose to investigate this virtual space because their students are highly engaged in social media using platforms such as, Facebook, Twitter, Instagram, or Snapchat, and using software such as BlackBoard or WordPress blogging. Social media will continue to evolve and fluctuate in popularity, but no matter the service or software, there will continue to be online spaces for communication, collaboration, learning, and future career growth. Since the role of education is to prepare students to be college and career ready, as delineated by the NGSS and CCSS, the use of social media as a component of schooling was explored. This project specifically investigated how social media can support three-dimensional learning in secondary science instruction.

The arguments for and against using social media in education have been discussed since its inception. Researchers have investigated informal learning and discovered how children and youth constructively build community and create knowledge outside of school (Asterhan & Bouton, 2017; Boyd, 2014; Greenhow, Gibbins, & Menzer, 2015). Multiple researchers have explored the application of social media in higher education showing that when students see the use of social media as authentic and relevant for class, they are willing to use it for learning and organization (Chromey, Duchsherer, Pruett, & Vareberg, 2016), to build communities of inquiry (Jones, Blackey, Fitzgibbon, & Chew, 2010), and to practice argumentative knowledge construction (Tsovaltzi, Puhl, Judele, & Weinberger, 2014). Other researchers have begun to debunk some of the widespread fears about student usage of social media and mobile technologies in schools including how social networking is a distraction and breeding ground for bullying when in reality, it has been shown to be an approachable community for knowledge sharing and creation (Asterhan & Rosenberg, 2015; Boyd, 2014; Warner, 2016).

While the use of social media in higher education is being explored, as are the informal spaces of teens and youth, the use of social media in formal secondary classrooms has been given far less attention. In 2011, Chao, Parker, and Fontana wrote that the impact of social media is "so widespread and inculcated into our culture that it is futile to try and stop their [social media] influence at the classroom door" (p. 324). Research is emerging to show why and how students use social media to communicate (Asterhan & Rosenberg, 2015) and that teachers are using it to build relationships with students, communicate information, and to teach twenty-first century literacies (Nowell, 2014). There is still, however, a substantial need for understanding best practices for using social media to enhance teaching and learning in formal secondary classrooms.

Computer-supported discourse

The intent of these studies was not to replace face-to-face communication in the science classroom or in professional learning efforts, but rather to determine how gaming and social media can enhance and extend the conversation occurring with students in class. A number of reviews present evidence on the usefulness of computer-based environments to support argumentation skill development (Scheuer, Loll, Pinkwart, & McLaren, 2010; Soller, Martínez, Jermann, & Muehlenbrock, 2005). These results, as well as the work of Linn and her colleagues and others, demonstrate the ability to engage students in discourse and argumentation in scaffolded and controlled web-based spaces (Jeong & Joung, 2007; Linn, Clark, & Slotta, 2003; Linn & Eylon, 2011).

Online features that support collaboration include a shared workspace that facilitates a social awareness of teammates, a chat function allowing for open-ended interactions, delineated roles, problem-solving actions, and graphical visualizations of performance (Soller et al., 2005). The chat and graphic visualizations are intended to give students a metacognitive perspective of their actions. Scheuer and his colleagues (2010) identified five different types of support for argumentation, including free form arguments, arguments based on transcripts, and system-provided prompts and examples. They suggested that by scaffolding good argumentation practices, the systems not only supported students in "learning to argue" but also supported "arguing to learn," helping students learn about specific domain topics through argumentation (p. 45).

Social media environments also enhance face-to-face interactions. Joiner, Jones, and Dohery (2008) reported results of two studies that examined the effectiveness of asynchronous argumentation as a face-to-face enhancement, finding computer-mediated communication (CMC) (1) gives more time to reflect and reply with thoughtful responses, (2) provides an opportunity to post opinions simultaneously, rather than having to practice turn-taking and possibly missing a window of sharing because the conversation has moved on, and (3) offers more equal participation among group members than face-to-face. Asterhan and Bouton (2017) suggest that social networking environments contribute to interactions by enhancing resource and knowledge sharing. The evidence suggests that a computer-mediated environment can support the type of social exchange seen during scientific argumentation.

Scientific argumentation in the NGSS science practices

Scientific argumentation has emerged as a key science practice. In "Taking Science to School," National Research CouncilNational Research Council, 2007) claims that students who are proficient in science (1) know, use, and interpret scientific explanations of the natural world; (2) generate and evaluate scientific evidence and explanations, (3) understand the nature and development of scientific knowledge,

and (4) participate productively in scientific practices and discourse. A specific type of discourse is scientific argumentation.

The NGSS call for the practice of scientific argumentation to be integrated throughout all grade levels and science content areas. The science and engineering practices require the use of higher level thinking, which is associated with arguments, evidence, and reasoning. For this project, engaging in argumentation throughout the school year was a key for success. Students had the opportunity to work within the AEG, Reason Racer game, and social media environments on multiple occasions, across multiple units. This work was not confined to one lesson, but taught iteratively, depending on the content being learned. Direct connections between specific NGSS practices and the learning environment for the teachers and students in this study are described below.

NGSS practice: asking questions

The *NGSS* emphasize that asking questions is critical to developing expertise in science. Specifically, students are asked to evaluate questions that challenge the premise of an argument and to interpret data. For example, students might have a question as to the believability of a claim being made from an experiment or in an article, video, or on the internet. In the unit developed for this project, students were asked to use their understanding of Mitosis and model how they thought Meiosis works and explain why siblings are different, despite their genetic origins. They posted their claims and associated models on social media and asked one another questions, offering counterarguments and rebuttals to determine who developed the best claim.

NGSS practice: analyzing and interpreting data

The *NGSS* specify that students consider the tools and technologies used to generate and analyze data to make valid and reliable claims, and to consider limitations to the strength of the claim based on that data. As part of this unit, students were asked to analyze various types of data including medical records to help diagnose a student with a specific disorder.

NGSS practice: engaging in argument from evidence

The *NGSS* expands the challenges students face when learning to include ways of analyzing reasoning. Across the grades, students must consider relevant and sufficient evidence and scientific reasoning behind explanations made to determine the metric of an argument, and construct counter arguments based on data and evidence. During the unit, students engaged in a Socratic seminar (Copeland, 2005; Polite & Adams, 1997) where they evaluated multiple sources and discussed claims, evidence, and reasoning surrounding epigenetics. They worked in teams, to argue one another's claims using well-reasoned evidence.

NGSS practice: constructing explanations

In this *NGSS* practice, students must construct explanations based on evidence consistent with scientific knowledge, principles, and theories; make quantitative and qualitative claims regarding the relationship between variables; and apply scientific reasoning, theory, and models to link evidence to claims to assess the extent to which the reasoning and data to support explanations or conclusions. During the unit, students evaluated data, facts, and opinions to construct an explanation for why a minor could be diagnosed with a specific genetic disorder. They explained to others how they analyzed the claim, and evaluated or judged its believability, then they shared why they made the decision they did. This practice supports the need for students of science to share their thinking with others and to engage in discourse as well as inquiry.

NGSS practice: obtaining, evaluating, and communicating information

The *NGSS* also emphasize the practice of obtaining, evaluating, and communicating information. Students are asked to critically read scientific literature to determine ideas or conclusions and summarize complex information. They are further challenged to synthesize, communicate, and evaluate the validity of a claim, methods, and design. During the unit, students constructed a diagnosis for a minor who likely has a genetic disorder. They completed an AEG based on medical records and family pedigree and they wrote a letter to the child and his family stating their claim, evidence, reasoning, and justification. This practice was the culminating performance for students to demonstrate that they have the ability to independently engage in the complex processes of argumentation in defending their own claims, as well as evaluating claims made by others. Students, as well as scientists, must be able to speak or write so that others can understand their thinking.

Methods

For this unit, the primary interest was determining the best way to facilitate the practice of argumentation through gaming and social media. A pilot study was conducted to identify how a unit developed using Reason Racer and social media supported the practice of argumentation as compared to classrooms that did not implement the unit.

Social media pilot study

Over 400 ninth-grade students participated in a pilot study during the 2015–2016 school year. All were from either suburban or urban Midwest schools. Teachers recruited for the study were volunteers who taught ninth-grade Biology in the participating school districts and were solicited via email. There were 181 students in the treatment group who actively participated in the social media enhanced argumentation unit and 221 students in the comparison group who conducted

business as usual for their Inheritance and Variation of Traits unit. The students completed pre- and post-surveys on their knowledge of scientific argumentation (Frey, Ellis, Bulgren, Craig-Hare, & Ault, 2015), their use of social media, their use of social media to practice scientific argumentation, and their confidence and motivation to use scientific argumentation. They also reported on their confidence in performance expectations at the end of the unit. Students in the comparison classrooms were demographically similar to those in the treatment classrooms.

Results

Argumentation and social media

Overall on the test of scientific argumentation, both the treatment and comparison groups scored significantly higher on the post-test when compared to the pre-test. In addition, the treatment group ($M = 27.52$) scored significantly higher ($p = .00$) overall than the comparison group ($M = 24.41$). Treatment and comparison students reported, on average, that they had one to five social media accounts and that they predominantly use those accounts to scroll through newsfeeds looking for pictures, videos, etc. When asked what they value more about social media, either the sending/sharing or receiving/viewing of information, the majority of students value both activities equally. Specifically, when the treatment students were asked how important the quality of their writing is when they post to social media sites, knowing that their peers may see their post, they reported a significant ($p = .02$) increase in importance between their pre-($M = 3.14$) and post-($M = 3.33$) responses (Table 1).

Table 2 shows how students reported their use of social media for argumentation using a five-point Likert scale. The treatment group reported significantly higher use of social media than the comparison group on all constructs measured, save one. The treatment group reported that they were significantly more likely (see bolded text, Table 2) to use social media to share scientific claims ($p = .00$), discuss scientific phenomena ($p = .00$), post-counterarguments and/or rebuttals to

Table 1. Social media treatment group pre/post ($n = 172$).

	Pre-Test		Post-Test			
	Mean	SD	Mean	SD	*t*	*p*
How important is social media to you? 5-point scale: Not at all important to Extremely Important	3.15	0.99	3.24	0.98	1.57	0.12
In general, how satisfied are you with the educational use of social media in your school? 5-point scale: Very dissatisfied to Very Satisfied	3.19	0.80	3.06	0.79	−1.82	0.07
How important is the quality of your writing when posting to social media sites, knowing that your peers may see your post? 5-point scale: Not at all Important to Extremely Important	3.14	1.03	3.33	0.98	2.30	0.02

Table 2. Scientific argumentation post-test comparison.

	Treatment group (n = 181)		Comparison group (n = 221)				
	Mean	SD	Mean	SD	t	p	η^2
Evidence	5.07	1.19	4.56	1.30	4.14	**.00**	.04
Qualifiers	5.06	1.41	4.15	2.24	4.93	**.00**	.05
Claims	5.23	1.48	4.71	1.82	3.17	**.00**	.02
Types of reasoning	4.03	1.55	3.38	1.75	3.96	**.00**	.04
Challenges to a claim	3.91	1.74	3.75	1.67	.93	.35	.00
Strength of reasoning	4.23	1.44	3.87	1.53	2.40	**.02**	.01
Overall score	27.52	5.33	24.41	6.49	5.28	**.00**	.06

others' claims (p = .00), demonstrate their knowledge of science content (p = .00), convince others to see their point of view/opinions about science (p = .00), understand other points of view/opinions about science (p = .00), and to follow scientists/researchers (p = .02) than the comparison group. In addition, the treatment group reported significantly higher ratings on their pre/post-test in the areas of sharing scientific claims (M = 2.51), discussing scientific phenomena (M = 2.55), and demonstrating knowledge of scientific phenomena (2.63).

Students in the treatment group reported a significant overall increase (p = .00) in confidence regarding scientific argumentation. They were more confident that they had the knowledge and skills needed to analyze and make strong scientific claims, that they had a process to go through to analyze or make a claim dealing with a science issue and that they were correct in their decisions about whether to accept or reject scientific claims that they hear or read about. These students also reported a significant overall decrease (p = .02) in their motivation to engage in scientific argumentation. Students reported that they were less motivated to engage in discussions about scientific argumentation or to explain their judgments about whether to accept or reject a claim to others. Overall in the comparison classrooms, there was no significant change in confidence and motivation related to scientific argumentation other than the item where students reported that they were less likely to be motivated to evaluate the evidence and reasoning made in support of claims.

Discussion

The practice of argumentation, making claims, using evidence and reasoning can be found in the NGSS and all of the CCSS, including language arts and mathematics. The idea that our students need to be critical thinkers, informed consumers and responsible digital citizens is a key for college and career readiness. In addition, the K-12 field of education continues to become more technology-rich. Teachers and researchers continually are trying to figure out how to take advantage of the affordances provided by technology and internet access. This work has parsed out specific strategies and methods to support higher order thinking through gaming and social media. Children and youth will continue to be entrenched in the digital worlds of gaming and social media and showing them how to perform productively and for learning is a key aspect of this line of research.

Students in the treatment classrooms learned the components of scientific argumentation and were more confident with usage than those in the comparison classrooms. Future studies need to explore the balance between building knowledge and confidence in argumentation and motivation to engage in the practice. In addition, more studies are needed to explore ways to physically practice scientific argumentation in safe spaces, both face-to-face and through computer-supported discourse.

Finally, the technologies available to students and teachers continue to evolve. Engaging and interactive applications and devices will continue to emerge that provide environments for communication, collaboration, and sharing, such as those skills demonstrated through argumentation. Both researchers and educators need to take advantage of these opportunities in order to continue to provide environments where students can engage in dialog and exchange information using technologies that are meaningful and representative of their social experiences.

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