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Minimizing Institutional and Instructional Barriers to Increase Students' Health Literacy through Genetics Education

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Abstract

One traditional avenue to developing health literacy is through health educational curriculum in primary and secondary schools. However, recent policy shifts that emphasize core curriculum learning standards decreased the ability of schools to offer health content. Thus, supplementing the core genetics curriculum with health content is a possible approach to increase health literacy in the current educational environment. Qualitative data suggest that control is the primary institutional and instructional barrier to the adoption and use of supplemental genetics educational materials. However, teachers report that supplemental educational materials with specific elements can help minimize this barrier and allow teachers flexibility to maximize the health content they can deliver. But to effectively build health literacy, supplemental materials must relate genetics to personal health. When combined with effective teaching practices, such as inquiry-based activities and content that is adaptable to different levels of student ability, supplemental genetics materials may help minimize barriers and make genetics education an effective conduit to build students' health and genetic literacy.

Background

Health literacy, which is one's capacity to obtain, understand, and apply basic health information and services (U.S. Department of Health and Human Services [DHHS], 2000), is a key concept in the promotion of protective behavior and informed decision-making about one's personal health. One's ability to read and comprehend prescription medication labels and understand potential prescription drug interactions are just two of many possible examples. And while public health officials and researchers have defined well the parameters of health literacy, fostering a health literate population in the United States has been more problematic.

One traditional avenue to developing health literacy is through health educational curriculum in primary and secondary schools. Teaching students about health topics at relatively early ages can promote positive attitudes and behaviors toward their health. But in today's evolving, standards-based educational environment, schools have less latitude and lower incentives than in previous years to offer standalone health content. In fact, there is little consistency between states on the topics covered in health classes or even the requirement for health education (National Association of State Boards of Education, 2009). Indeed, with the implementation of No Child Left Behind, students in U.S. schools now spend less time on health topics to allow for more time on core academic subjects such as math, science, reading, and writing (Morse, Wilbur, & Ballard, 2004; National Education Association, 2004).

With the reduction of free-standing school-based health content, schools may pursue another avenue for developing health literacy by infusing health content into standard curricula, most notably in science topics like human genetics. Indeed, genetics education can be an important tool in developing health literacy because of its application to and effects on personal health. For example, understanding traits and inheritance and what it means to carry a genetic

mutation can help inform personal decisions that may lead to positive health outcomes. But even here teachers face substantial time and resource constraints that make problematic delving deeply into the health aspects of genetics, in part because most state standards on genetics do not require core genetics content be extended to address how genes impact personal health outcomes (American Society of Human Genetics [ASHG], 2009). As a result, there is a growing trend among teachers to augment typical textbook approaches to genetics education by using supplemental or open content materials (Trotter, 2009). The use of supplemental educational materials on genetics allows teachers to expand on basic genetic principles, thereby increasing the probability of improved health literacy in students.

But the use of supplemental educational materials faces important institutional and instructional barriers, such as how to get approval from school administrators to use these materials, how to assess the quality of the materials, and how to make educational experiences for students sufficiently engaging. This paper takes a first empirical look at this issue. More specifically, this paper reports on qualitative research that investigates the relationship between teachers' use of supplemental materials to build health literacy through instruction on genetics, the institutional and instructional barriers to doing so, and how to overcome those barriers to increase health literacy in middle school students.

Promoting Health Literacy through Genetics Education

Genetic research is a relatively young science that has exploded in public importance. Rapid advancements in the field of genomics have forced society to consider the ethical, legal, and social implications of new knowledge, technology, and capabilities related to genetics and genomic research. The blossoming of the field of genetics has coincided with a call to push genetics education into primary classrooms. Indeed, the National Research Council (NRC),

through the National Science Education Standards, has pressed for introductory topics in genetics, such as the basic understandings of inheritance, to be adopted in the curricula of Kindergarten through fourth grade. NRC has also urged that the basic principles of heredity in genes be introduced to students in fifth grade (Hott et al., 2002).

Genetics education in elementary and middle schools aims to set a foundation for advanced genetics study in secondary and postsecondary schools, where genetics takes an increasingly important role in general science studies (ASHG, 2004; Hott et al., 2002). But it also serves as a promising avenue to promote health literacy. Indeed, by teaching genetics to students, teachers have a ready-made and reliable method to allow students to consider and analyze their personal health. This approach is the development of personal genetic literacy, which may create "sufficient knowledge and appreciation of genetics principles to allow informed decision-making for personal well-being and effective participation in social decisions on genetic issues" (Bowling et al., 2008, p. 16). Not only may the development of genetic literacy have pronounced individual benefits, but it may positively impact society more broadly. Indeed, Jennings (2004) argues that the promotion of genetic literacy serves broader public health values, such as "health promotion, respect for rights, equity, social justice, and enhanced quality of life as an active participant in collective activities" (p. 40).

To use genetics to develop students' health literacy, classroom instructional approaches must be formulated and implemented carefully. The backbone of genetics pedagogy in primary schools involves the use of textbooks. But faced with the complexity of teaching genetics and the often cursory coverage of topics in textbooks, teachers frequently turn to supplemental materials to help them build or refine their lesson plans and classroom activities (NetDay, 2004). However, teachers who are preparing to teach genetics may have difficulty adopting appropriate

supplemental materials because they face substantial institutional and instructional barriers. At the institutional level, teachers must ensure that their curriculum, including supplemental materials, meets state and national standards of learning or integrates other skills development (National Academy of Sciences [NAS], 1996; Todd, 1995). At the instructional level, not only is genetics difficult to teach and learn (e.g., Bahar, Johnstone, & Hansell, 1999; Cavallo, 1996), but teachers also often confront a lack of equipment, materials, and space, a perceived insufficient time in the curriculum, and deficient teacher training (National Foundation for Educational Research [NFER], 2008). Thus, a key question is how teachers can overcome these barriers, a question that this paper begins to address.

Method

We collected data from three sets of research participants, including seventh and eighth grade science and health teachers, seventh and eighth grade students, and experts in genetics and science education. We detail our data collection approaches with each population below.

Participants

Teachers. We conducted two focus groups with science and health teachers. The first group included eight seventh grade teachers. The second group included eight eighth grade teachers. Of the total teacher population, there were 14 women and two men. Nine of the teachers were white, six were black, and one self-identified as "other." All participants teach at different schools in the Atlanta metropolitan region. Twelve of the participants teach at traditional public schools, two teach at public magnet schools, and two teach at sectarian private schools.

We worked with a recruitment company to recruit and enroll teachers into the focus groups. To do so, we provided the recruitment company with detailed screening criteria, which

included appropriate grade taught, number of years taught at the appropriate grade, and school location (urban, suburban, or rural). We required that, for a teacher to be enrolled into the study, he or she must have taught genetics. We also screened potential participants on the extent to which they feel comfortable teaching genetics. The responses ranged from very comfortable to very uncomfortable. The final pool of participants included nine teachers who rated themselves as very comfortable teaching genetics, five teachers who were somewhat comfortable, one who was somewhat uncomfortable, and one teacher who was very uncomfortable.

Students. We conducted two focus groups with seventh and eighth grade students. There were eight students in each focus group, and each group was comprised of four boys and four girls. Of the total student population, ten were white, four were black, one was Asian, and one self-identified as "other." The students attend different schools in the Atlanta metropolitan region, including urban, suburban, and rural counties. The student population attended nine different public schools, three magnet schools, and four sectarian private schools.

We worked with the same recruitment company to recruit and enroll students into the focus groups. The screening criteria included the appropriate grade of the student and whether they had a moderate or high interest in science. Of the total student population, seven students indicated they strongly liked science and nine students indicated they somewhat liked science.

Expert Panelists. We recruited six people in the fields of genetics and science education. We solicited them based on their degrees and areas of expertise in genetics and science education and their contributions to the academic literature. Four panelists hold doctorates and are active researchers. Of these four panelists, three work primarily in genetics and genomics and the fourth works in science curriculum development and science instruction. The other two panelists are

middle school life sciences teachers who have developed laboratory-based curricula in human genetics.

Procedure

We conducted the focus groups at a focus group facility in the Atlanta metropolitan region on two nights in February 2009. Before the focus groups, we obtained written and informed consent from all participants. Teachers signed their own consent forms. Parents signed the consent forms for the students. A focus group facilitator with more than 15 years of experience led the groups while we observed and took notes from a back room with a one-way mirror. For both teacher groups, the facilitator used the same interview protocol, which contained several qualitative questions and related probes. The facilitator also used an interview protocol during the two student focus groups. Each of the focus groups lasted two hours, and all focus groups were digitally recorded with permission of the participants.

We collected data from the expert panelists through a telephone conference call. The call lasted roughly one hour and was guided by a detailed interview protocol that contained several open-ended questions. We used this approach for two key reasons. We wanted the panelists to provide specific answers to questions about the use of supplemental materials to teach genetics in primary schools, and we wanted their reactions to ideas offered by their peers on the call. With permission of the panelists, we audiotaped the call.

We used a two-prong approach to analyze the focus group and expert panel data. First, we coded our field notes to identify key themes and address the research goals noted above. Second, we reviewed the digitized recordings and audiotape for interesting contextual information or quotations.

This study has important limitations. For example, because we collected data from teachers and students in only one metropolitan region, the data may be ungeneralizable to teachers and students in other areas of the U.S. The limited number of focus group and expert respondents further limits the study's generalizability. As a result of these limitations, the findings below should be viewed cautiously.

Results

The data reveal three key findings about the relationship between genetics education and the development of health literacy through the use of supplemental educational materials.

Control is the primary institutional and instructional barrier to the adoption and use of genetics educational materials.

At the institutional level, teachers in both focus groups noted their limited control over curriculum decisions, although the private school teachers in the study noted fewer constraints. Teachers indicated the need to "sell" the use of supplement materials to their department heads and principals. In this regard, the teachers were quite concerned about cost and the time to requisition class materials. One teacher noted that it takes her school as long as three months to provide funds to buy materials for class. Another teacher noted that it takes multiple years to make curriculum decisions. A third teacher indicated that he needs evidence of effectiveness to make his case for purchases of any curricular materials.

With regard to instructional barriers, teachers noted that they face pronounced pressure to achieve student proficiency in order to meet state standards. Teachers argued that this factor, in turn, leads to significantly limited control over the genetics topics to which their students are exposed. For example, teachers must ensure their core curriculum content covers state standards.

But, due to limited time, covering all the state standards prevents teachers from covering any one topic in-depth. The heterogeneity of student ability and classroom composition also present key challenges. Teacher participants from urban and suburban schools stitched together an image of a typical classroom that includes roughly 30 students with a range of English language proficiency, knowledge of and interest in science, performance capabilities, and special needs. Many of the teachers indicated that they teach to the average students and acknowledge that this is sometimes to the detriment of higher or lower achieving students.

Supplemental genetics educational materials can help teachers minimize institutional and instructional barriers, but they need to contain specific elements to be effective.

Teachers in both groups reported that a well-designed educational supplement is an important mechanism for augmenting textbook materials and standards-based lesson plans. But to minimize the institutional and instructional barriers discussed above, teachers noted that the supplement must contain several elements. For example, to address institutional constraints, the supplement must feature content that meets and exceeds state standards. In fact, because of the proscribed nature of science curricula, particularly in public schools, the supplement must contain information that expands -- rather than replaces -- the mandated core genetics content in school districts. Without a standards-based approach, teachers report that school administrators will be reticent toward, and may block adoption of, the supplement, regardless of the extent to which it engages and motivates students.

With respect to instructional barriers, teachers reported that supplemental materials should contain ample background information and resources, especially when the supplemental materials address topics outside of core content. Indeed, such "educative curriculum materials," particularly in science, are one way to promote teacher learning and understanding (Ball &

Cohen, 1996; Davis & Krajcik, 2005; Schneider & Krajcik, 2002). The supplement should also provide teachers with additional teaching tools, such as how to guide a discussion on sensitive topics or how to anticipate student thoughts and reactions (Davis & Krajcik, 2005) and be customizable to address the teachers' specific pedagogical needs. For example, teachers must be able to pick and choose what genetics content to use from the supplement and how and when to use it. Customizability allows teachers the freedom to work within their core curriculum, while being sensitive to broader school administration, parental, or community issues. Teachers suggested that each of these elements may work to make them more comfortable teaching the core and extended genetics content. Teacher comfort is an important consideration because it is a key element in students' perspective of an engaging classroom.

Reflecting the changing nature of technology and educational instruction in the U.S. and the time and resource constraints teachers face, teachers also suggested that educational supplements on genetics should be web-based. Being structured as a web-based or virtual supplement allows teachers the choice of assigning it as homework, thereby continuing unabated with traditional in-class lesson plans.

Playing into the prospects of teachers using supplemental genetics materials effectively is students' reported strong desire to learn genetics. Indeed, many students in both focus groups indicated that genetics was their first or second favorite science topic, and most students showed a substantial interest in traits. Indeed, students noted that they wanted to learn why we look like we do, how traits are passed through generations, how they skip generations, how traits inform their future, how they relate to family issues, and how things can go wrong with genetic inheritance. But students also noted that particular elements must be included in supplemental genetics materials to make them engaging. For example, they generally want computer-based

materials that include activities with varying difficulty levels and the ability to track their progress. Students also reported that the smart use of media, such as transitioning from a graphic representation of a cell to an actual photograph of a cell to help with later identification, makes learning interesting.

Finally, there was consensus among the expert panelists that supplemental genetics educational materials should include a series of plug-in lesson plans that augment core genetics curriculum by focusing specifically on the legal, ethical, and social implications of genomic research. The panelists reported that a lesson plan may include suggestions on how to use current events to discuss genetics topics to help teachers draw explicit links to popular culture, in-class inquiry-based activities, and at-home computer-based activities that appeal to a wide range of students. The panelists suggested that such an approach will help to balance the demands of a standards-based environment by expanding genetics concepts to encompass broader health issues in an accessible, engaging, and meaningful way.

To effectively build health literacy, supplemental educational materials must relate genetics to personal health decisions.

The expert panelists indicated that supplemental genetics materials should relate genetics to health decisions by educating students on genomics issues that impact society. An example is the Genetic Information Nondiscrimination Act (GINA) of 2008. The panelists suggested using policy examples, like GINA and its benefits and limitations, as hooks to discuss the importance of health decision-making and its implications for youth and their families' health. The panelists also noted that supplemental materials should focus on genetic conditions, variations, and similarities. For example, they suggested the use of genetic conditions as a springboard to discuss complex diseases. There are many common complex diseases, such as heart disease and

asthma, with which students will be familiar, so discussions on these topics may make health decision-making relevant to them.

Teachers and the panelists indicated that, in order to be effective, the supplemental materials must be interesting and relevant to both students and teachers. To create relevancy, supplemental materials must draw links between science and real life because the attention and imaginations of students will be more likely captured by real stories. They also suggested using phenotypes to highlight personal characteristics, such as a hitchhiker's thumb or attached earlobes that a student may see in him or herself, or how genetics was used to identify family members separated during Hurricane Katrina.

The teachers and panelists also indicated that, to spur the interest of teachers and students, the supplemental materials should be inquiry-based. One approach is to begin each lesson with a question related to a genetics topic that engages students by being relevant to their lives or linked to popular culture. Students could then work to develop and defend their answer to the question by using content and activities from the supplemental materials. This hands-on approach will allow students to move away from their reliance on textbook or lecture-based learning. Another approach the panelists suggested is to follow a more informal, student-led examination of the question, an approach that may help non-native speakers and lower achieving students in the classroom, with a classroom discussion of formal genetics terminology and concepts. The panelists noted that most students feel passionately about personal topics, so genetics-focused supplemental materials must relate genetics to relevant, real life examples in order to deepen understanding and to build health literacy.

Discussion

The data reveal widespread optimism among teachers and expert panelists that supplemental genetics educational materials may produce not only educational benefits for students, but also have the secondary effect of building students' health literacy. This is a particularly important finding in today's crowded and constrained educational environment. Still, the findings present a cautionary tale of how to formulate such materials. Indeed, our data suggest that the primary challenge to their effective construction and use are control-related institutional and instructional barriers. The data suggest that teachers may be able to diminish control-related barriers if the supplements are well-devised and extend learning on a few specific genetics topics rather than replace an entire curriculum that has been approved by school boards and school administrators.

Still, the most interesting finding in this analysis relates to what the teachers and panelists failed to discuss, which is how to make high quality genetics supplements readily available and easy to find. A review of the Internet reveals hundreds of supplements that are available to teachers for little or no cost, but one may hypothesize that the quality of these supplements varies widely. Short of reading through the materials and experimenting with them in the classroom, there is little way for teachers to quickly ascertain the supplements' fit with the teachers' pedagogical needs and their overall quality. This situation leaves unanswered the question of how teachers can make informed decisions about the quality of currently available supplemental materials. Until a viable method is devised to allow teachers and administrators to compare and contrast the quality of available supplements and make informed choices about which to implement in their classroom, their effectiveness in building health literacy may be limited.

References

American Society of Human Genetics. (2004, September). *Enhancement of K-12 Human Genetics Education: Creating a Cooperative Plan*. American Society of Human Genetics Education Summit. Retrieved June 26, 2008, from http://www.ashg.org/pdf/K12Sumitreport.pdf

American Society of Human Genetics. (2009). *Genetics Education State Standards* [Database]. Retrieved October 30, 2009, from http://www.ashg.org/education/k12_statestandards.shtml

Bahar, M., Johnstone, A. H., & Hansell, M. H. (1999). Revisiting learning difficulties in biology. *Journal of Biological Education, 33*(2), 84-86.

Ball, D. L., & Cohen, D. K. (1996). Reform by the book: What is-or might be-the role of curriculum materials in teacher learning and instructional reform? *Educational Researcher, 25*(9), 6-14.

Bowling, B. V., Acra, E. E., Wang, L., Myers, M. F., Dean, G. E., Markle, G. C., et al. (2008). Development and evaluation of a genetics literacy assessment instrument for undergraduates. *Genetics, 178*(1), 15-22. doi: 10.1534/genetics.107.079533

Cavallo, A. M. L. (1996). Meaningful learning, reasoning ability, and students' understanding and problem solving of topics in genetics. *Journal of Research in Science Teaching, 33*(6), 625-656. doi: 10.1002/(SICI)1098-2736(199608)33:6<625::AID-TEA3>3.0.CO;2-Q

Davis, E. A., & Krajcik, J. S. (2005). Designing educative curriculum materials to promote teacher learning. *Educational Researcher, 34*(3), 3-14. doi: 10.3102/0013189X034003003

Hott, A. M., Huether, C. A., McInerney, J. D., Christianson, C., Fowler, R., Bender, H., et al. (2002). Genetics content in introductory biology courses for non-science majors: Theory and practice. *BioScience*, *52*(11), 1024-1035.

Jennings, B. (2004). Genetic literacy and citizenship: Possibilities for deliberative democratic policymaking in science and medicine. *The Good Society*, *13*(1), 38-44. Retrieved October 13, 2009, from http://74.125.155.132/scholar?q=cache:wv8ClzxtsowJ:scholar.google.com/&hl=en&as_sdt=2000

Morse, L., Wilbur, K., & Ballard, K. (2004). Unintended consequences: Implications for health and physical education. Presented at the No Child Left Behind forum, February 20-21, 2004, Reston, VA. Retrieved October 24, 2006, from http://www.aahperd.org/aahperd/template.cfm?template=nclb.html

National Academy of Sciences. (1996). *National Science Education Standards*. The National Academies Press, Washington DC.

National Association of State Boards of Education. (2009). *State School Healthy Policy Database* [Database]. Retrieved October 30, 2009, from http://www.nasbe.org/healthy_schools/hs/

National Education Association. (2004). No subject left behind? Think again. *NEA Today*, *23*(3), 26-27.

National Foundation for Educational Research. (2008). *NFER Teacher Voice Omnibus February 2008 Survey: Science Enquiry*. Retrieved October 13, 2009, from http://www.nfer.ac.uk/what-we-offer/teacher-voice/PDFs/science-enquiry.pdf

NetDay. (2004). *Insights and Ideas of Teachers on Technology: National Report on NetDay Speak Up Day for Teachers 2004*. Retrieved October 13, 2009, from http://netday.org/speakup/pdfs/netdaysud4t2004report.pdf

Schneider, R. M., & Krajcik, J. (2002). Supporting science teacher learning: The role of educative curriculum materials. *Journal of Science Teacher Education, 13*(3), 221-245.

Todd, R. J. (1995). Integrated information skills instruction: Does it make a difference? *School Library Media Quarterly, 23*(2), 133-138.

Trotter, A. (2009). Teachers get resourceful with 'open content.' *Teacher Magazine, 2*(2), 7-9. Retrieved October 12, 2009, from http://www.teachermagazine.org/tsb/articles/2009/03/16/02open.h02.html

U.S. Department of Health and Human Services. (2000). *Healthy People 2010* (2nd ed.). With Understanding and Improving Health and Objectives for Improving Health. 2 vols. Washington, DC: U.S. Government Printing Office. Retrieved October 12, 2009, from http://www.healthypeople.gov/Document/pdf/Volume1/11HealthCom.pdf