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Developing a Cross-Age Teaching Programs: The Benefits to the Student 'Teachers'

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Abstract
Cross-age teaching is a technique where an older student acts as 'teacher' and teaches concepts to younger students. This paper includes a literature review that discusses the benefits of cross-age teaching to the older 'teachers,' and reviews a program developed by the researcher based on the benefits of good cross-age teaching programs, where 11th grade honors chemistry students create, develop, and assess a science lesson to teach 5th grade science students. The process is detailed, and concludes with the students and teachers reflecting over the results and what changes could be made to improve such a program in the future. Finally, applications of cross-age teaching programs are explored, and the research concludes the benefits of being the 'teacher' are advantageous to all levels of students. Such programs are in need of more collaboration and effort on the part of educators and researchers, but the benefits gained by all students make effort well worth it.

Keywords: cross-age teaching, peer teaching, teaching pedagogy, teaching strategies

Introduction
I am in front of my honors chemistry classroom at the board, reviewing how to complete advanced mole problems with my students. I go over the procedure one more time, look for lost faces, and ask for questions. The class is largely quiet except for a mad whispering between students on the middle right-hand side of the room. I asked the them what was wrong, what they needed to know. Tasha (not real name), looking vastly relieved, explained to me 'It's okay, Miss Dixon. I asked Taylor how to do it and she explained it so I could understand. I'm fine now.' Instead of being upset that Tasha felt the need to go to Taylor in the first place, I chose to be proud that Taylor could explain the procedure so well.

In recent years, the practice of students teaching other students has been widely employed. Originally, this practice was viewed as an effective way to increase one-on-one instruction. However, the benefits for both the tutor and the tutees are now being recognized. (Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003). Instructional strategies used in K-12 education that involve students playing the role as 'teacher' include peer tutoring of all kinds (cross-age, same-age, reciprocal, and non-reciprocal), cooperative learning, reciprocal teaching, and many lesser-known strategies (Puchner, 2003). The purpose of this article is to examine these strategies, apply them to a current public school classroom project, and reflect upon the benefits and future studies that should be implemented involving this technique.

The project discussed in this article focuses on cross-age teaching in which an older student assumes a teaching role in order to implement activities, guide, or cause learning by younger students. Demonstration of teaching-like behaviors (demonstrating, explaining material to others, asking questions of others to bring understanding) and lesson planning (Puchner, 2003) are examined. A literature review examining current thinking on this topic is followed by implementation strategies based on this research and how they were applied to a practical project involving public school science students.

Using the literature review as a template, the researcher developed her own cross-age teaching project. The teachers were grade 11 Honors Chemistry students and the students were fifth grade science students. Focused on were the benefits of this strategy for the student-teachers, and characteristics of quality cross-age teaching programs not mentioned in the research found. Upon reflection, the researcher acknowledges more work needs to be done in facilitating programs such as these, but

discusses the benefits to many student populations, including students with honors and students with disabilities. The researcher concludes that cross-age teaching is a concept that is highly adaptable to many situations, and if monitored carefully, can be beneficial to not only the tutored students, but also to the tutors themselves.

Why Use this Strategy?

While cross-age teaching is beneficial to both the younger, tutored students [tutees], this article focuses primarily on the benefits to the honors high school students [honors teachers]. Those benefits are the development of abstract thinking, identity formation, autonomy, achievement, and transition to adulthood (Murdock, Lee, Paterson, 2003).

1. *Development of Abstract Thinking*

Piaget (1952) noted that during adolescence, many changes in cognition occur including developing capacities to think logically, manipulating mental representations, thinking in three-dimensional ways, and planning and implementation of activities. The honors teachers in this project created a lesson plan based on fifth grade Ohio State Standards and Next Generation Science Standards [NGSS]. Objective-driven lessons included a hands-on activity and an assessment. Tutors taught their lessons then assessed the fifth graders' learning. This supports Fuchs, Fuchs, Karns, Hamlett, Dutka, and Katzaroff (1996), who noted that children who learn the most in peer tutoring contexts are those who provide detailed and complex explanations to other children.

2. Identity Formation

In his stage development theory, Erikson (1963), defines identity as a 'sense of community that gives adolescents a link to their past and a direction for their future' (p. 14). Young adolescents need opportunities to try out different roles, to master tasks, and to feel they belong to a group and are accepted (Murdock, Lee, & Paterson, 2003). Further, it is suggested (Urdan, Midgley, & Wood, 1995) that task-focused activities divert attention from social and ability comparisons and allow young teens to acquire competencies. Seemingly agreeing with this, Urdan et al. (1995) advocate teamwork, authentic roles in the community, and recognition for taskmaster by peers and adults. Murdock et al. (2003), note that teamwork is a requirement by most peer teaching programs, along with reflection.

3. Autonomy

Autonomy can be classified as behavior autonomy, which is defined as the ability to govern one's own behavior (instead of being directed by adults), and emotional autonomy, which is an adolescent's growing capacity to think, feel, and act on his or her own (Steinberg, 2002). Fertman (2000) asserts that adolescents need opportunities to make decisions, express opinions, and imagine the consequences of their behavior. Cross-age teaching programs provide opportunities for adolescents to make decisions since they are acting as teachers and not 'teacher helpers.' Teens feel the success of the lesson is their responsibility. Murdock et al. (2003) note that adolescents' confidence grows as their teaching increases and they experience success.

4. Achievement

Science classrooms are places where students correlate their achievement in these subjects with their attitudes toward science classes (Choi & Chang, 2009). Cross-age teaching allows teens to experience success in an area in which they may have failed. The subject matter is at a lower level so it is more easily mastered. Since teens' ability to teach material does not seem to correlate at all with school grades (Dean & Murdock, 1992), they can feel competent regardless of their past performance with a subject. In fact, Murdock et al. (2003) observed repeatedly that the teens who seem to derive the most benefit from serving as cross-age teachers are those who have not achieved the highest levels of academic success themselves. In the few studies that noted the tutor's academic outcome after tutoring, Cohen, Kulik, and Kulik (1982), found that 87% of tutors showed improvement, especially in science.

5. Transition to Adulthood

Adolescence is often viewed as the time when teens learn the 'rules' for being an adult. They develop the skills necessary to become parents, workers, and productive citizens (Murdock et al., 2003). Researchers seem to agree (Murdock et al., 2003) that adolescents need strategies and opportunities to help transition to adulthood. Among ideas to support this are working in community service (Gamebone, Klem, & Connel, 2002), and other programs that strengthen communities and bring adolescents in contact with mentors. Cross-age teaching promotes skills that aid this transition. As teachers, teens learn adult work skills and develop good work habits like preparation, punctuality, and enthusiasm (Murdock et al., 2003).

In other studies, adults who observed teens working as teachers saw that they were patient and nurturing with the children. The teens were both surprised and pleased with the level of admiration the elementary students showed them (Murdock et al., 2003). Teens also felt they were helping children in a real way, meeting a need. This gave them a sense of pride and accomplishment. In addition, teens learned to empathize with their teachers. They now understood the work teachers put into daily lesson planning, doing activities, and teaching concepts.

Characteristics of Good Programs Implemented into this Practical Project

For a cross-age teaching program to be successful, five criteria must be met (Murdock et al., 2003; Lee, C.H. & Murdock, S. 2001; Kalkowski, 1995). Along with each listing is a description of how each applied to the cross-age teaching assignment that was employed.

1. Assess and design the programs based on goals, objectives, and resources at hand.

Since interest in science often wanes in middle grades (Yanowitz & Vanderpool, 2004), honors high school students tutoring fifth grade students made sense. First, the researcher gained permission from the high school and primary school principals to contact the fifth grade teachers in the district. They were very pleased to give permission, and both fifth grade science teachers were happy to work with the researcher. The state standards and the NGSS were distributed to the high school students with the initial assignment worksheet that was created (See Appendix B). All requirements of the assignment were thoroughly reviewed and included a learning objective based on the state standards, a hands-on activity, and an assessment. With extra grant money from the science department budget, the school district purchased the supplies needed for the hands-on activity. The tutors were given a day of class time to complete their research although they spent a generous amount of time outside the classroom in research as well.

2. Establish specific, measurable objectives.

After thorough research, no similar projects were found so the researcher made the rubric for this project. It is considered a work-in-progress and is included in Appendix D.

The honors students, working in groups of 2 or 3, had several requirements. They needed to develop good interaction with the fifth graders. They should have practiced their presentation of the lesson and were REQUIRED to do their activity/lab before doing it with the fifth graders. They also needed to become science 'experts' related to the objective taught and be able to answer tutees' questions. They needed to consider whether the amount of rigor was appropriate for the students and how they would know if the students learned the lesson. The hands-on activity was very important. It needed to be not only fun but also needed to support their objective. The lesson needed to be age-appropriate and be completed comfortably in 30-35 minutes. The all-encompassing question at the end was: What did they want the fifth graders to walk out of the class knowing?

3. Provide support to your tutors

Before sending honors high school students to a fifth grade classroom, it was important to go over ground rules with them. Some were used to working with younger children, but many were not. We discussed the need for maturity and patience, reviewed classroom management techniques, and carefully considered each group's chosen objective.

What greatly helped was that after the first group presented, they discussed the experience with the class and offered advice. It was fascinating to hear the story from their perspective and gave me new insight related to how children perceive adolescents. A favorite story was that a fifth grader tried to explain to the district's top sprinter why track was not really a sport. The sprinter took it in good grace, but it really tested his patience and manners.

4. Support by teachers and administrators

Support from the whole district is essential to the success of any tutoring endeavor. In addition to the principals and the elementary teachers, the high school teachers were also asked to dismiss the groups from class ten minutes early so they could take their supplies to the elementary school. The superintendent attended the first presentation and was impressed proud that the district's high school and elementary teachers chose to work together for the good of all students.

5. Keep parents and the community informed

This is essential for this project. Parents took honors students shopping for supplies, and drove them to school to deliver those supplies. The community rallied round them as well. The project was featured in two local newspapers and on the school's website, and many positive comments were heard about the program.

Tips for Future Cross-Age Teaching Projects

The first tip for anyone who would try this type of project in the future is about communication, primarily with the honors chemistry students. In the beginning phase of developing a lesson plan, constant monitoring of their progress is crucial. The honors chemistry students were required to display their in-process plans each week to check for development and to receive feedback. The honors teachers were given approximately two months to prepare their lesson, and the fifth grade teachers and researcher had to approve the lesson plan before it was presented. An early version of a sample lesson plan is included in Appendix C. This plan was later added to and revamped before the final presentation.

Another practical idea learned is having a 'practice' session for the honors teachers. They practiced their lesson with their own peer group by presenting them to their honors chemistry class, and received teacher and student feedback. This then improved their presentations for the fifth graders based on the feedback given.

A helpful part of this project was that each lesson was taught more than once. The honors teachers taught their lesson twice, once in the morning and once in the afternoon. After their first session, they reflected upon the experience and discussed changes to be made for the afternoon session. They were clearly more confident and at ease with both the content and the younger students in the subsequent lesson. They then felt more confident to make lesson decisions and try new techniques with the elementary students.

What did the researcher learn for next time?

One of the biggest factors incorporated in this project that was not in the research was the use of reflection. After all of the groups had taught, both the teachers and high school honors teachers were asked to reflect on their experience (Appendix A). The 5th grade teachers decided that next year they would decide what science subjects needed more instructional time or more activities to emphasize the concept, they would ask the honors students to develop related lesson plans.

The high school students' reflections seemed to coincide with this. Students indicated that when presented with so many topic possibilities, they had trouble narrowing down what to teach. A considerable time was spent in their research trying to make this decision, and they would have liked to have made better use of that time. They asked for a focused list of topics to choose from instead of having to decide for themselves out of all of the standards.

The researcher selected this 'Honors Chemistry' class for this project since it was a 'pilot-test' for a cross-age teaching project. While these students were approved to take this higher level class, there were still included both higher and lower achieving students in the mix. However, based on its success the researcher plans to use it with students of all levels. This is due to the lower level honors chemistry students experiencing perhaps greater success with both self-concept in science and with the elementary students. Lower level honors chemistry students were identified as those needing additional explanation of chemistry concepts and practice. Perhaps because of this, they provided more and more thorough explanations to the elementary students than those chemistry students who just 'get it' with little explanation.

Greater self-concept and empathy were also confirmed in this project. Students who had to this point focused mostly on their own lives found themselves empathizing with the tutees. They understood the tutees' feelings of frustration and impatience. As students themselves, the tutors encouraged and comforted the elementary students better than their teacher could, and that seemed to make a difference. Along with this point, the high school students also seemed to take greater personal responsibility regarding absences and tardiness, making sure any appointments did not conflict with their teaching, research, or reflecting time.

It is interesting to note the range of grades the high school students earned. The bulk of their grade was based on improving from the run-through to the actual presentation. Did the honors high school students push themselves? Were they out of their comfort zones? Did they explain science concepts in detail, yet simply enough for a fifth grader to grasp? The researcher believed all students did this so they all received a grade of of A or B. The level of grade was determined by how well they incorporated the feedback they were given. Next year, it is planned to require that the activity must consist of a repeated lab, not just necessarily an activity. The lab will have a data sheet, and the follow up assessment will be graded with the students rather than the honors high school students quickly grading papers during their presentation, which they reflected did not make the best use of their time.

As mentioned, this project received good reviews from the 5th grade teachers, the 5th grade students, the principal, superintendent, and even the parents. But how about the honors teachers? What did they have to say about the experience in their reflections? All fourteen honors teachers completed the reflection in Appendix A. Their reactions were varied. Five students already were interested in becoming teachers, and this experience cemented that interest for them, and confirmed their future career plans. The other nine did not want to become teachers beforehand, and indicated that this experience, while enlightening, did not change their minds. The individual comments supported this, but also found they seemed to learn a new appreciation for their teachers. One student mentioned that he did not 'know what teachers did all the time before…that they put so much work into teaching.' They came to realize and respect what lengths their teachers have gone to over the years to make the lessons interesting, relevant, and rigorous. Even if they did not want to become teachers, they were happy and impressed at how the 5th graders received them. Several comments mentioned how excited the classes were to see someone new, older, and 'cool.' I hope this made them realize what impact they can have on leadership at their schools in academics and beyond.

Conclusion

The purpose of this article was to examine the process of cross-age teaching and explore the benefits of a cross-age teaching project involving honors chemistry students as teachers. Since the project was facilitated in an honors chemistry class, after examining the five key benefits of cross-age teaching for the honors teachers (honors chemistry students), the researcher reflected on the practicality and application of each step. The research also presented five key steps to forming a successful cross-age teaching program. It explained how those steps were followed in this project as well. Hopefully the reader will find that the program is advantageous, adaptable, and deserving of the effort to initiate.

The most current research available specifically for projects such as this comes largely from the last decade. More prototype programs need to be established by groups of teachers and administrators working collaboratively across the disciplines. The assignments for the student teachers need to be refined and a rubric for scoring should be developed. Another area to address is the need for 'chunking' the project in realistic, do-able sections for the student-teachers. A great deal of outside-the-classroom work was needed to complete this project, but the researcher felt the need to closely monitor the honors teachers' progress. It is felt that this system could be further developed to run more smoothly than it was here.

Why should so much effort be put into such a concept? Based on the study done here, there are applications for many different groups of students. Besides being an excellent project for students who are gifted, there is great potential for students with disabilities as well. Often in a public school, the students who receive services are in their own 'areas' for much of the school day. Even though inclusion allows special education teachers and general education teachers to teach side-by-side, this researcher has noticed that students with disabilities stay largely within their own subgroups in classes, study halls, and at lunch. This form of 'isolation' could be greatly mitigated with the use of cross-age teaching strategies. Students with honors or students of general education can teach lessons along to the students with disabilities resulting in many benefits. All students would gain socialization time with those of potentially varying cultures, values, and socioeconomic diversity. Students getting to know each other better could lead to greater integration of different groups in academic and extra-curricular social situations.

Given appropriate attention and creativity, the flexibility of cross-age teaching strategies can benefit all teachers in all subjects. But the most important benefit is that it can be modified to help students of diverse backgrounds. This often-overlooked concept has a place in the education system today to ensure not only academic success, but success in a wide variety of other areas and can enforce the holistic meaning of the word 'education.'

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Appendix A
Reflection Assignment

F.H.S. Honors Chemistry
Teaching Reflection

Name _____
Date _____ Period _____

Please answer the following questions honestly.

1. What did you think went well during your lesson?
2. What did not go as well as you would have hoped during your lesson?
3. Did anything happen that surprised you or you were not expecting?
4. Did you feel 'comfortable' teaching the students and interacting with them?
5. How did the second time you did your lesson compare with your first? Did you do anything differently your second time through?
6. If you had the power now to go back in time and give yourself advice when you were given the assignment, what would you say?
7. If you had to rate this project from 1 (thank GOODNESS this is over!!!) to 10 (I think I found a new career), what would you give it and why?
8. Now that you have looked on it from this perspective, what is your opinion about the process of education in the United States right now? What would you change? Do you think about it differently than you did before?

Appendix B
Honors Chemistry Cross-Age Teaching Assignment

F.H.S. Honors Chemistry
Cross-Age Teaching Assignment

Name _____
Date _____ Period ____

Directions: In groups of two or three, you are going to teach a science lesson to a class of fifth grade students. I am giving you copies of state standards and NGSS for fifth grade. Your group must create a lesson plan that has the following parts: An objective (that aligns with the standards), a hands-on activity, and some type of assessment (quiz, question and answer, wrap-up activity).

You will teach this lesson in two months. You will have one chemistry class period to research, but are absolutely encouraged to do more research outside of class. Your group and I will be in constant contact, as the fifth grade teachers and I must approve your lesson plan before your presentation.

Dates to Remember: Monday, February 6th will be your in-class research day. The laptop cart will be here for you. The first thing on your list to do is find an objective and hands-on activity. Make a list of the materials you will need for your activity for a total of 60 students. This list is due to me by February 17th, so that I may start gathering your supplies. I recommend you find an area on their standards that you like, feel comfortable with, and have covered recently in a science class. I will be making a first check of your progress on Monday, February 13th, and would like to see what you've researched thus far.

Your final grade on this project will be based on the rubric I have given you. I expect a relative content expert, being comfortable with your audience, and pushing yourself in your presentation. Most of all, I want to know what you want the fifth graders to walk out knowing, and if you think they accomplished that. I am here for you every step of the way.

Why? You may be asking why you have to teach a fifth grade science lesson in an Honors Chemistry class. You have completed many science classes, but science is more than taking a test. I want you to be able to explain scientific concepts in detail, model scientific thinking, and demonstrate the process of doing science. All of your previous science classes have been preparing you for this, in the different science disciplines, and now is your time to shine!

Remember, you may email me at the school email address at any time, and I will get back with you. If you are unsure of anything, please ask. I look forward to reading your lesson plans and hearing you teach!

LESSON PLAN TEMPLATE

Objective:

Standards:

Outline of the 35 minutes:

Hands-on activity:

Assessment:

Appendix C
An Early Version Lesson Plan (That was later corrected)

Slime Lesson Plan

By: Deleted

What are the three states of matter? Did you know that there is a word for the state that possesses qualities present in a solid and a liquid? It's called a polymer...

Polymer:
A polymer possesses qualities present in a solid and in a liquid matter. This means it can behave like a liquid, in the sense that it can follow the shape of its container, but can at the same time be picked up just like a solid. If you think back to the properties of matter, the particles of a solid are very intact and compact while those of the liquid are slightly more spread out causing it to break apart. However, particles in a polymer behave in a way where they chain themselves together causing it to behave like liquid but not too loose to break apart or flow.

Supplies needed:

- 2 Gallons of White Glue
- Water
- 1 box of Borax - Does anyone know what borax is also used for? (whitening clothes)
- 1 box of Food Coloring
- Ziploc Baggies
- Bowls
- Spoons
- Napkins

Objectives:

- Be able to explain what makes up a polymer and give examples of polymers you see everyday

Directions:

1. Mix 1 teaspoon borax in 1 cup of water. Stir until borax is dissolved.
2. In a separate container, mix ½ cup (4 oz) white glue with ½ cup water.
3. Add food coloring, if desired.
4. After borax is dissolved and glue is diluted, combine the two solutions.
5. Stir one slime solution into the other. The slime will begin to polymerize immediately.
6. Mix it as much as you can, then remove it from the bowl and finish mixing it by hand.
7. Store slime in sealed ziplock bags, preferably in the fridge.

Slime Questions & Discussion

Discussion:

Slime borders liquid and solid, which makes it very fun to play with. Looking back at our experiment, the slime was created by mixing glue and the borax solution together. Now the question is, what's in glue and borax that caused them to behave this way, and producing a slime?

The glue mixture is expected to behave like liquid and is therefore likely to flow. When we included borax in the mixture, the borax prevents the glue from flowing like normal. The result is then a material that is liquid like, but does not flow. We call this kind of material a polymer.

Questions:

1. What is polymer?

- Both a solid and a liquid. Molecules which are tiny little molecules chain together which makes an item hold its shape and then be altered.

2. What are some other examples of polymer? What do they have in common with the slime we made today?

- Rubber, silly putty, DNA, proteins such as nails, rubber, anything plastic, jell-o

3. What is a physical property? What are two physical properties of polymers?

- Physical properties can be observed or measured without changing the composition of matter. Elasticity, super strength, light weight, color.

4. What happened to the borax when you put it in the water?

- It became cloudy, borax began to dissolve into the water. (physical change)

5. Did a chemical or physical change occur?

- Physical change because the mixture cannot be reverted back to what it was.

Appendix D
Cross-Age Teaching Assignment Rubric

Rubric

Things I will be looking for watching you teach:

1. Interaction between TG team and between TG and 5G 10 points
a. Between the teaching group [TG] and the 5th graders [5G]
b. Did you give them many opportunities to participate?
c. Were you friendly and approachable to the students?
d. Between members of the [TG]
e. Were you all smooth together? Was the presentation rehearsed? You knew who was doing each part?

2. Objectives 10 points
a. What is the lesson you teaching?
b. Did the students 'get it?' How do you know?
c. Did the lesson have appropriate rigor for the [5G]?
d. Were you TG knowledgeable about your subject?

3. Hands-on 10 points
a. Was the activity engaging?
b. Did the students both have fun AND learn the objectives?
c. Was the activity appropriate age/grade level?

4. Technicalities 10 points
a. Did you fill all of your allotted time?
b. Were both you and 5G comfortable?
c. Did you listen to advice given during your practice run and improve?

5. Program 10 points
a. Did you introduce, present your lesson clearly to the 5G?
b. Did they understand your directions?
c. Was the lesson /activity as organized as it could be?
d. Did you have an appropriate follow-up activity?

The BIG Question: What do you hope the children walk away knowing, and how will you ensure it happens?

Please think about these as you plan and teach. There is no such thing as perfection, but I am looking for growth in all areas between your practice run with our class and your presentation to the fifth grade.