

**Breaking Old Traditions and Changing Mindsets
in the
Math Classroom**

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A genuine connection between academic knowledge and real-life application is arguably the most important element of learning. Oftentimes, this is missing in math instruction. A traditional math classroom is extremely teacher-centered, also known as “sit and get” learning. The teacher stands in front of the classroom lecturing students, hoping that by copying what they see, the students will understand how to do the math. In addition to the lecture format, math skills are often taught in isolation, with application incorporated at a later time. Students aren’t given an early opportunity to attach the importance of skill to its real-world relevancy. In a traditional classroom, students are expected to master the skill alone before they are offered a chance to use it in a critical-thinking-inspired situation. The attention span of the current generation of students we teach is being pulled in too many directions for this style of teaching. Teachers have to compete with these distractions by making their content as relevant to students’ lives as possible. Students nowadays need to know why these lessons in mathematics are important; and need help attaching the skills that they learn, to their long-term conceptual understanding, through rich tasks and project-based learning. There is a plethora of research available supporting project and problem-based learning in mathematics. This literature review is a comprehensive analysis that will highlight research that supports project-based/student-centered learning as opposed to traditional/teacher-based learning.

This study addresses the importance and benefits of the project and task-based learning. A student perspective is collected and analyzed to determine if math teachers should refrain from the lecture-style approach to mathematics, and move towards problem-solving environments that create connections to the real world and provokes critical thinking. The overall goal of the project is to produce a data-driven article convincing math educators to reconstruct their lessons from traditional learning to project-based learning. The project starts with a literature review,

analyzing several bodies of research that examines the struggle for students to learn math, and the evidence currently available to support project-based math instruction. Next, I surveyed several groups of students at my school, to collect actual data from the population in which I teach. The findings from the literature and data analysis were used to draw important conclusions on how math teachers should proceed with lesson planning and delivery of instruction in the upcoming school year.

Research Design

I chose to survey students to analyze their beliefs to see if it is aligned with the research shown through project-based learning in math. Raw student data was collected through a survey of 8th-grade students from a collaborative math class; a general education math class; and an accelerated math class. Students were given 9 questions to answer honestly and anonymously. The survey asks them about their preferred learning style; math strengths and weaknesses; and feelings towards tasks and projects.

The questions in the survey were designed to gauge how students think they learn math best and their opinions of math projects. I intentionally surveyed three different student populations that perform at a range of academic levels from the lower achieving math students to the highest achieving math students in the school. The results from the survey are displayed through charts. Analysis of the various charts leads to findings and conclusions that will either support or oppose the theory of project-based learning being a stronger instructional approach in math class than traditional teaching has been.

Student Data Analysis

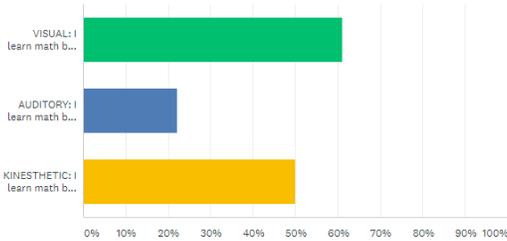
Student Survey

(Question #1)

Collaborative Math 8 Class

What type of learner are you? *Check ALL that Apply*

Answered: 18 Skipped: 1

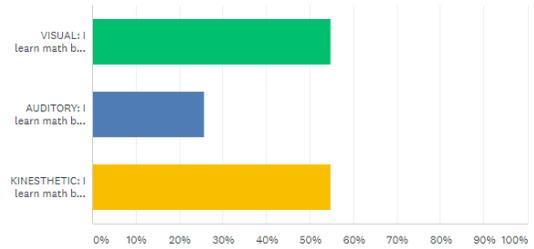


ANSWER CHOICES	RESPONSES
VISUAL: I learn math best through looking/watching	61.11% 11
AUDITORY: I learn math best through listening	22.22% 4
KINESTHETIC: I learn math best through physically doing activities	50.00% 9
Total Respondents: 18	

General Education Math 8 Class

What type of learner are you? *Check ALL that Apply*

Answered: 31 Skipped: 0

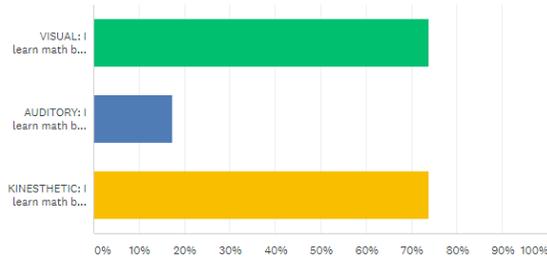


ANSWER CHOICES	RESPONSES
VISUAL: I learn math best through looking/watching	54.84% 17
AUDITORY: I learn math best through listening	25.81% 8
KINESTHETIC: I learn math best through physically doing activities	54.84% 17
Total Respondents: 31	

Accelerated Algebra I Class

What type of learner are you? *Check ALL that Apply*

Answered: 23 Skipped: 0



ANSWER CHOICES	RESPONSES
VISUAL: I learn math best through looking/watching	73.91% 17
AUDITORY: I learn math best through listening	17.39% 4
KINESTHETIC: I learn math best through physically doing activities	73.91% 17
Total Respondents: 23	

Overall Findings:

The majority of the students surveyed expressed that they are more visual and kinesthetic learners, as opposed to auditory. This implies that students learn math best through seeing and doing in the math classroom. Tasks and projects provide more learning opportunities for

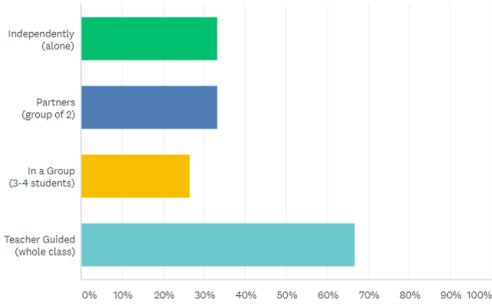
students to learn based on their preferred learning style than the traditional lecture method of teaching.

(Question #2)

Collaborative Math 8 Class

How do you prefer to practice math in school?

Answered: 15 Skipped: 4

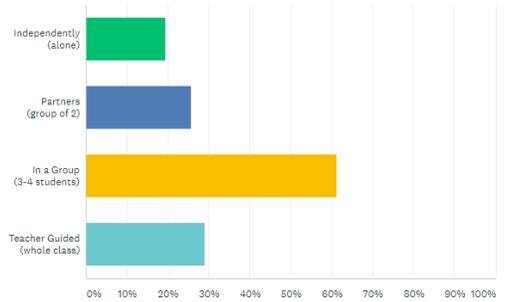


ANSWER CHOICES	RESPONSES
Independently (alone)	33.33% 5
Partners (group of 2)	33.33% 5
In a Group (3-4 students)	26.67% 4
Teacher Guided (whole class)	66.67% 10
Total Respondents: 15	

General Education Math 8 Class

How do you prefer to practice math in school?

Answered: 31 Skipped: 0

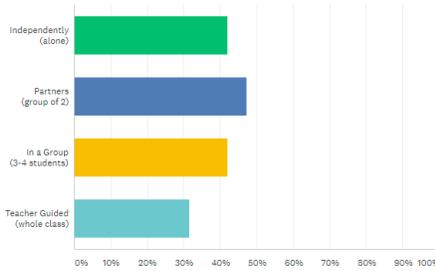


ANSWER CHOICES	RESPONSES
Independently (alone)	19.35% 6
Partners (group of 2)	25.81% 8
In a Group (3-4 students)	61.29% 19
Teacher Guided (whole class)	29.03% 9
Total Respondents: 31	

Accelerated Algebra I Class

How do you prefer to practice math in school?

Answered: 19 Skipped: 4



ANSWER CHOICES	RESPONSES
Independently (alone)	42.11% 8
Partners (group of 2)	47.37% 9
In a Group (3-4 students)	42.11% 8
Teacher Guided (whole class)	31.58% 6
Total Respondents: 19	

Overall Findings:

In the collaborative classroom setting, containing a blend of special education and general education students, most students want that constant teacher guidance that lecture-based

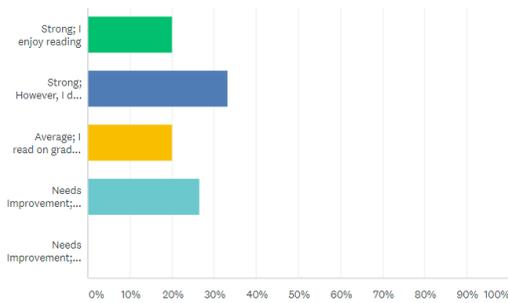
teaching provides. The general and accelerated populations prefer to work with a partner or in groups. Tasks and projects allow for more collaboration within the classroom, which is what most students desire while learning math.

(Question #3)

Collaborative Math 8 Class

Challenging math problems often require you to read. How would you best describe your reading ability?

Answered: 15 Skipped: 4

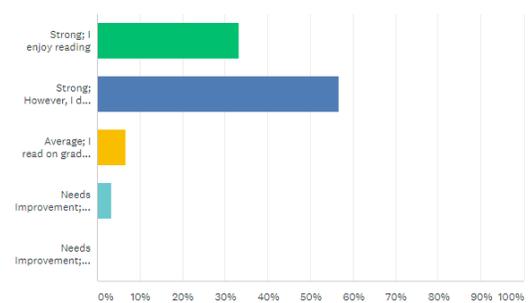


ANSWER CHOICES	RESPONSES
Strong; I enjoy reading	20.00% 3
Strong; However, I do NOT really enjoy it	33.33% 5
Average; I read on grade level	20.00% 3
Needs Improvement; I am working on getting stronger at it.	26.67% 4
Needs Improvement; I don't care to get better	0.00% 0
TOTAL	15

General Education Math 8 Class

Challenging math problems often require you to read. How would you best describe your reading ability?

Answered: 30 Skipped: 1

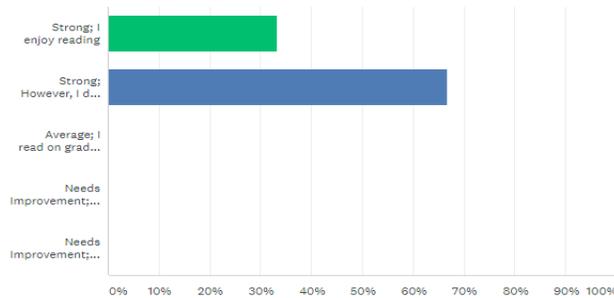


ANSWER CHOICES	RESPONSES
Strong; I enjoy reading	33.33% 10
Strong; However, I do NOT really enjoy it	56.67% 17
Average; I read on grade level	6.67% 2
Needs Improvement; I am working on getting stronger at it.	3.33% 1
Needs Improvement; I don't care to get better	0.00% 0
TOTAL	30

Accelerated Algebra I Class

Challenging math problems often require you to read. How would you best describe your reading ability?

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
Strong; I enjoy reading	33.33% 6
Strong; However, I do NOT really enjoy it	66.67% 12
Average; I read on grade level	0.00% 0
Needs Improvement; I am working on getting stronger at it.	0.00% 0
Needs Improvement; I don't care to get better	0.00% 0
TOTAL	18

Overall Findings:

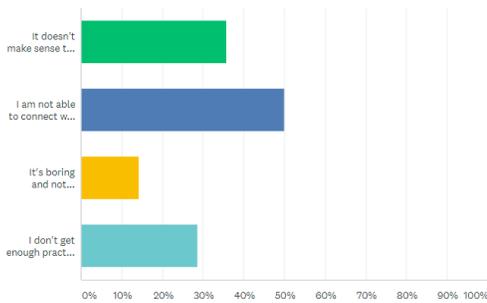
Student ability and comfortability with reading are important when implementing tasks and project-based learning. The trend in the data shows that there is a correlation between reading and math. The strongest math students are also the strongest readers. The struggling math students acknowledged that they are not all strong readers. This data implies that there is a correlation between reading and math ability. Math tasks and project-based learning is an excellent way to incorporate reading practice across curriculums.

(Question #4)

Collaborative Math 8 Class

What are your biggest issues with learning math in middle school? *Check ALL that Apply*

Answered: 14 Skipped: 5

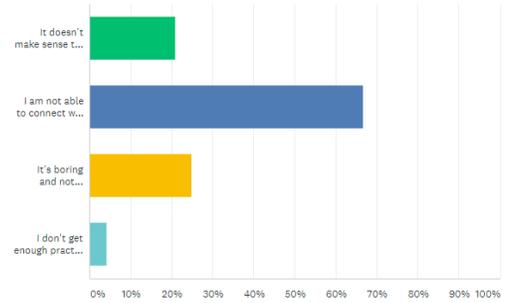


ANSWER CHOICES	RESPONSES
It doesn't make sense to me	35.71% 5
I am not able to connect what I learn in math to real life	50.00% 7
It's boring and not important	14.29% 2
I don't get enough practice in math and need more help	28.57% 4
Total Respondents: 14	

General Education Math 8 Class

What are your biggest issues with learning math in middle school? *Check ALL that Apply*

Answered: 24 Skipped: 7

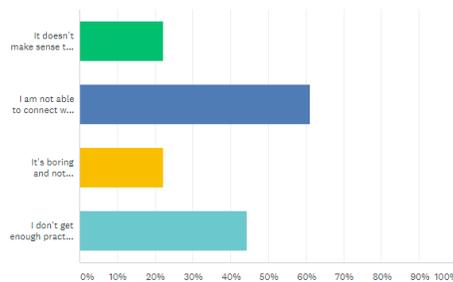


ANSWER CHOICES	RESPONSES
It doesn't make sense to me	20.83% 5
I am not able to connect what I learn in math to real life	66.67% 16
It's boring and not important	25.00% 6
I don't get enough practice in math and need more help	4.17% 1
Total Respondents: 24	

Accelerated Algebra I Class

What are your biggest issues with learning math in middle school? *Check ALL that Apply*

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
It doesn't make sense to me	22.22% 4
I am not able to connect what I learn in math to real life	61.11% 11
It's boring and not important	22.22% 4
I don't get enough practice in math and need more help	44.44% 8
Total Respondents: 18	

Overall Findings:

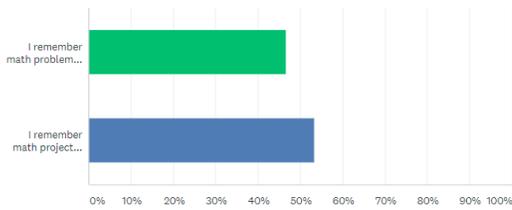
The data shows that students believe the biggest issue in learning math is the lack of connection being made to the real world. This category received the most votes in all 3 levels of learners. Tasks and projects are designed to present students with a real-world issue/scenario and use mathematic skills and reasoning to find solutions.

(Question #5)

Collaborative Math 8 Class

Choose which type of activity you still remember doing 6th through 8th grade?

Answered: 15 Skipped: 4

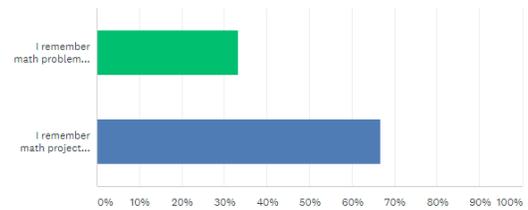


ANSWER CHOICES	RESPONSES
I remember math problems on a textbook or worksheet	46.67% 7
I remember math projects and major challenge questions/tasks	53.33% 8
TOTAL	15

General Education Math 8 Class

Choose which type of activity you still remember doing 6th through 8th grade?

Answered: 30 Skipped: 1

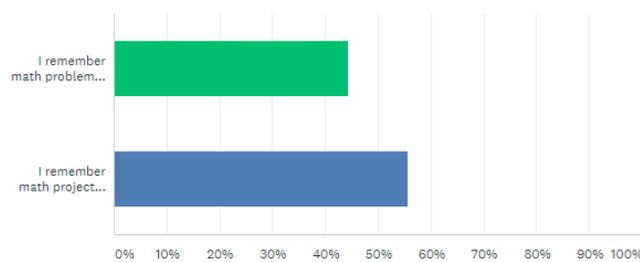


ANSWER CHOICES	RESPONSES
I remember math problems on a textbook or worksheet	33.33% 10
I remember math projects and major challenge questions/tasks	66.67% 20
TOTAL	30

Accelerated Algebra I Class

Choose which type of activity you still remember doing 6th through 8th grade?

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
I remember math problems on a textbook or worksheet	44.44% 8
I remember math projects and major challenge questions/tasks	55.56% 10
TOTAL	18

Overall Findings:

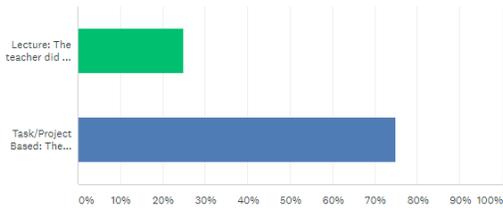
According to the data presented, all 3 math classes remember challenges brought forth through tasks and projects more than they remember problems practiced in textbooks. Regardless of how much they resist pushing themselves past their cognitive comfort levels, they remember when they are challenged in math class. Tasks and projects provide a rich learning experience that goes beyond recall and affords students to hold on to learning experiences for years.

(Question #6)

Collaborative Math 8 Class

Which did your favorite middle school math teacher (6th, 7th and/or 8th) do to make you enjoy their class?

Answered: 12 Skipped: 7

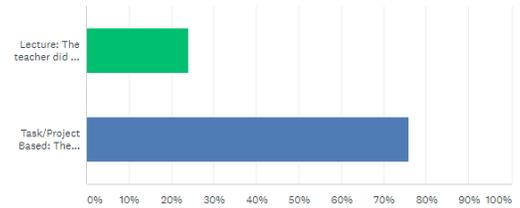


ANSWER CHOICES	RESPONSES
▼ Lecture: The teacher did a lot of talking and made you take notes; then made you practice problems.	25.00% 3
▼ Task/Project Based: The teacher spoke sometimes; most of the class time was spent figuring out challenge problems; performing tasks; and/or completing a project.	75.00% 9
TOTAL	12

General Education Math 8 Class

Which did your favorite middle school math teacher (6th, 7th and/or 8th) do to make you enjoy their class?

Answered: 29 Skipped: 2

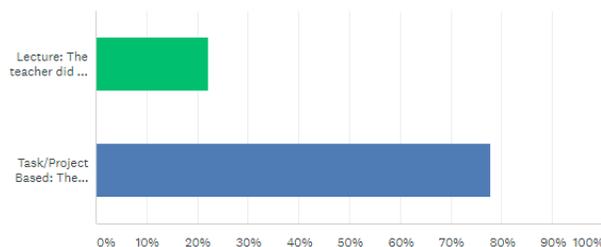


ANSWER CHOICES	RESPONSES
▼ Lecture: The teacher did a lot of talking and made you take notes; then made you practice problems.	24.14% 7
▼ Task/Project Based: The teacher spoke sometimes; most of the class time was spent figuring out challenge problems; performing tasks; and/or completing a project.	75.86% 22
TOTAL	29

Accelerated Algebra I Class

Which did your favorite middle school math teacher (6th, 7th and/or 8th) do to make you enjoy their class?

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
▼ Lecture: The teacher did a lot of talking and made you take notes; then made you practice problems.	22.22% 4
▼ Task/Project Based: The teacher spoke sometimes; most of the class time was spent figuring out challenge problems; performing tasks; and/or completing a project.	77.78% 14
TOTAL	18

Overall Findings:

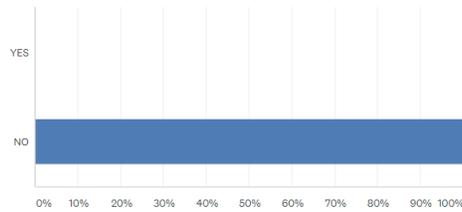
It is clear from the data that students do not like the lecture approach when learning mathematics. They prefer for teachers to talk when necessary and then allow them to reason and solve the problems. This moves teachers to more of a facilitator role and creates a student-centered learning environment.

(Question #7)

Collaborative Math 8 Class

Can you list some of the math projects you completed in middle school? (6th, 7th, and 8th grades)

Answered: 4 Skipped: 15

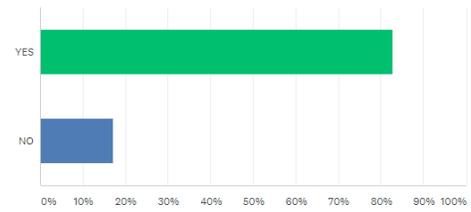


ANSWER CHOICES	RESPONSES
YES	0
NO	4
TOTAL	4

General Education Math 8 Class

Can you list some of the math projects you completed in middle school? (6th, 7th, and 8th grades)

Answered: 29 Skipped: 2

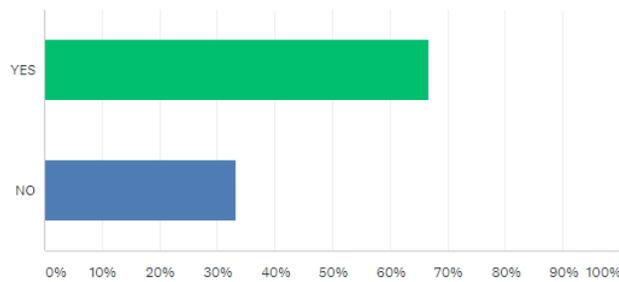


ANSWER CHOICES	RESPONSES
YES	24
NO	5
TOTAL	29

Accelerated Algebra I Class

Can you list some of the math projects you completed in middle school? (6th, 7th, and 8th grades)

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
YES	12
NO	6
TOTAL	18

Overall Findings:

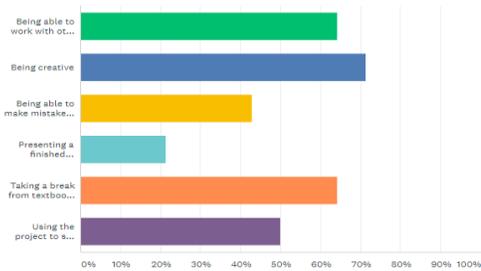
The students in the collaborative setting stated that they would not be able to list any math projects that they've completed in middle school. This could be due to poor memory or that they've never been exposed to tasks and projects in any of their math classes. The impact from tasks and projects appears to be greatest within the general education population. This subgroup is typically the largest in schools. The data shows that students connect with math through tasks and projects.

(Question #8)

Collaborative Math 8 Class

Check what you like MOST about working on those projects you listed in #7. *Check ALL that Apply*

Answered: 14 Skipped: 5

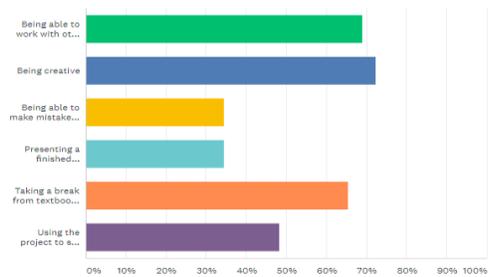


ANSWER CHOICES	RESPONSES
Being able to work with other students	64.29% 9
Being creative	71.43% 10
Being able to make mistakes and fix them during the project	42.86% 6
Presenting a finished product instead of just an answer	21.43% 3
Taking a break from textbook practice	64.29% 9
Using the project to see how math is used in real life	50.00% 7
Total Respondents: 14	

General Education Math 8 Class

Check what you like MOST about working on those projects you listed in #7. *Check ALL that Apply*

Answered: 29 Skipped: 2

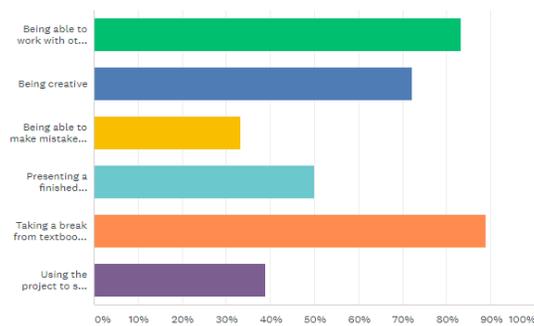


ANSWER CHOICES	RESPONSES
Being able to work with other students	68.97% 20
Being creative	72.41% 21
Being able to make mistakes and fix them during the project	34.48% 10
Presenting a finished product instead of just an answer	34.48% 10
Taking a break from textbook practice	65.52% 19
Using the project to see how math is used in real life	48.28% 14
Total Respondents: 29	

Accelerated Algebra I Class

#7. *Check ALL that Apply*

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
Being able to work with other students	83.33% 15
Being creative	72.22% 13
Being able to make mistakes and fix them during the project	33.33% 6
Presenting a finished product instead of just an answer	50.00% 9
Taking a break from textbook practice	88.89% 16
Using the project to see how math is used in real life	38.89% 7
Total Respondents: 18	

Overall Findings:

The results in this question reveal that students like to be creative, collaborate with classmates, and get away from the skill drill that is found in textbooks. They are not yet comfortable making mistakes through the process, nor presenting their work to their peers. Making mistakes and learning from them is how math is learned. Presenting your solutions and steps to solving a problem is a life skill that will be used in adulthood through jobs and careers. This further supports the need to implement tasks and projects within math classrooms.

(Question #9)

Collaborative Math 8 Class

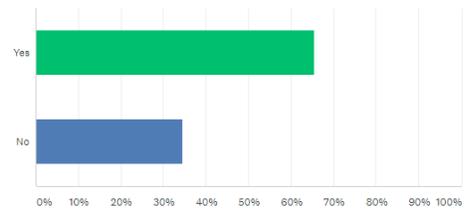
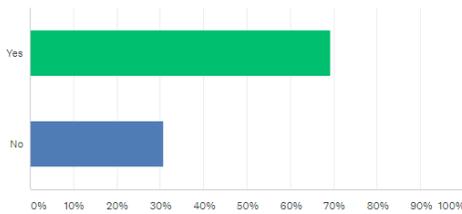
General Education Math 8 Class

Do you wish your math teachers used more challenge problems and projects, instead of textbooks and worksheets?

Do you wish your math teachers used more challenge problems and projects, instead of textbooks and worksheets?

Answered: 13 Skipped: 6

Answered: 29 Skipped: 2



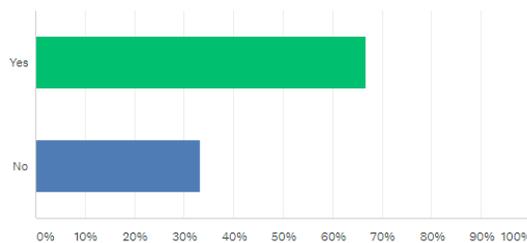
ANSWER CHOICES	RESPONSES
Yes	69.23% 9
No	30.77% 4
TOTAL	13

ANSWER CHOICES	RESPONSES
Yes	65.52% 19
No	34.48% 10
TOTAL	29

Accelerated Algebra I Class

Do you wish your math teachers used more challenge problems and projects, instead of textbooks and worksheets?

Answered: 18 Skipped: 5



ANSWER CHOICES	RESPONSES
Yes	66.67% 12
No	33.33% 6
TOTAL	18

Overall Findings:

The majority of the students surveyed wish math teachers would use fewer textbooks and worksheet practice and provide more learning activities through challenging avenues of assignments.

The research presented in this study supports the notion of the task and project-based learning being beneficial in mathematics classrooms. The articles stress the changing of student dynamics and evolving technological society. The student survey highlights what they are looking for from math teachers. Teachers can no longer depend on traditional, lecture-style methods to effectively teach math concepts to today's adolescents. Students need to connect the numeracy skills they learn, to bigger concepts that solve real-world problems. Obstacles are standing in the way. Students are going to remain reluctant to accept the challenge if teachers do not accept it first. There needs to be complete teacher buy-in to pursue the minds of young people to step out of their comfort zone enough to allow the process to lead them to deep, conceptual learning. Teachers also need to be willing to learn along with their students. Math teachers need to deviate from the belief that they have to constantly show students how to do the math, and create more of an inquiry-based environment that allows them to be responsible for their mathematical thinking.

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