SPECIAL EDUCATION AND STEM

How Do Edmonds School District Teachers Teach STEM to Their Students?

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This paper was written to gain an understanding of how high school special education teachers in the Edmonds School District are teaching STEM based curriculum to their students. Developing research shows that more must be done to address the unique needs of special education students, and more is still developing into how STEM can be taught effectively to fit those needs. After reviewing current literature on the topic of Special Education and STEM in Washington State, I have found barriers to both teachers and students that deserve further investigation. I hope this paper will be a positive addition to the discourse surrounding this topic by offering new insights that may lead to effective changes that will benefit students.

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Part One – Purpose of Study

There has been a growing call for an increase of science, technology, engineering, and mathematics (STEM) based education, but has that call reached Special Education (SpEd)? I suggest neglecting this student population will have a detrimental effect by reducing their job prospects or their goals in higher education. The population I'm focusing on are the students with behavioral and learning disabilities, and the question I look to answer is: How do SpEd teachers in the Edmonds School District (ESD) teach STEM to their students? I am researching this question because I want to understand how we can better educate the underserved SpEd population in ESD and beyond. By looking at where we are at now, we can get a baseline of where our education system is in the ESD and use that to find ways to improve. With more attention being paid to STEM, potentially novel ways of teaching STEM to SpEd students could provide crucial guidelines for future development.

What turned me to this topic was working for the ESD as a paraeducator I spent some time working at different elementary schools but much of my time was at Lynnwood High School. My mother is a SpEd teacher at that school and was lucky to be placed within her department. Hearing about her experiences with her students and her deep devotion to their success piqued my interest in high school education.

It was, however, my work helping the high school students with their senior projects that really sparked my desire to find out how we can better serve the students in the SpEd system. Admittedly I had my own biases about what the students were capable of doing. When I first learned of SpEd, my mind went to students who had some level of deficit due to autism or another handicap.

I quickly learned how wrong I was, because the students I worked with are remarkably bright. Some of them do have emotional or behavioral issues, but others come from difficult family lives, come from immigrant families who have a host of unique challenges, or simply need a little extra support.

I remember one student who was a member of the school's robotics club. This student stands out because he showed me the work that he was doing with the robotics club and how their team was going to a regional tournament. It shocked me how adept he was at understanding the basics of robotics but was in some ways being held back being a part of the SpEd system.

This relatively brief time I had working with this student made me think: Is it time we rethink how we educate our students in the SpEd system?

So, the purpose of this study was to speak with SpEd educators and find out how are teachers in the ESD teaching STEM based curriculum to their students. I hoped to learn about their successes and what challenges they have with teaching STEM to their students. While funding is often the underlying issue, what other barriers are SpEd students facing? Is it a possible lack in general understanding of the sciences like biology? Are our future teachers being trained in culturally relevant social topics like cyberbullying that touch on STEM? What kind of communication exists between the SpEd and STEM departments?

Part Two – Literature Review

My hypothesis for my research topic was that there are no specific policies or curriculum that has been created to teach STEM to SpEd students. To find some literature to support or refute this topic I focused my search on STEM education to SpEd students in Washington State

There is developing research into SpEd and STEM education separately, but the researching looking at the need for STEM *in* SpEd is still slowly developing. One article I have found observes that, since 1990, Washington State has mirrored national shortages in both STEM and SpEd endorsed teachers, despite these endorsements having greater chances of finding employment within three years of graduation (Goldhaber, Krieg, Theobald, & Brown, 2015).

Also, a 2016 report submitted by the Office of the Superintendent of Public Instruction (OSPI) to the WA state legislature shows what is being done in the state to address the need for an increase in STEM education. A grant was started in 2015 where the state allocated $12.5M for STEM education and, starting in 2019, graduating students are required to have completed three science-based classes (Kanikeberg, Noahr, Black, & Rogers, "STEM Pilot Project Grant Program", 2016).

Literature focusing on SpEd in Washington state comes from studies including the relationship among career and technical education (CTE). This study replicates earlier findings that students with learning disabilities (students typically in SpEd) have better outcomes if they are enrolled in a concentration of CTE courses and if they spend more time in general education, compared to others who do not (Theobald, Goldhaber, Gratz, & Holden, 2019).

A study out of Virginia Tech and Embry-Riddle Aeronautical University's Worldwide Campus investigated this topic more broadly. This study began with an understanding that an increase in inclusive STEM classes would mean an increase of students with disabilities. It asked if both SpEd and STEM teachers had the appropriate credentials to teach the topic effectively. The article cites a report that says the increase of SpEd students has had a significant impact the role of the general education

teachers who characteristically identify themselves as being unprepared to educate students with disabilities.

A notable revelation from the article shows that (in secondary school education) a higher percentage of SpEd teachers had STEM certification than STEM teachers had SpEd endorsements, see below chart from the article (Williams, Jr, Ernst, & Rossi, 2018).

Teaching Area	Teachers with SWDs	Case-load SWDs	SPED Certification	STEM Certification	SPED Degree	STEM Degree
Elementary						
STEM All	83.7%	12.74	5.3%	27.6%	2.7%	23.6%
Science	89.9%	14.04	2.8%	26.4%	3.0%	19.3%
Mathematics	79.8%	7.09	5.3%	27.8%	2.9%	27.9%
Technology & Engineering Education	85.9%	45.70	15.2%	31.5%	0.0%	35.9%
Special Education	98.9%	14.44	94.0%	2.7%	76.2%	4.8%
Secondary						
STEM All	91.8%	12.04	5.5%	81.8%	3.9%	68.6%
Science	93.3%	13.35	4.7%	84.5%	2.8%	74.7%
Mathematics	90.0%	10.19	6.5%	80.4%	4.9%	63.4%
Technology & Engineering Education	94.3%	16.11	4.1%	77.5%	3.4%	69.0%
Special Education	99.9%	27.47	94.4%	10.8%	74.8%	6.5%

Note. SWD is students with disabilities. SPED is special education. STEM is science, technology, engineering and mathematics education.

While is it encouraging to see that there are some who do choose to be educated in both SpEd and STEM, not enough do so, and it is important that SpEd teachers work with STEM teachers to come up with effective ways for them to teach their students successfully.

Part Three – Methodology

The goal for my research was to get a clearer view of where we are at now in terms of educating SpEd students STEM based curriculum. I wanted to better understand not only where our teachers feel we are succeeding, but also where they felt they are struggling professionally. By listening to their experiences, I hoped to find lessons across the district and see what can be done to support our teachers and their students. One question I asked is if there is anything that they would like me to know about teaching STEM because I don't want to assume that I already know what they feel about the topic or what they need.

My methodology was primarily interviewing eight teachers in high schools in the Edmonds School District. I chose ESD because I am familiar with the district, having been a student and an employee. Each of the four high schools I chose are also representative of an average high school in Washington. Schools like Edmonds-Woodway, Meadowdale, and Mountlake Terrace have a majority Caucasian population from 49%-55.6% percent (like the state average of 54.1% in WA) and no other racial group making up more than 25%. Lynnwood High is the most diverse school with a Caucasian population of 36.2% and an Asian and Latino population of 23% and 23.6% respectively (see demographic information tables 1-5 in appendix).

I used connections I have in Lynnwood and Meadowdale high schools as initial points to start off and asked them who else I should interview as I research. I reached out to those connections via e-mail that included a brief personal introduction, an overview of what the study is about, and asking if they would be willing to take 15 minutes of their time to meet with me. I let them know that, with their permission, I planned on audio recording the interview which I transcribed.

Questions I asked the teachers included asking if they have additional credentialing in STEM education and how they planned on teaching STEM based topics to their students (see annex for full question list). I left the interview open for follow up questions.

Participants in my study included eight educators from Lynnwood and Meadowdale High School, one of them being a substitute teacher who works in both the high school and middle school levels, and one who transitioned from a high school teacher to an assistant principal. I felt it important to also obtain a perspective from an administrator.

Demographics of the student population from the four included high schools (Edmonds-Woodway, Lynnwood, Meadowdale, and Mountlake Terrace) who are listed as having some sort of disability ranges from 10-16% compared to 14.6% of students statewide ("Report Card Washington State Report Card," n.d.).

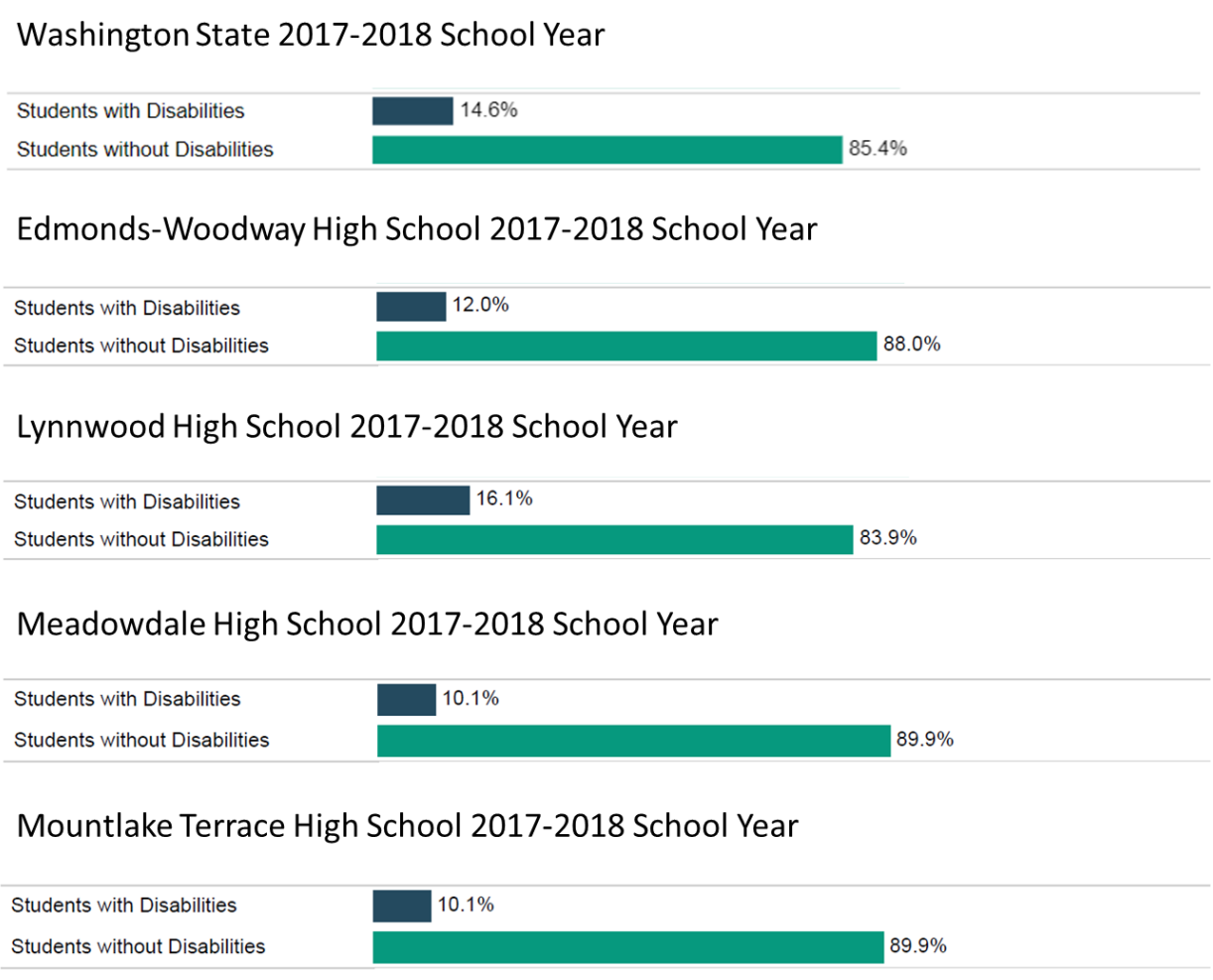

Fig. 1 percentages of students enlisted in Washington State and four Edmonds School District high schools with disabilities compared to students without disabilities. "Report Card Washington State Report Card," n.d.

In most cases each high school meets or performs higher than the state average (see appendix tables 1-5, ("Report Card Washington State Report Card," n.d.). Meadowdale High has 92% of their students graduate in four years, over 10% higher than the state average in the 2017-2018 school year. Fifty-five percent of students at Edmonds-Woodway High beat the state average (49.4%) in meeting standards in math. Mountlake Terrace has the highest English Language Arts (ELA) competencies at 76.9% over the state average of 59.4%.

The teachers I interviewed have been teaching from at least three years to ten or more, one being a substitute teacher who works both in the middle and high school age range. To preserve a level of anonymity I have chosen to give the teachers interviewed pseudonyms.

Mrs. Rosie is a social studies teacher who described herself as a veteran teacher who is not specifically SpEd endorsed but has experience working with that population. Mrs. Tea is a newer teacher (about three years) who is SpEd and English Language Learner (ELL) endorsed and teaches English. She recently received her master's degree in school counseling. Mrs. Brando has been teaching about five years and is SpEd endorsed teaching math. Mrs. Carolina is a veteran teacher who has worked at the high school and middle school level as a substitute. She is also experienced working in SpEd. Mrs. Granger is a former SpEd teacher, who has taught both math and English for several years and has recently been elevated to an administrative position at one of the local high schools. Mrs. Diana is a SpEd teacher who is the chair of her department in her high school and has been working there for about five years and teaches English. I was also connected with two paraeducators, one I will refer to as Mrs. McKinnon and the other Mrs. Aurora. Paraeducators are individuals who work closely with teachers to provide additional 1:1 education support to students or to the entire class. They also assist the teachers with lessons as needed and help with administrative duties like grading papers and tests. While they were not part of my initial focus, their experiences have provided equally as important and sometimes unique perspectives on the students they work with. There is one teacher that was

mentioned in my interviews who teaches the sciences (including physics) that I will name Mr. Ravenclaw, who I was not able to connect with, but was spoken very highly of for his willingness to meet the needs of SpEd students.

Lastly, I should note that there are eLearning options along with a fifth high school (Scriber Lake) that I omitted in my research as it is considered an alternative school and only accepts a small number of students based on certain criteria (see Fig 6).

Part Four – Results and Discussion

Results of my readings into STEM and SpEd, and my interviews with the educators in ESD, largely lead me to my hypothesis that there are no specific policies or curriculum that is geared towards SpEd students. While only two of the teachers I spoke with had any experience with teaching mathematics, Mrs. Brando and Mrs. Granger, none of them claimed confidence in teaching to the sciences, technology, or engineering.

Some important themes that emerged from my research is SpEd teachers are interested in STEM topics. A surprising barrier that SpEd students could be facing is all four high schools have different class schedules and, in some cases, different course offerings. Also, experienced teachers are adopting tools to help their students, but there is some frustration at having access to training.

SpEd teachers *are* interested in STEM

Generally, there is a willingness from the STEM teachers to alter their coursework to address the needs of any SpEd students that may be in their classes. As Mrs. Granger explained, if a student was having a particularly tough time, they would have a chance to "get it back together you know with para[educator] support." Meaning that even though a SpEd student is having a difficult time with a STEM subject, they are given opportunities to catch up.

Mrs. Tea mentioned one of her students who wanted to enroll in Mr. Ravenclaw's class due to his reputation as being a fair teacher. "[Mr. Ravenclaw] will accommodate for our kids." Mrs. Tea explained to me even though this student had a math-based specially designed instruction plan. The only issue with a particular student that she mentioned was their attendance, but she told me that Mr. Ravenclaw said that the student "He would have been fine if he started off with [better] attendance he would have been able to pass my physics class which is huge…"

Mrs. Rosie, who has also created an inclusive diversity-based course in her school, also states that Mr. Ravenclaw has been running "a club for STEM, and that's the second year running this year. So, anyone can join that. Anyone can join."

Mrs. Carolina discussed with me her experience with a teacher she has worked with that makes the effort to adjust his courses to meet the needs of his students. She said the teacher "has three different levels of materials, and the students choose the level they want to do the reading at. But he always has them specify what level they're going to work at."

But there are barriers to entry into STEM courses…

While it seems that there are STEM teachers who are open to teaching SpEd students, there are some barriers to students who may wish to enroll in a STEM course. One barrier is that the schedules for the different high schools varies significantly (see Figs 2-5).

EDMONDS WOODWAY BELL SCHEDULE

Monday - Thursday		Friday	
1st/2nd	7:20-9:04am	1st	7:20-8:18am
Advisory	9:11-9:41am	2nd	8:27-9:19am
		3rd	9:28-10:20am
3rd/4th	9:48-10:38am		
A LUNCH	10:30-11:08am	**A LUNCH**	10:20-10:50am
3rd/4th cont.	11:13-12:02pm	4th	10:55-11:47am
3rd/4th	9:48-11:32am	4th	10:29-11:21am
B LUNCH	11:32-12:02pm	**B LUNCH**	11:21-11:51am
5th/6th	12:09-1:50pm	5th	11:56-12:48pm
		6th	12:57-1:50pm

A LUNCH:	English, Life Skills, Math, Social Studies, Technology, World Language
B LUNCH:	Art, Explore, FaCS, Learning Support, Music, P.E., Science, ELL, DHH
Mon/Weds	1st, 3rd, 5th periods
Tues/Thurs	2nd,4th,6th periods

Fig 2 Edmonds-Woodway Bell Schedule ("Bell Schedules," n.d.) – Edmonds-Woodway runs on a Monday through Thursday 50-minute class period also 1,3,5/2,4,6 with Fridays having shorter class periods and students attending all six classes.

LYNNWOOD BELL SCHEDULE

Monday - Friday

Tutorial	7:05-7:20am
1st	7:20-8:10am
2nd	8:15-9:05am
Advisory	9:10-9:35am
3rd	9:40-10:30am
1ST LUNCH	10:30-11:05am
4th - 1st lunch	11:10am-12:00pm
4th - 2nd lunch	10:35-11:25am
2ND LUNCH	11:25-12:00pm
5th	12:05-12:55pm
6th	1:00-1:50pm

Fig 3 Lynnwood Bell Schedule ("Daily Schedule," n.d.) - Lynnwood operates with a standard Monday-Friday period 1-6 schedule

MEADOWDALE BELL SCHEDULE

Monday-Thursday*		Friday	
1st/2nd	7:20-9:22am	1st	7:20-8:20am
		2nd	8:26-9:20am
3rd/4th	9:27-10:31am	3rd	9:26-10:20am
1ST LUNCH	10:31-11:01am		
3rd/4th cont.	11:05-11:53am	**1ST LUNCH**	10:20-10:50am
		4th	10:56-11:50am
3rd/4th	9:27-11:19am		
2ND LUNCH	11:23-11:53am	4th	10:26-11:20am
		2ND LUNCH	11:20-11:50am
5th/6th	11:58-1:50pm		
		5th	11:56-12:50pm
		6th	12:56-1:50pm

*Known as achievement time (AT) the last 15 minutes of class time (Mon-Thurs) is allotted for teachers to provide instruction to students who are below a C grade level. Those not in AT may use this time between classes to meet with other students, do homework/projects, or use the library.

Fig 4 Meadowdale Bell Schedule (2018-2019 Regular Bell Scehdule.docx," n.d.) - Meadowdale High runs on a block schedule, where a student will have three 2-hour classes which rotate between a period 1,3,5 and period 2,4,6. Fridays are period 1-6 but

MOUNTLAKE TERRACE BELL SCHEDULE			
Monday/Wednesday/Friday		Tuesday/Thursday	
0 period	6:21-7:15am*	0 period	6:21-7:15am*
1st	7:20-8:08am	1st	7:20-8:14am
2nd	8:13-9:01am	2nd	8:19-9:13am
P.A.S.S. 9:06-9:43 HBN		3rd	9:18-10:18 HBN
3rd	9:48-10:36am		
		1ST LUNCH	10:23-10:53am
1ST LUNCH	10:41-11:11am	4th - 1st lunch	10:59-11:52am
4th - 1st lunch	11:16-12:04pm		
		4th - 2nd lunch	10:23-11:17am
4th - 2nd lunch	10:41-11:29am	**2ND LUNCH**	11:22-11:52am
2ND LUNCH	11:34-12:204pm		
		5th	11:57-12:51pm
5th	12:09-12:57pm	6th	12:56-1:50pm
6th	1:02-1:50pm	7th	1:55-2:51pm*

Fig 5 Mountlake Terrace Bell Schedule ("Bell Schedules," n.d.)- Alternatively, Mountlake Terrace has a break-up in their schedule of Monday, Wednesday, Friday on what they call a P.A.S.S. period with Tuesdays and Thursdays being normal period 1-6

*these classes are optional for students

Without a standard schedule across the schools, if a student from Edmonds Woodway is interested in participating in the horticulture course that is offered at Lynnwood, they might not be able to do so because the schedules for each school might not allow for it.

There are also inconsistencies in which school offers various STEM classes (Fig 6). Lynnwood High is the only school that offers a horticulture class, while Edmonds-Woodway teaches the only marine sciences course, and Meadowdale teaching anatomy and physiology. Each of these courses, however, are subject to having a teacher available to teach it and demand of the students to offer it.

These barriers can be particularly troublesome for SpEd students for there reasons mentioned above, but it should also be considered if the course being offered is taught at a level and pace that the SpEd student can maintain. Also, if the student's Individual Education Program (IEP) does not allow for the student to take a STEM course at a different school (a reason could be the differing school schedules, or if the student needs to have an additional period for instruction).

Core Courses	Offered At
Biology	all
Chemistry	all
Earth/Space Science	all
Honors Biology	all
Honors Chemistry	EWH/LHS/MDH
Physical Science	all
Physics	all

Electives	
Astronomy	MTH/LHS/MDH
Biology COE*	all
Biotechnology	MTH/LHS/MDH
CHS Astronomy	MTH
Environmental Science	SLH
Geology	SLH
Anatomy & Physiology	MDH
Marine Science	EWH
Zoology	MTH

District Science Equivelancy Courses	
Aerospace Engineering	MTHS
Applied Engineering & Manufactering	all
Auto Technology	all
Auto Technology - advanced	all
Biotechnology	MTH/LHS/MDH
Healthcare Profession	all
Horticulture	LHS
Horticulture - advanced	LHS
AP Computer Science A	MTH/LHS/MDH

All = all high schools in ESD
EWH = Edmonds Woodway High
LHS = Lynnwood High
MHS = Meadowdale High
MTH = Mountlake Terrace High
SLH = Scriber Lake

Fig 6 – List of STEM courses offered at all, or some, of the high schools in the Edmonds School District

*collection of evidence (COE) are credits that can be earned by a student to satisfy a .5 credit to English, math, or science if they failed a semester/course in any of these areas in their 9th and 10th grade year. No more than .5 credits will be granted in each discipline.

Challenges for Veteran Teachers

Beside the barriers that SpEd students face in finding classes they have an interest in, the teachers are also facing challenges of their own. It was mentioned in a couple of my interviews (by Mrs. Granger and Mrs. Diana) that the more experienced teachers are also struggling to keep up with the change in pace with the inclusion of more STEM based courses.

Mrs. Rosie explained, "…we would have to take it upon ourselves to get additional training. And being someone that has taught for a while, I never was introduced to any of that kind of the way [sic] that new teachers are being taught." She continued on when talking about additional training, "I would say with the young younger teachers… I feel like there's more of 'Maybe I'll go into this or maybe I'll go into that.' So you would be leaving quite a veteran group behind you unless we got additional training."

Mrs. Diana, the chair of her department, also expressed her concerns saying the required training "…is not weekend training you do two days at eight hours." And that it's a "huge undertaking. It's not like you can read a book and then you can teach. And being a special education teacher there's so much that you have to do outside of your classroom. You don't have time. It's like, you just don't have time."

In voicing her experience as a newer teacher, Mrs. Tea said that City University requires that incoming teachers take a course in SpEd to learn how to modify their courses. So, there does appear to be a movement with incoming educators to address the needs of SpEd students.

Mrs. Brando expressed her opinion that "people should start off teaching Special Ed…like when we did our Proteach" which is an assessment of teachers' abilities to teach effectively to their students.

When I asked the teachers how they taught STEM based courses to their students, Mrs. Rosie stated she taught a course on cyber warfare and fake news. Mrs. McKinnon said that in health class, they talk about mental health and cyberbullying. There is a district wide requirement that all students watch a video about cyberbullying.

New Teaching Tools

Like the topics that are influencing student's lives are changing, so are the tools that teachers have at their disposal. I was told of computer-based tools that SpEd teachers use to supplement their classes. MobyMax is used in math classes to give students a chance to learn the basics of mathematics up to an eighth-grade level (this program is meant for a kindergarten through eighth grade education). This tool is also available for the sciences. Mrs. Brando touted Khan Academy, which is a free, online service that offers exercise, instructional videos, and other personalized tools that help students learn at their own pace.

Teachers also have district "Tech Coaches" who are available to assist teachers with any technology-based issues they may have in their classrooms (with their students' Chromebooks for example). They also offer summertime professional development courses to help teachers become more familiar with tools like Canvas. There is an increase in use of internet-based tools like Google Docs that is helpful for students to turn in assignments who may otherwise worry about losing an important paper.

Part Five – Conclusion

My research and interviews with the teachers who work with this unique population in the Edmonds School District has shown that while teachers are adapting to the changes in our society's expectations of them, there is still some work that needs to be done.

Unfortunately, I was only able to interview a small number of teachers from only two of the four schools I was interested in, due to the time constraints of the school year and the additional requirement of getting permission from the school district. This limitation of how long students are in school is not a new topic and one that should certainly be considered. How much more time can we spend ensuring students are getting the best possible education if we increase the school year to involve the summer months? How much time do teachers spend trying to re-educate what information has been lost when their students are away?

I would also recommend that the school district consider making the school schedules more uniform, so that if a student does want to participate in a class that is not offered at the home school, there is less of a chance that opportunity won't be missed.

Mountlake Terrace High seems to be the gold standard in STEM education. Further research into what that school is doing and seeing what can be done to implement their curriculum policies across all the district high schools could be beneficial, so all students have an equal chance at receiving similar educations.

On a larger scale, I would look more into what the credentialing process is for SpEd and STEM teachers and find ways to encourage more would-be teachers to embrace both SpEd and STEM credentialing. Is there a gender gap as well that could be influencing who becomes a SpEd or STEM teacher that can also be addressed?

There is still much work to be done in our education system to benefit students, but I am hopeful in speaking with the dedicated women who chose to work with the underserved SpEd population, that we are on the right track.

Part Six – Works Cited & Appendix

Works Cited

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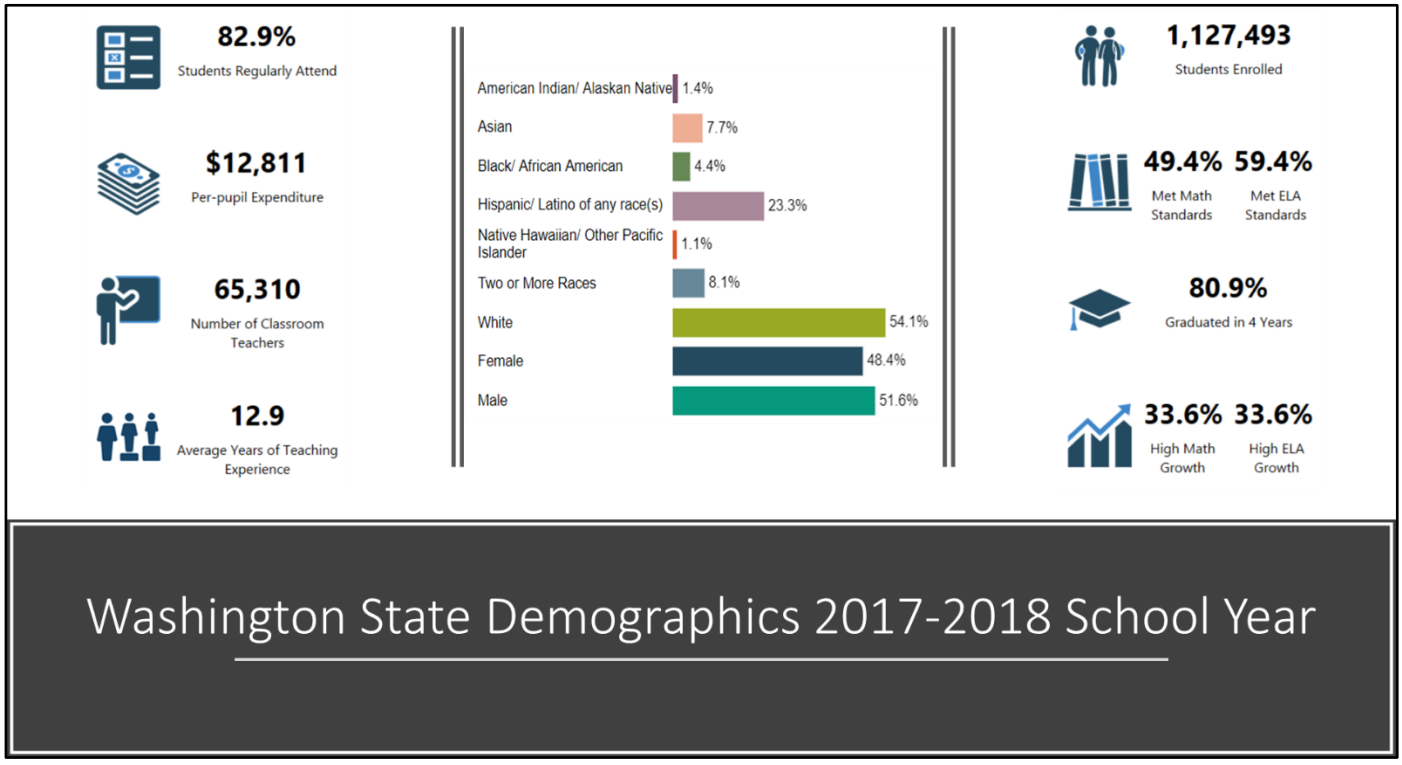
Appendix



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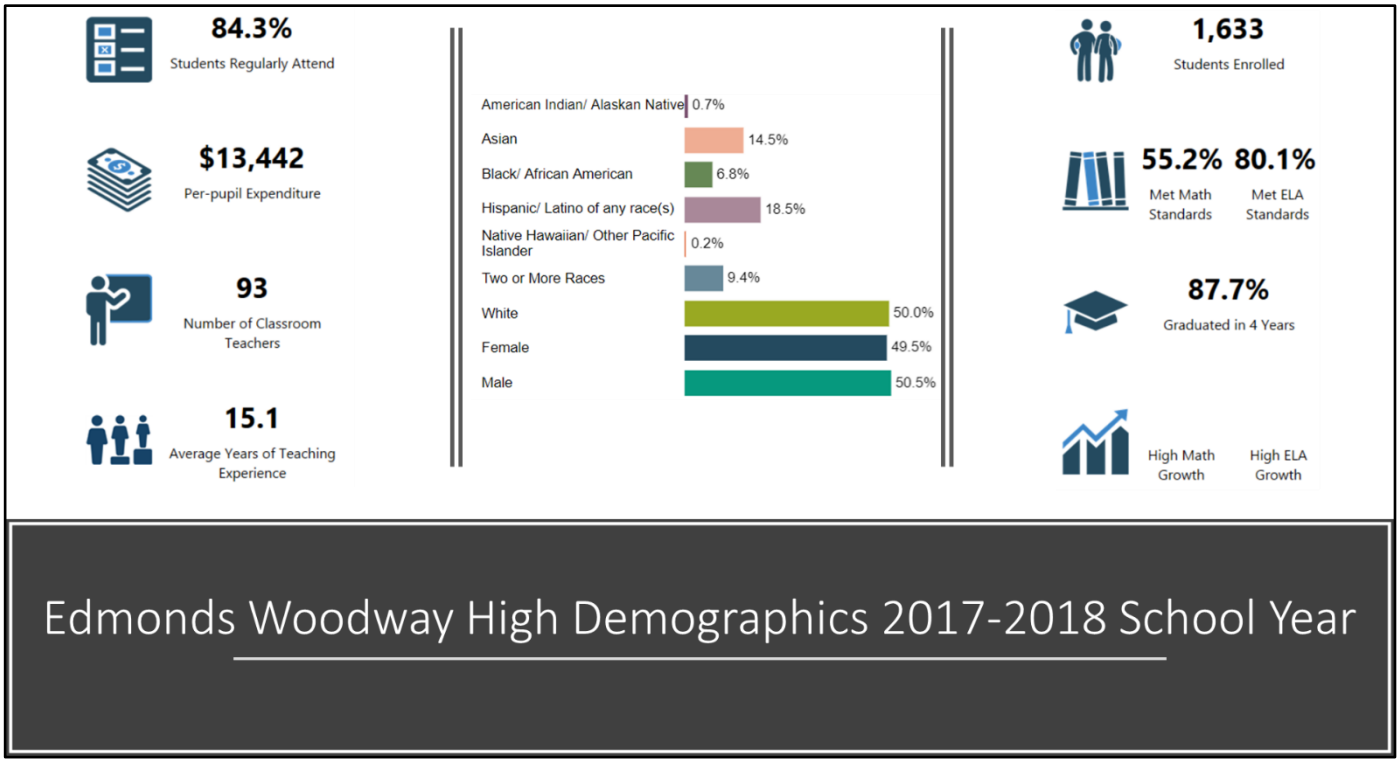

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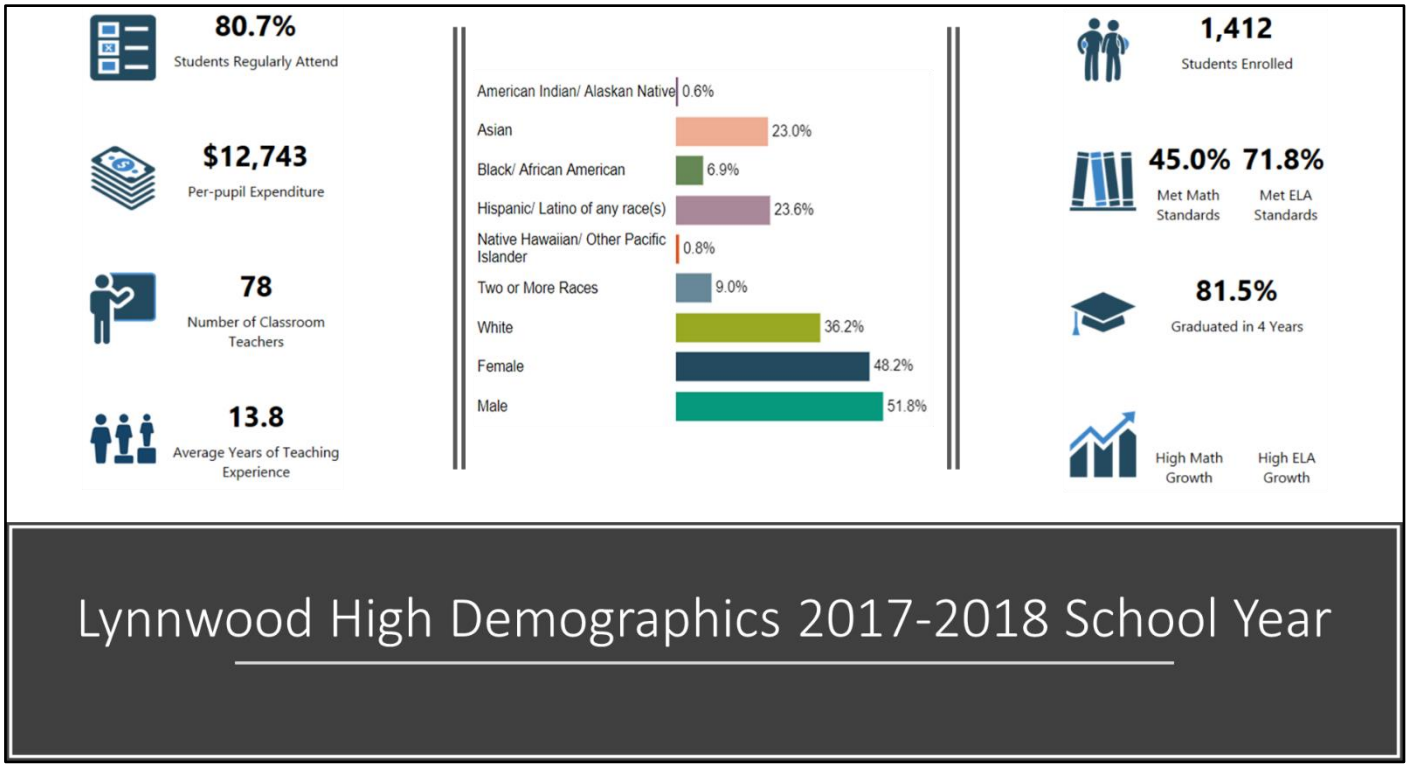

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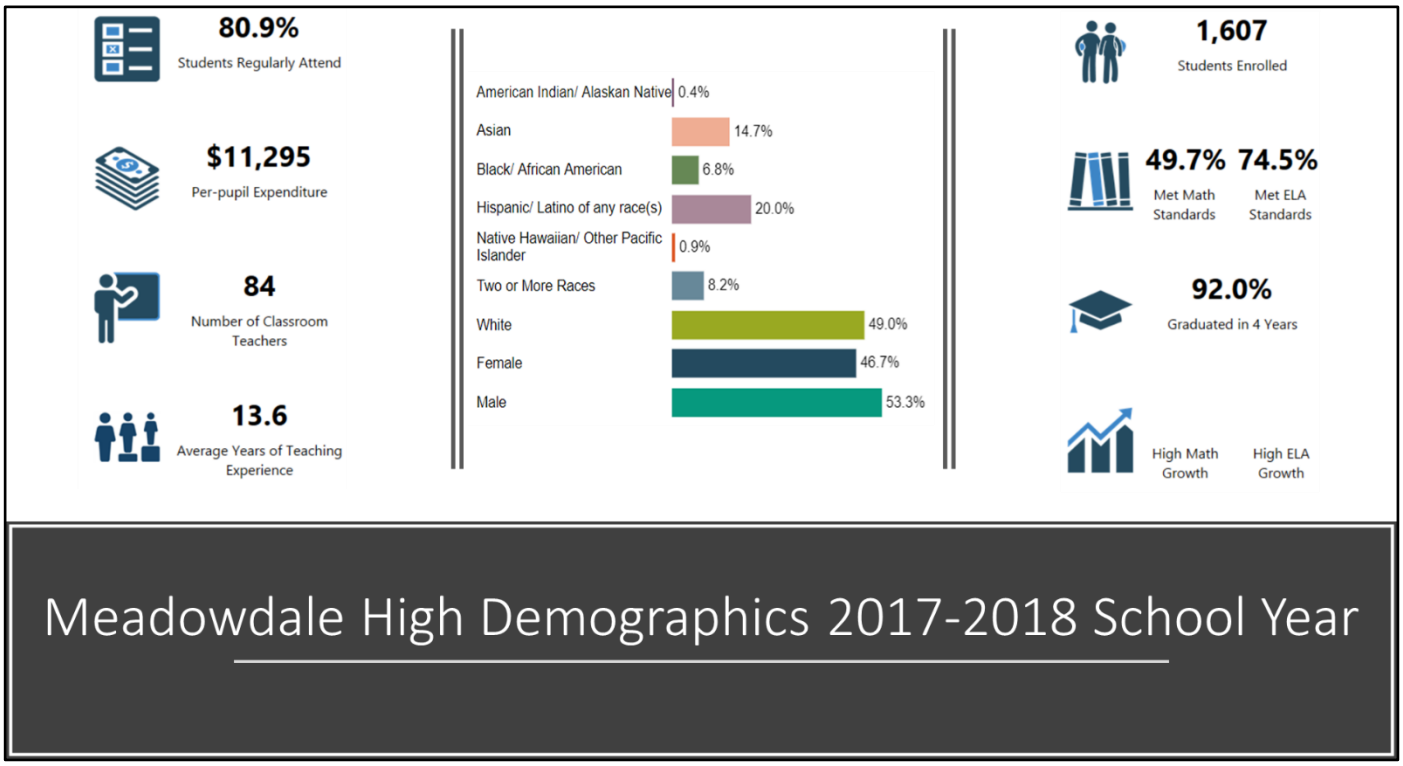

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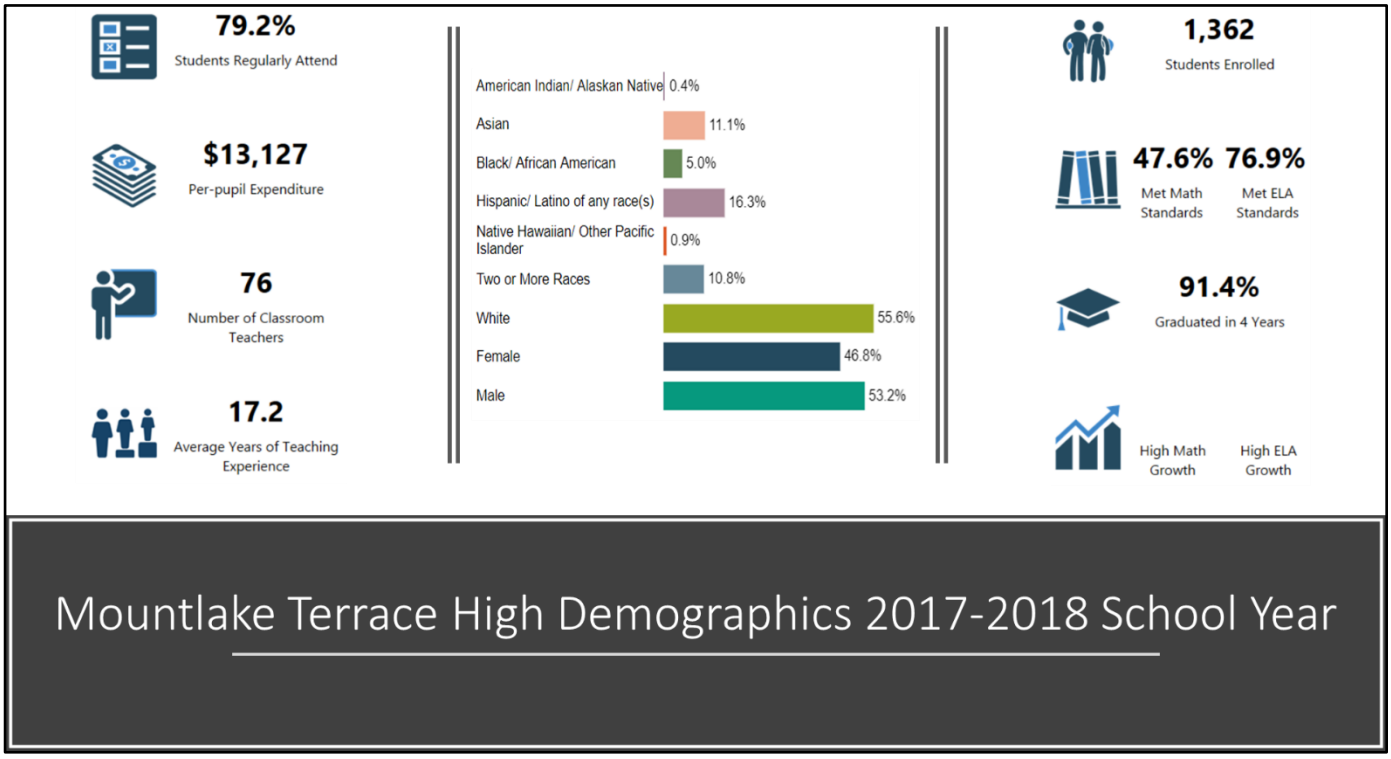

Table 5

Interview Questions

- Do you have any STEM based education or endorsement(s)?
- How do you teach STEM to your students?
- Do you feel that STEM can be integrated into other lesson plans?
    - What about social issues like cyberbullying and how we communicate?
    - What about understanding environmental issues like climate change?
- What have some of your successes been?
- What about difficulties you've faced?
    - What would you rate the level of communication between SpEd and STEM departments?
- Is there anything else you'd like to add about STEM education for your students?
- Is there anyone else you'd recommend I speak with?