

## The Growth of VEX Robotic Competitions in Utah and the Rocky Mountain Region

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### Abstract

During the 2008-2009 school year, the Utah State University (USU) VEX Robotics team competed for the first time in the VEX Robotics World Championship. VEX annually hosts this championship to identify and award the best middle school, high school, and college robotics teams. A major goal of the USU VEX Robotics Team, through a partnership with the Rocky Mountain NASA Space Grant Consortium (RMNSPC) is to promote middle and high school students in Utah and the Rocky Mountain Region to develop an interest in science, technology, engineering, and mathematics (STEM) through encouraging and assisting students and schools through competitive robotics. This paper discusses the goals and results of the efforts of the USU VEX Robotics Team over the past four years.

### Robotic Competitions and STEM

For the past thirty years in the United States, there has been a push to create interest in science, technology, engineering, and mathematics (STEM) content fields within middle and high school students. One of the more successful activities that have been developed to spark this interest is robotic competitions. Caron (2010) states that “competitions add a level of engagement that is often hard to achieve in a traditional classroom setting” (p. 21). Teachers and

students are not getting involved in robotic competitions only for the excitement. Research studies have shown that students who participate in robotic competitions are able to gain a better understanding of STEM concepts (Kolberg & Orlev, 2001; Nugent, Barker, Grandgenett, & Adamchuk, 2010; Robinson, 2005; Sklar, Johnson, & Lund, 2000). Using robotics in the classroom gives students the opportunity to apply concepts and skills that are being taught throughout the STEM curriculum. Nugent, et. al., (2010) suggests that allowing students to engage in hands-on projects such as robotics, “can help youth translate abstract mathematics and science concepts into concrete real-world applications” (p. 392).

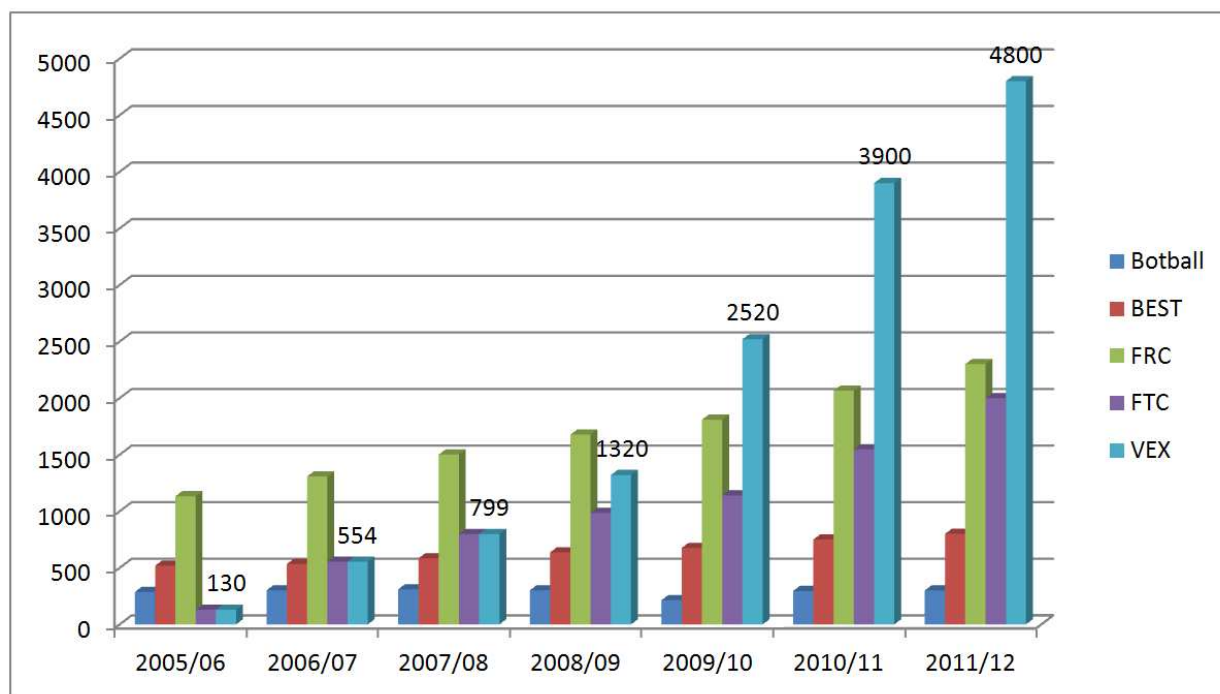
There are numerous robotic competitions available that offer unique attributes appealing to students and teachers. A look at two websites, [robotevents.com](http://robotevents.com) (2012) and [robots.net](http://robots.net) (Rainwater, R., Arrick, R., Brown, J., 2012) offers a list of popular robotic competitions that include, but are not limited to:

- Botball
- Carnegie Mellon Mobot Races
- FIRST (For Inspiration and Recognition of Science and Technology)
  - Junior FIRST LEGO League
  - FIRST LEGO League (FLL)
  - FIRST Tech Challenge (FTC)
  - FIRST Robotic Challenge (FRC)
- National Robotics Challenge (NRC)

- Robo Games
- Robotics Innovations Competition
- TSA VEX
- Trinity College Fire Fighting and RoboWaiter Contest
- VEX Robotics Competition

The USU VEX Robotics team competes in the VEX Robotics College Challenge, and uses the VEX Robotics Competition for middle and high school students to reach out to the students in the Utah and Rocky Mountain Region. “The VEX Robotics Competition is the largest and fastest growing middle and high school robotics program globally with more than 3,500 teams from 20 countries playing in over 250 tournaments worldwide” (Innovation First International, Inc., 2012). Figure 1, shows the number of teams that compete in select robotic competitions starting with the 2005-2006 school year and continuing through the 2011-2012 school year.

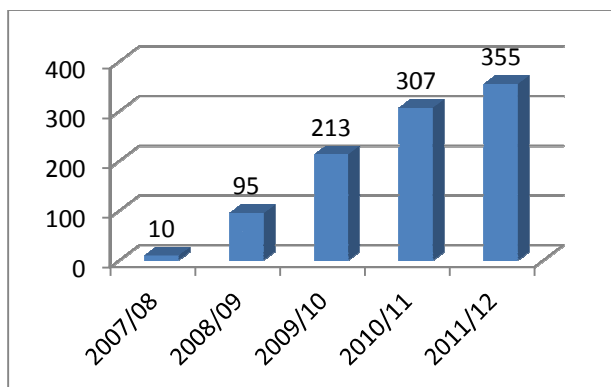
VEX has developed national partnerships with Intelitek, the Technology Student Association (TSA), and Project Lead the Way (PLTW). TSA has a membership of 150,000 middle and high school students and administrators that participate annually in competitions at the state and national levels (Technology Student Association, 2010). Intelitek is a worldwide leading developer, producer, and supplier of comprehensive training systems for engineering, manufacturing, automation, and industrial technologies (Intelitek, 2010). “PLTW is the largest nonprofit provider of innovative and rigorous STEM education programs. More than 500,000 students at nearly 3,500 schools have taken part in PLTW classes” (Project Lead the Way, 2010, ¶ 1). These partnerships have enabled VEX to reach more schools on a yearly bases. VEX’s success can also be attributed to several other factors including an exciting sporting event mentality through the use of a



**Figure 1.** The number of teams competing in select competitions by year.

team alliance system.

VEX also created a level playing field by using standardized parts available at a more affordable cost. A new team can be competitive their first season for \$1500-\$2000. The tournament format of VEX allows local teams to host regional tournaments (VRC) during any time of the year. A team is able to compete in an unlimited number of regional tournaments throughout a competition season. Figure 2, shows the number of local events hosted by VEX each year. Teams are encouraged to make design changes in between these regional tournaments, allowing for a greater level of success at subsequent events that team may compete in. Through these local tournaments, teams are able to qualify for national and international championships.



**Figure 2.** The number of VEX Regional Competitions hosted each year.

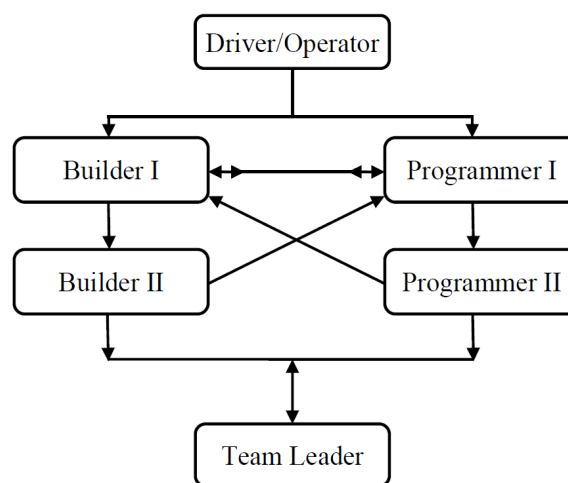
### Our Goal

In 2008 when the USU VEX Robotics Team began competing in the VEX College Challenge, there were no middle or high school teams competing from Utah or Idaho. There were also no local VRCs being held in Utah or Idaho. The goal of the USU VEX Robotics team since that year has been to encourage the growth of robotics in the classroom, using VEX as the catalyst, in the Rocky Mountain region. This encouragement first focused on Utah, then

expanded to Idaho and other surrounding states.

### Our Outreach

To begin the growth of VEX in Utah, the USU VEX Robotics Team started the Design Academy during the 2009-2010 school year. The Design Academy hosts local middle and high school students from Cache Valley in an after school program. The instructors and mentors for the Design Academy are current undergraduate and graduate students from the School of Applied Sciences, Technology and Education and the College of Engineering at USU. Students in the Design Academy are taught using a curriculum developed as part of a Plan B Master's Project by a member of the college robotics team. The curriculum entitled Competitive VEX Robot Designer Curriculum (Engineering and Technology Curriculum Team, 2010), is designed to teach students to build and program structurally sound robots to compete in the VEX Robotics Competition.



**Figure 3.** Graphic of the Scope and Sequence showing the Skill Sets of the Competitive VEX Robot Designer Curriculum.

Figure 3, shows the six skill sets that students work through during the Design Academy. The curriculum is available online at [www.etcrr.com](http://www.etcrr.com), and is free to anyone interested in using it.

The USU VEX Robotics Team held the first VRC in Utah on January 9, 2010. The team

continues to hold a regional tournament every year. In addition to hosting a VRC and coaching the Design Academy, the college team promotes VEX through national and state presentations and summer workshops see Tables 1, 2, and 3 for a complete list).

**Table 1.** List of publications by the USU VEX Robotics Team.

<b>Author(s)</b>	<b>Title</b>	<b>Location</b>	<b>Date</b>
Robinson, T. P. & Stewardson, G.A.	Exciting Students Through VEX Robotic Competitions	The Technology and Engineering Teacher	In Press
Robinson, T. P.	Implementing VEX Robotic Competitions in the Rocky Mountain Region	Proceedings of the 17 <sup>th</sup> Annual Fellowship Symposium. Sponsored by the Rocky Mountain NASA Space Grant Consortium, Utah State University, Logan, UT	May 11, 2011
Williams, S.	Providing STEM Experiences Through Robotic Competitions for Students and Teachers Grades 6-12	Proceedings of the 16 <sup>th</sup> Annual Fellowship Symposium. Sponsored by the Rocky Mountain NASA Space Grant Consortium, Utah State University, Logan, UT	May 12, 2010
Robinson, T. P.	Development of a Secondary School Curriculum for Competitive VEX Robotic Teams Meeting in Formal and Informal Learning Environments (M.S. Project)	Utah State University, Logan, UT	2010

**Table 2.** List of presentations by the USU VEX Robotics Team.

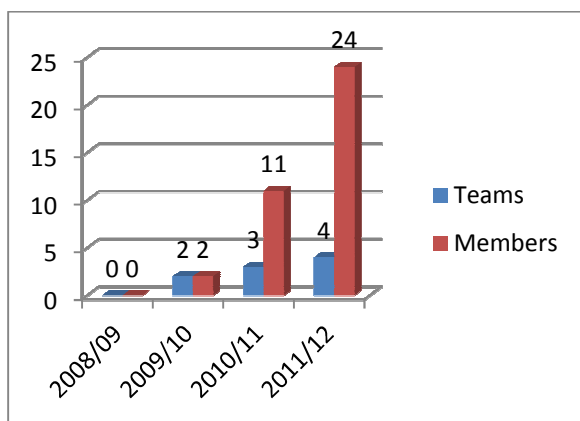
<b>Presenter(s)</b>	<b>Title</b>	<b>Location</b>	<b>Date</b>
Robinson, T.	VEX Robotics Demonstration	TSA Fall Leadership Conference, West Jordan, UT	October 15, 2011
Stewardson, G.	The Exciting World of VEX Robotics and How to get Started	TSA Fall Leadership Conference, West Jordan, UT	October 15, 2011
Stewardson G, & Robinson, T.	Utah State Curriculum Resources: Robotics, Energy, and Manufacturing	Utah Technology and Engineering Summer Conference, Orem, UT	June 15-16, 2010
Stewardson, G. & Robinson, T.	Exciting the Next Generation through Robotic Competitions	73 <sup>rd</sup> ITEEA Conference, Minneapolis, MN	March 24-26, 2011
Stewardson, G.	VEX Robotics: How to Get Started	Northern Utah Academy for Math, Engineering, and Science, Layton, UT	November 12, 2010
Robinson, T	Hands on VEX Demonstration	Northern Utah Academy for Math, Engineering, and Science, Layton, UT	November 12, 2010
Stewardson, G.	Leading Through VEX Robotics	TSA Fall Leadership Conference, West Jordan, UT	October 9, 2010
Robinson, T., & Helm, B.	Hands on VEX Demonstration	TSA Fall Leadership Conference, West Jordan, UT	October 9, 2010
Stewardson, G.	VEX Robotics Exhibition	Utah Technology and Engineering Summer Conference, Pleasant Grove, Utah	June 15-16, 2010
Thomas, A.	Utah State Design Academy Project	Proceedings of the 16 <sup>th</sup> Annual Fellowship Symposium. Sponsored by the Rocky Mountain NASA Space Grant Consortium, Utah State University, Logan, UT	May 12, 2010
Stewardson, G.A., & Williams, S.	Developing 21st Century Skills Through Robotics	72 <sup>nd</sup> ITEEA Conference, Charlotte, NC	March 18-20, 2010
Stewardson, G. & Williams, S.	VEX Robotics for the High School	Utah Technology and Engineering Summer Conference, Pleasant Grove, UT	June 17-18, 2009

**Table 3.** List of workshops presented by the USU VEX Robotics Team.

<b>Presenter(s)</b>	<b>Title</b>	<b>Location</b>	<b>Date</b>
Clarke, R. & Stewardson G.	Introduction to Competitive VEX Robotics	Utah State University, Logan, UT	July 6-8, 2011
Williams, S, Helm, B., Stewardson, G.	4-H VEX Robotics Workshop	Utah State University, Logan, UT	July 20-22, 2009

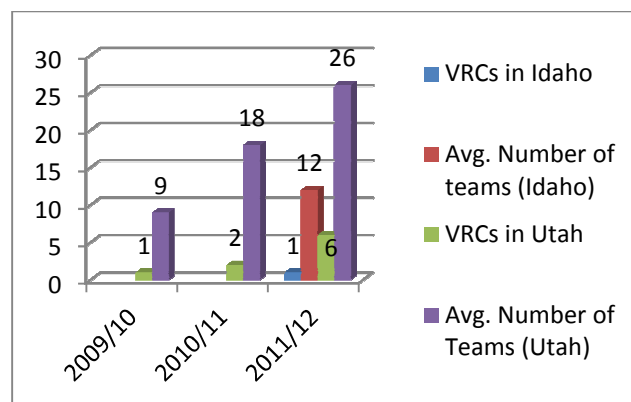
## Longitudinal Growth

When the Design Academy began in 2009 there were only two students that participated in a local VRC. During the 2011-2012 school year, the number of participants in the Design Academy was limited to 24 students, and the number of teams was limited to four. Figure 4, shows the growth of the number of students and teams participating in the Design Academy.

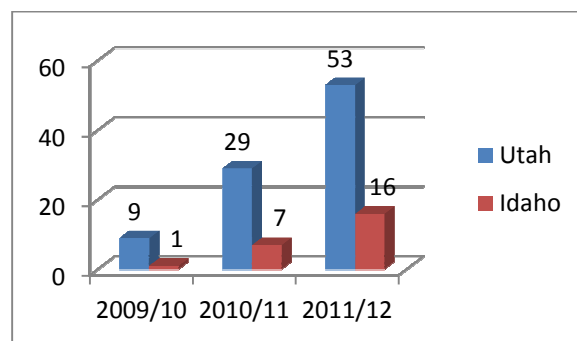


**Figure 4.** The number of Design Academy members and teams by year.

After USU hosted the first regional competition in Utah, there has been a steady increase in the number of VRCs held. This year there were 6 local tournaments, with USU hosting the Utah & Mountain Region VEX Robotics Championship on February 25<sup>th</sup>, 2012. At each of the local VRCs the number of teams was limited to 32, and each tournament averaged 26 teams competing. Figure 5, shows the growth of the number of VRCs held and average number of teams attending in Utah. This year Idaho held its first local VRC which had twelve teams in attendance. Throughout the last three years, there has been a steady increase in the total number of teams competing in Utah and Idaho, Figure 6, shows the growth of the total number of teams for both Utah and Idaho.

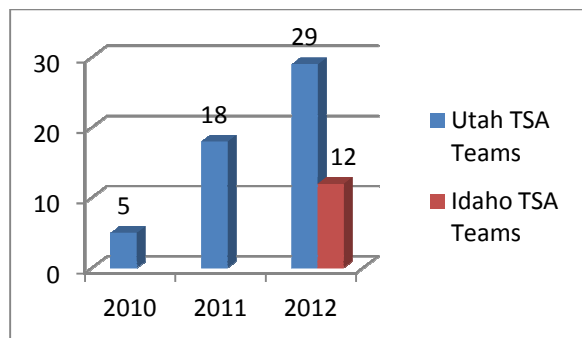


**Figure 5.** Total number of VRCs held in Utah each year, and the average number of teams at each regional.



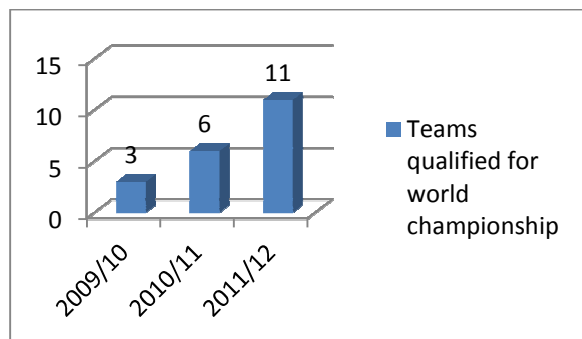
**Figure 6.** Total number of teams participating in Utah and Idaho by year.

The USU VEX Robotics Team makes presentations to the TSA chapters at the TSA Leadership Conference every year. As a direct result of this relationship, the State TSA Conference now includes a VEX TSA event. This year was the third annual Utah TSA Tournament. Each year there has been a steady increase in the number of teams participating in this tournament. Figure 7, shows the growth of the Utah TSA event over the past three years. During the 2009-2010 and the 2010-2011 school year, the Utah TSA event winner went on to compete at the national TSA event. Those teams went on to win the National TSA VEX Tournament. The 2011-2012 VEX season also marks the first year that Idaho hosted a state TSA event. There were 12 teams that competed in this initial Idaho TSA event.



**Figure 7.** Number of teams that competed in the Utah & Idaho TSA VEX Tournaments.

The 2011-2012 season has seen the most teams from Utah and Idaho qualify for the 2012 VEX Robotics World Championship, than any previous season. This year there were 11 teams that qualified to compete at the world level. Figure 8 shows the steady increase of the number of teams competing at the world championship from the Rocky Mountain Region.



**Figure 8.** Number of teams that qualified for the world championship from Utah and Idaho VRCs.

Part of a VEX Regional Competition includes skill challenges. There is a Robot Skills Challenge that tests a driver's ability to score the maximum number of points in one minute, and a Programming Skills Challenge which tests a programmer's ability to autonomously score the maximum number of points in one minute. The Rocky Mountain Region had one team in the top 30 of the Robot Skills Challenge and five teams in the top 30 of the Programming Skills Challenge. The top thirty in each challenge

qualified for the world championship. These numbers are out of over 4800 teams competing in VEX.

Through local VRCs, teams can also qualify for the National VEX Robotics Championship. Several teams from Utah went to compete in the national championship March 15-17, 2012 in Omaha, Nebraska. Two teams from Utah placed in the top 12 at the U.S. National VEX Robotics Championship.

The Utah, Idaho, and Mountain Region has continued to see a steady growth in the number of teams competing, the number of local VRCs hosted, and the quality robots being designed. The USU VEX Robotics team will continue to be a crucial part of this expansion and growth.

### Future Goals

The USU VEX Robotics team will continue to support VEX Robotics as a STEM activity by performing the following outreach:

- Oversee the Design Academy
- Host the Utah & Mountain Region VEX Robotics Championship
- Supervise and assist with VRCs in Utah and Idaho
- Update online curriculum
- Compete internationally in the VEX Robotics College Challenge
- Present at international, national, and state conferences
- Write publications for international and national journals
- Host workshops for teachers in the region
- Conduct a Delphi study to identify the outcomes of students participating in VEX Robotics

- Create an instrument to measure the self-efficacy of students participating in VEX robotics
- Conduct a longitudinal study measuring students' self-efficacy before, during, and after participating in VEX robotics

The past three years have seen the VEX Robotics Competition explode into the classrooms of Utah and Idaho. This growth is expected to continue over the next several years. The USU VEX Robotics Team is dedicated to staying at the forefront of this growth in Utah, Idaho, and the Rocky Mountain Region.

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