Lawrence Technological University

# ROBOFEST 2018 ~ 2019 Annual Report

Contents




**(Figure 1)** World Robofest 2019 participants on May 18 and major sponsors

## 1. Analysis of Robofest Team Participation Data

Robofest® is Lawrence Technological University's world-wide robotics program for students in 4th - 12th grade and college. Student teams design, construct, and program their autonomous robots to compete for trophies in a variety of competitions. Robofest's mission is to generate excitement & interest among young people for Science, Computer Science, Technology, Engineering, and Mathematics (STEM), develop soft skills such as teamwork, leadership, creativity, communication and problem solving, and prepare them to excel in higher education and technological careers.

In the 2018~19 academic year, a total of **2,489** students in **829** teams participated from 14 countries (Canada, China, Egypt, Ecuador, Ghana, Hong Kong, India, Macau, Mexico, Nigeria, South Africa,

South Korea, Taiwan, and United Arab Emirates) in addition to 10 US States (California, Florida, Hawaii, Illinois, Indiana, Michigan, Minnesota, Ohio, Oregon, and Washington). 449 site volunteers registered as judges, check-in, setup/cleanup crew, etc.

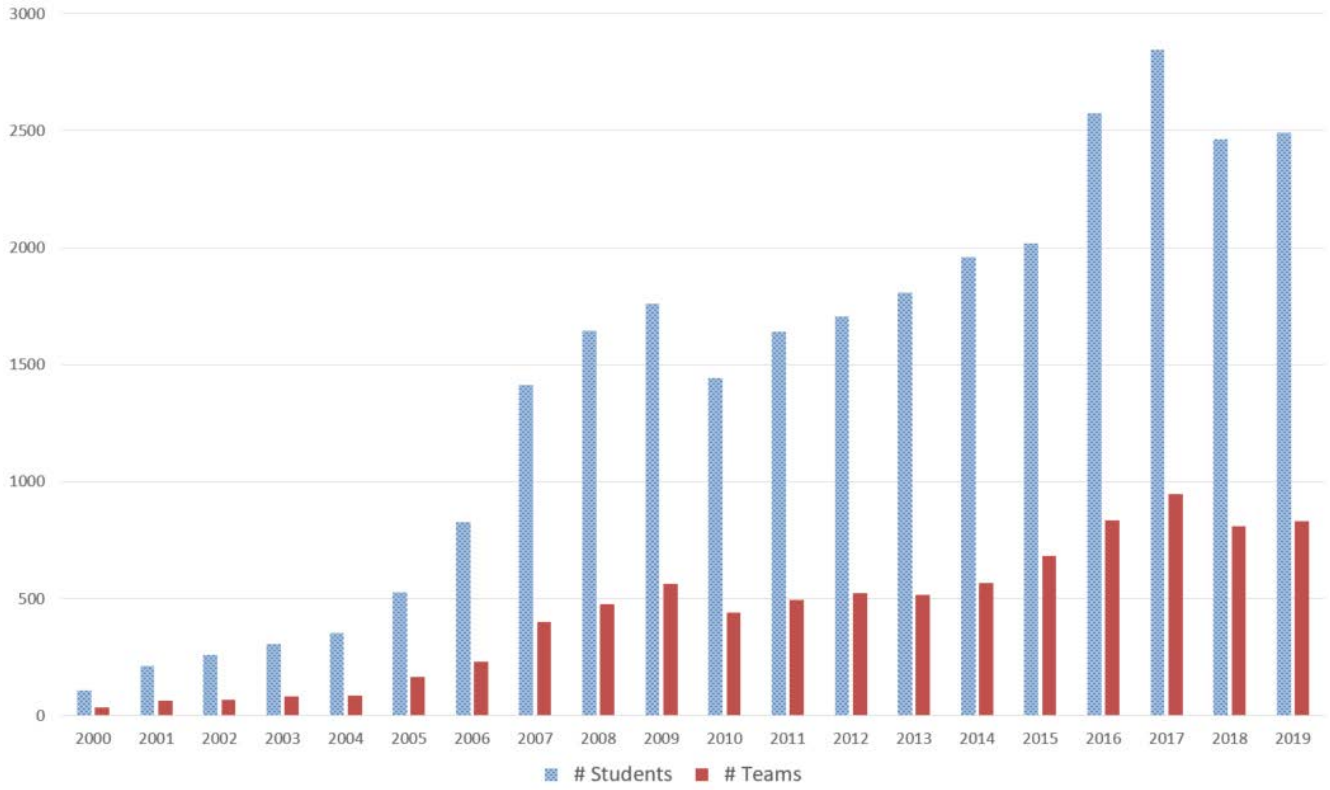
| Site Name | # Coaches | # Teams | # Players |
|---|---|---|---|
| Abuja_BaunSTEMRobotics_Nigeria | 8 | 8 | 40 |
| Alexandria_SiliconWaha_Egypt | 27 | 40 | 186 |
| Bangalore_InternationalSchool_India | 8 | 39 | 96 |
| Beaverton_Techforkids_OR | 6 | 6 | 7 |
| Belleview_Cornerstone_FL | 3 | 17 | 60 |
| BloomfieldHills_Cranbrook_MI | 11 | 30 | 91 |
| BloomfieldHills_Cranbrook_MI_BottleSumo | 10 | 19 | 44 |
| BottleSumo_Camp1_EV3_LTU_MI | 6 | 8 | 17 |
| BottleSumo_Camp2_VIQ_LTU_MI | 3 | 5 | 10 |
| Canton_Achieve_MI | 14 | 16 | 54 |
| Canton_CCA_MI | 10 | 14 | 51 |
| Canton_Gallimore_MI | 12 | 12 | 36 |
| CenterLine_MCS_MI | 3 | 7 | 26 |
| Chicago_HolyTrinity_IL | 4 | 19 | 47 |
| Cloquet_MN | 2 | 13 | 25 |
| Detroit_UDJH_MI | 4 | 15 | 53 |
| Detroit_BatesAcademy_MI | 1 | 6 | 31 |
| Detroit_UPSM_MathDance1_MI | 1 | 10 | 19 |
| Detroit_UPSM_MathDance2_MI | 1 | 10 | 20 |
| Dover_IndependenceAcademy_FL | 3 | 8 | 16 |
| Dubai_CitySchoolInternational_UAE | 3 | 17 | 48 |
| Hyderabad_SanskritiSchool_India | 10 | 46 | 155 |
| MI_Invitational_Jr_APR26* | 8 | 11 | 36 |
| MI_Invitational_Jr_APR27* | 8 | 12 | 34 |
| MI_Invitational_Jr_APR27_PM* | 6 | 9 | 31 |
| MI_Invitational_Sr_APR27* | 7 | 9 | 30 |
| Oldsmar_Nielsen_FL | 11 | 32 | 80 |
| PearlCity_HIFusionED_HI | 12 | 47 | 145 |
| Saline_WCA_MI | 6 | 8 | 17 |
| Sharjah_UAE | 1 | 18 | 58 |
| Southfield_MacArthur_MI | 1 | 5 | 24 |
| Troy_Bethany_MI | 9 | 13 | 39 |
| USA_Video_Qualifier | 24 | 29 | 88 |
| WestBloomfield_WBHS_MI | 21 | 41 | 121 |
| Wolfville_Acadia_Canada | 18 | 29 | 85 |
| World_Championship_BottleSumo_May16 | 19 | 27 | 75 |
| World_Championship_BottleSumo_May17 | 46 | 63 | 153 |
| World_Championship_Exhibition** | 11 | 11 | 44 |
| World_Championship_Game** | 20 | 33 | 96 |
| World_Championship_RoboArts | 7 | 7 | 30 |
| World_Championship_RoboParade | 16 | 20 | 75 |
| World_Championship_UMC | 27 | 29 | 76 |
| World_Championship_Vcc | 9 | 11 | 20 |
| **Total** | **440** | **829** | **2,489** |

(*) Some teams were re-formed after qualifiers. It is true some teams are double counted, but we do not have detailed data.
(**) USA teams are not added to this data to avoid double counting of the same teams who participated in USA qualifiers.

**(Table 1)** Number of Registered Participants at Robofest 2018-19 Official Competition Sites

Table 1 shows the total number of officially registered coaches, teams, and students for each site for the 2018~19 year. Note that Warmup and Virtual Regional sites are not added to this table to avoid double counting of the same teams who participated in qualifiers. This table shows only the data on Robofest web database system. China, Ecuador, Ghana, Hong Kong, Macau, Mexico, South Africa, and South Korea used their own registration systems. World Championship data above shows only the teams that advanced and participated in World Championship at LTU in May.

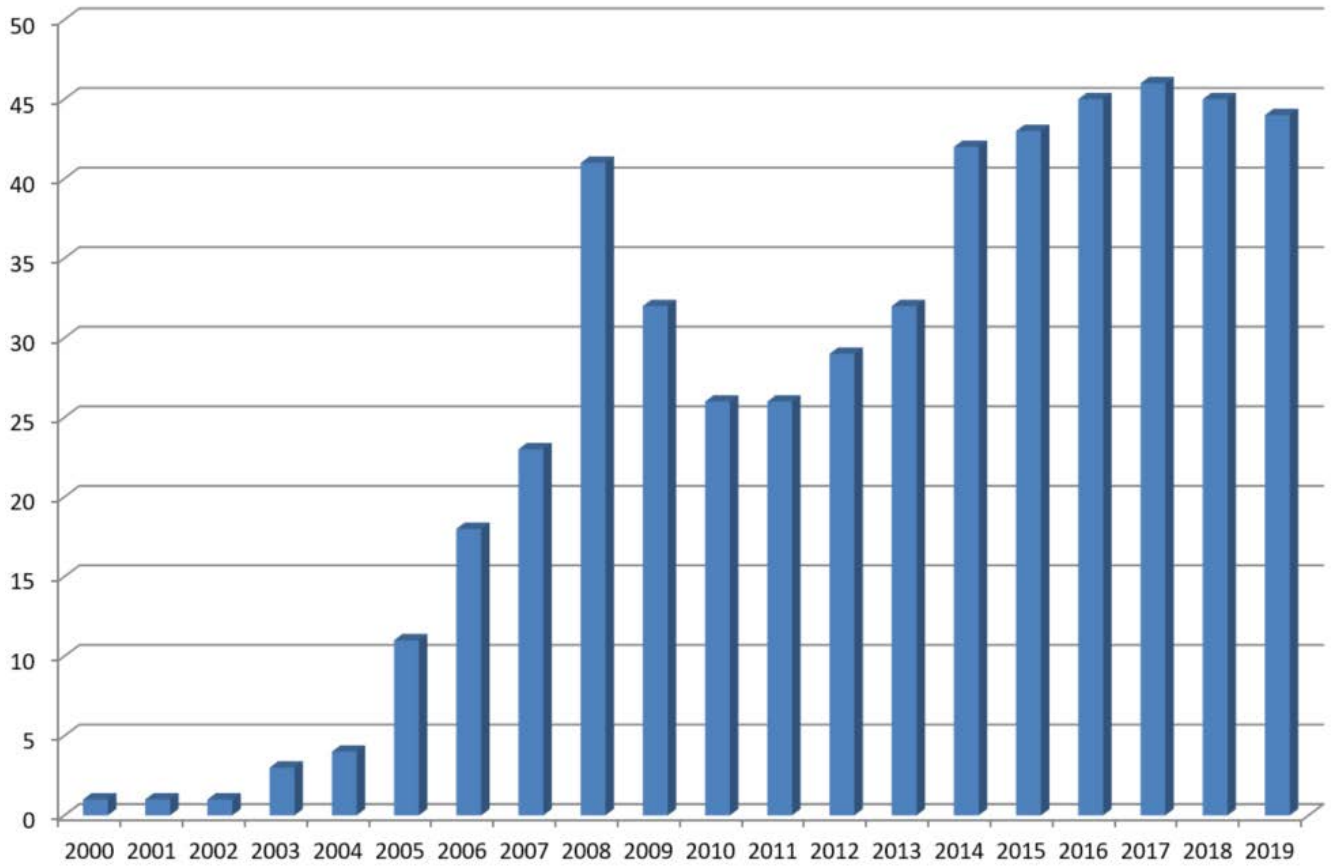
The average Robofest team size in 2019 was 3.0, which is same as that of last year. The average number of students per team size since 2000 is 3.3. We believe this small team size is good for effective learning, because each student has more opportunities to contribute to the team's objectives. Figure 2 shows the number of student participants since 2000. The cumulative number of registered students and teams in our web database since 2000 has reached 28,368.



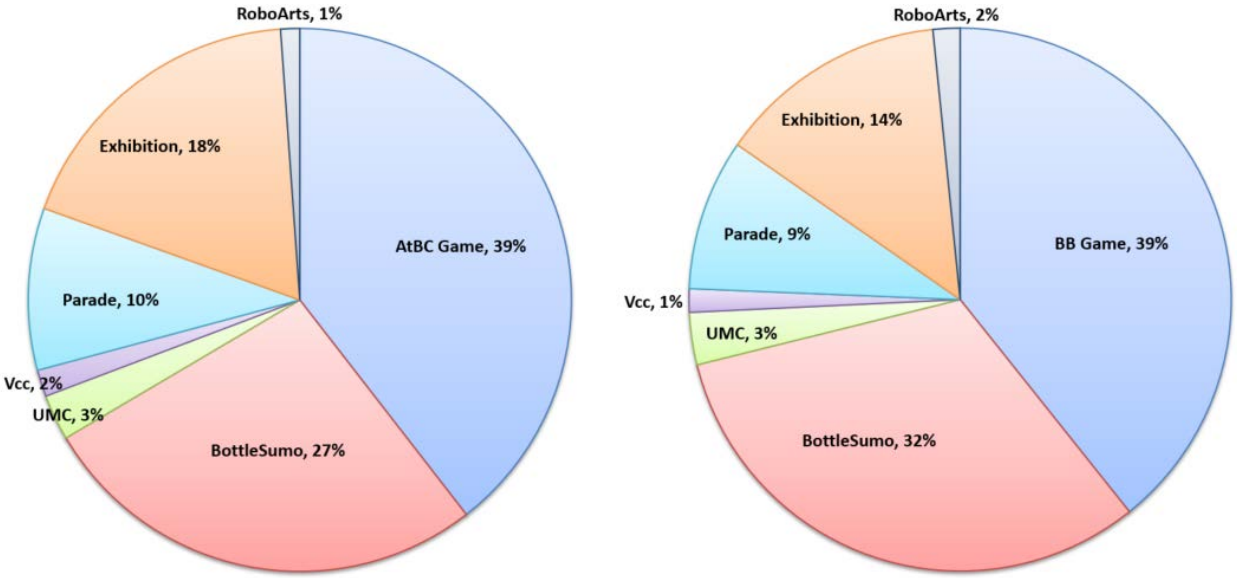

**(Figure 2**) Number of Robofest Student Participants and Teams Since 2000

The total number of Robofest competition site locations listed in Table 1, excluding warmup and virtual regional competitions, was 44 in the 2018-19 year. On average, 57 students and 19 teams participated per competition site that Robofest managed. Figure 3 shows the history of number of official competition sites since the inception of Robofest.

Robofest offers a variety of categories in which to compete. 39% of teams participated in the BinaryBlocks (BB) Game. The second most popular category was BottleSumo with 32%, then Exhibition with 14% of teams. Pie charts in Figure 4 below show percentages of teams by competition category.



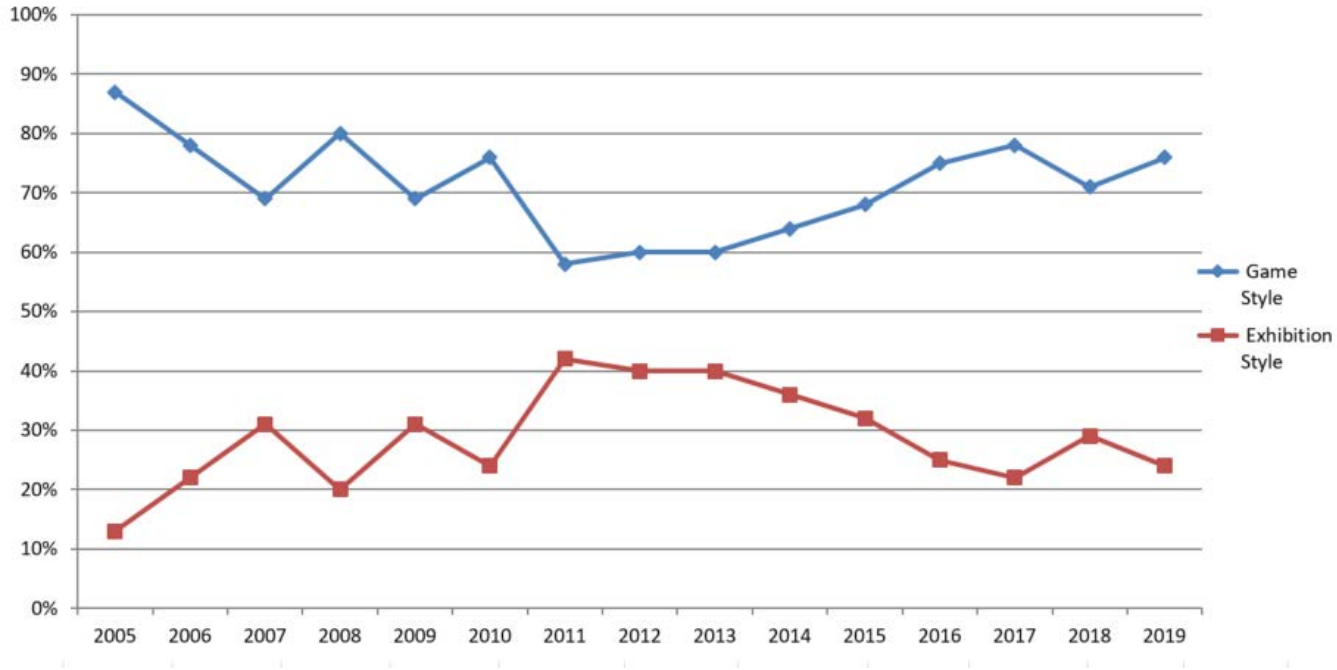

**(Figure 3**) Number of official competition site locations




**(Figure 4)** Percentages of Teams per Competition Category in 2018 (left) and 2019 (right)

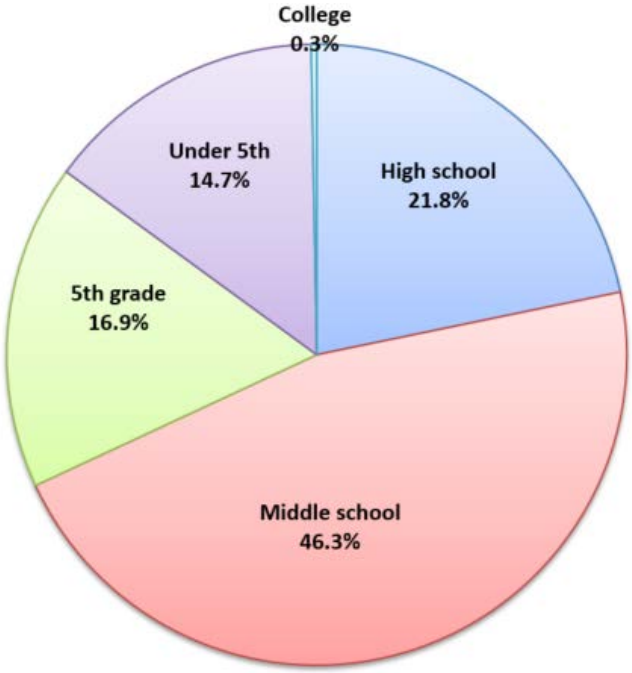
Robofest competitions can be generalized into two categories: Games that use fixed rules (including BottleSumo, Vision Centric Challenge, and Unknown Mission Challenge) and open-ended style that has no or a few fixed rules (including Exhibition, RoboParade and RoboArts). Figure 5 shows the trend

of number of teams between Games and Exhibition since 2005. We can see that the participation in the open-ended exhibition style categories was slightly decreased in 2019.

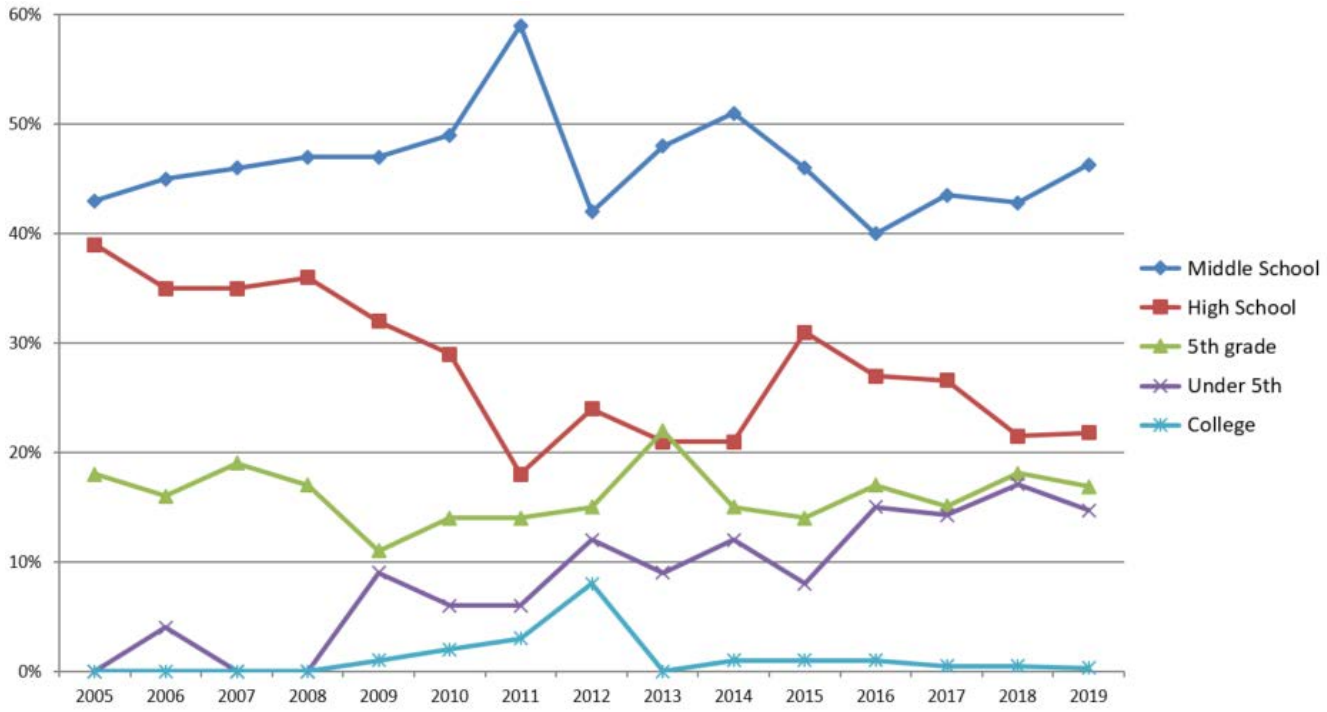



**(Figure 5)** Percentages of Game style teams and Exhibition style teams

Figure 6 shows student participation by academic level; 46.3% of the students were from middle school (6th through 8th grade). Figure 7 shows the trend of each age group since 2005. The participation of upper elementary students is increasing in general.

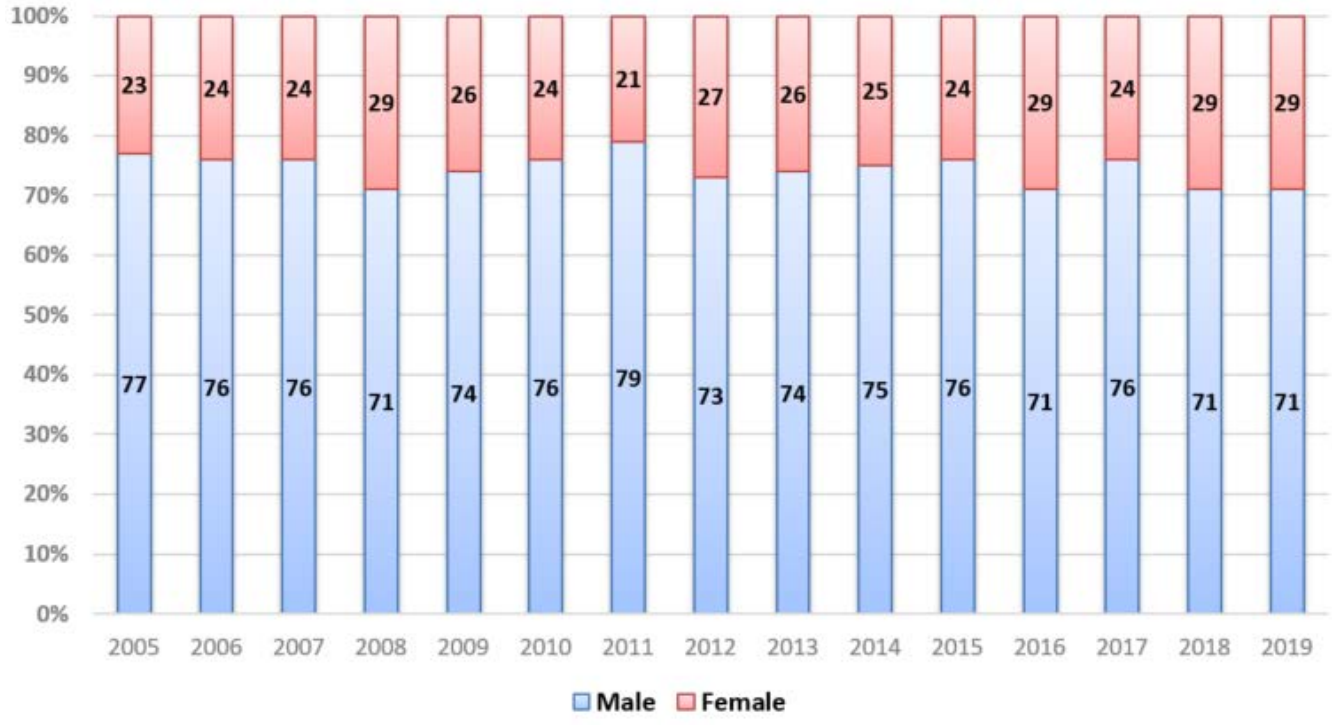



**(Figure 6)** Percentage of Student Participants per School Grade in 2019



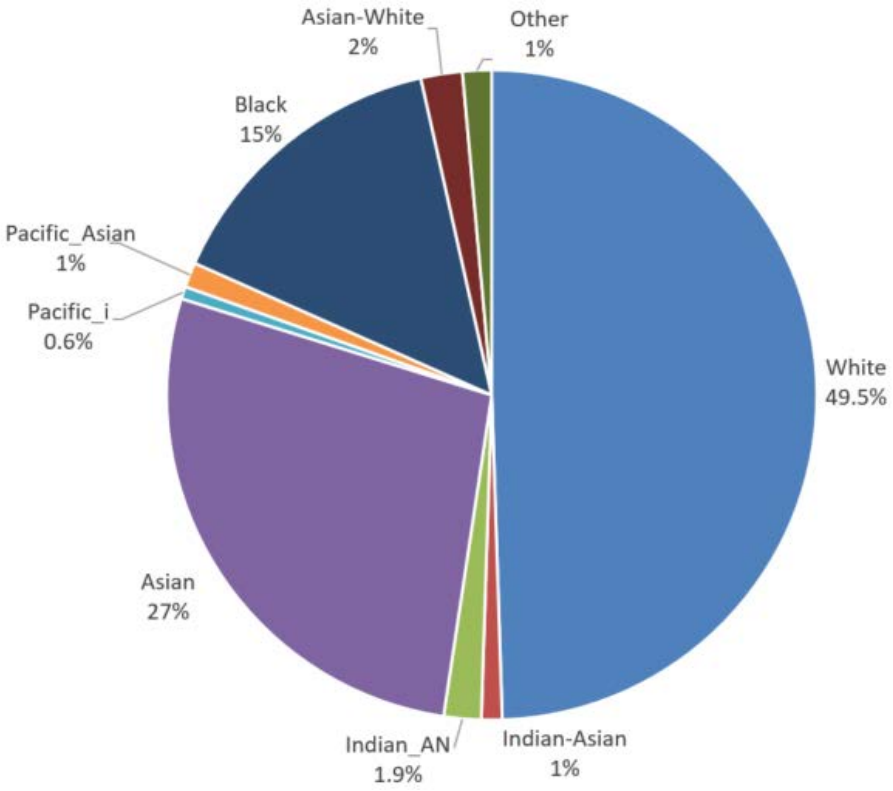

**(Figure 7)** Percent of age group since 2005

Regarding gender, we experienced an increase of female student population in recent years; 71% were male and 29% were female students. Figure 8 shows the gender ratios of Robofest students each year since 2005. The average since 2005 had been 74.4% male and 25.6% female. Note that the data is taken directly from our registration database. Many international students' data is excluded.



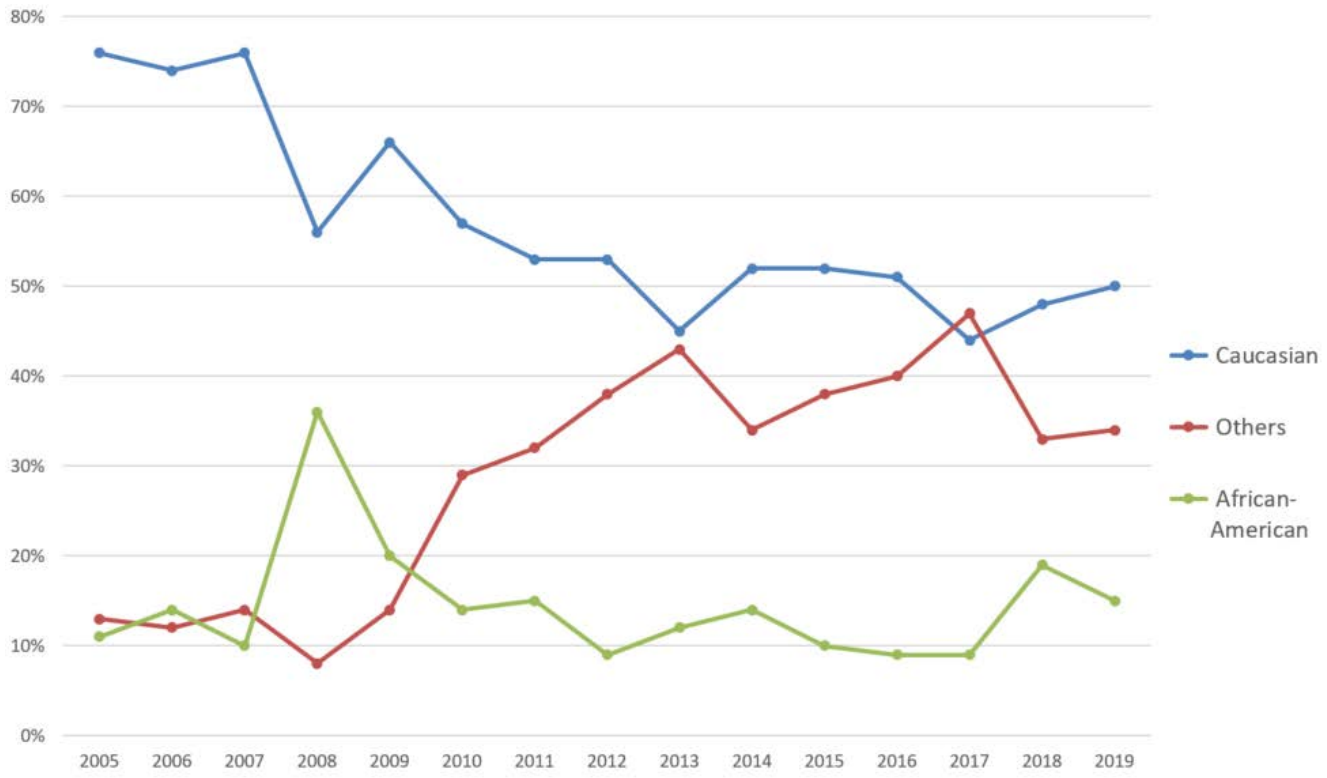

**(Figure 8)** Gender Ratios of Robofest Students

In 2018, we introduced a new optional field on the registration system to identify ethnicity when a coach registers team members online. Because the field on the online form was not required, a majority of coaches did not provide the students' ethnicity information. The following data is from 485 (20.7%) students. 15% of Robofest 2019 students were African American as shown in Figure 9. Figure 10 shows the changes since year 2005. Asian, Indian-Asian, Indian_AN (Alaskan Native), Pacific Islander, Pacific_Asian, Asian-White, and other ethnicity classes are grouped into "Other" to show the data in the same categorical format as before. Note that the ethnicity data is only from the students registered on our system. Data from the majority of international students are not included.

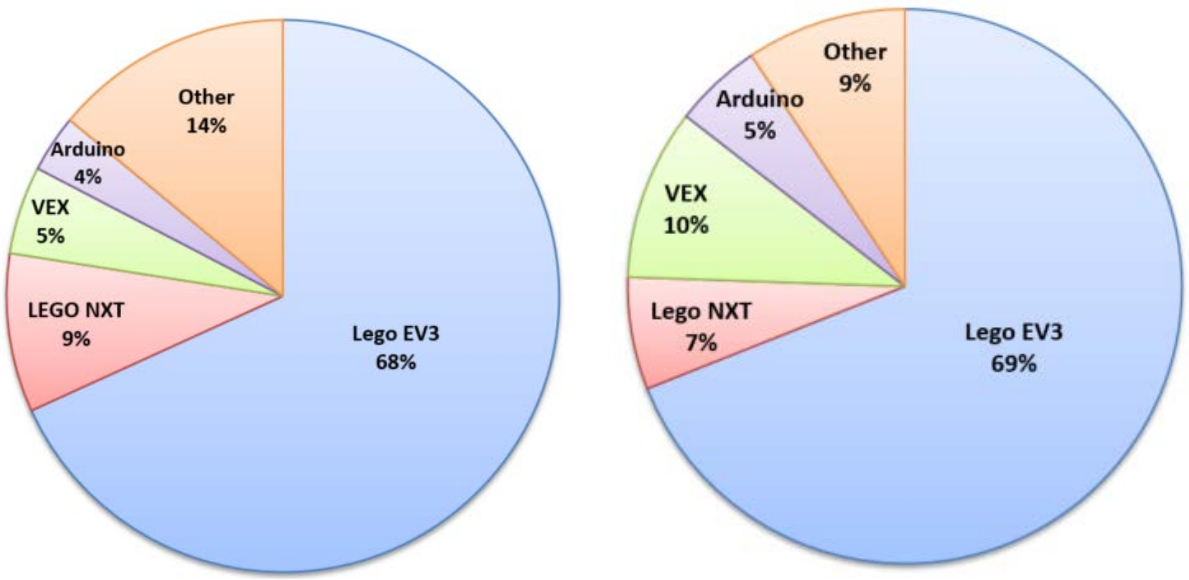



**(Figure 9)** Percentage of Student Participant by Ethnicity Data

Robofest is completely open and allows the use of *any* robotics platform, which is one of its unique features. Figure 11 shows the data on robotics kits used by the teams. The majority of the teams (69+7=76%) were using LEGO products. 2nd generation Lego NXT kits are still being used (7%). The use of VEX platforms increased from 5% to 10% in 2019.



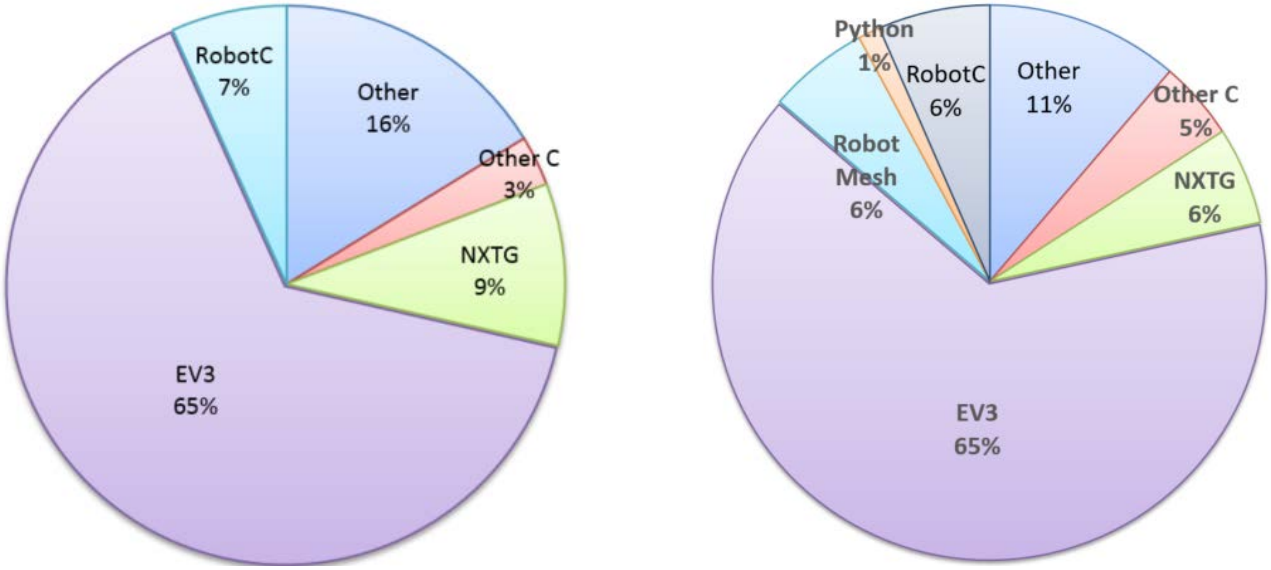

**(Figure 10)** Robofest Ethnicity Data since 2005 (The surge of African American in 2008 was due to a targeted grant)




**(Figure 11)** Percentage of Robotics Kits Used by teams in 2018 (left) and 2019 (right)

Robofest remains focused on getting student participants to learn STEM through computer programming/coding and testing. The languages used in Robofest 2019 are graphed in Figure 12. Student teams continue to use advanced and varied forms of programming languages. Allowing students to use whatever programming language they prefer is one of the unique features of Robofest.

"Other C" in the figure includes EasyC, IC, NQC, NXC and Arduino C (Sketch). RobotC became popular for high school teams when Carnegie Mellon Robotics Academy provided free licenses for Robofest teams beginning in 2009. All C-style languages together totaled 11%. Scratch-like Robot Mesh for VEX IQs was used by 6% of teams. "Other" includes Java and C#. Robofest provides opportunities to learn professional programming languages and helps prepare our students for future professional career paths. Robofest students continue to show advanced technical skills and improvements in their STEM and Computer Science abilities. This is possible because of the many dedicated coaches and technical mentors associated with Robofest.




**(Figure 12)** Percentage of Programming languages used in 2018 (left) and 2019 (right)

## 2. Robofest 2019 Coach & Volunteer Survey Results

This section shows the results of the following anonymous web surveys.

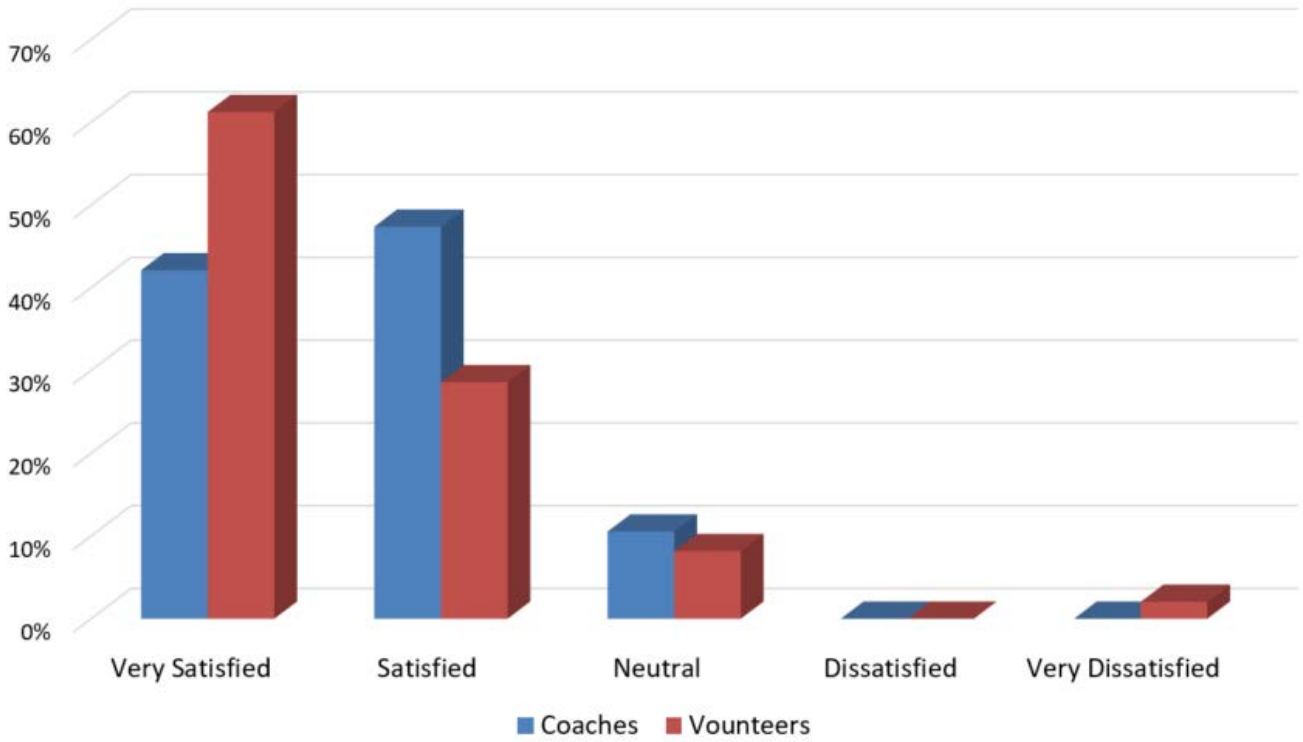
- Coach survey (38 coaches participated)
- Site Volunteer survey (49 volunteers participated)

Table 2 shows the satisfaction rate from each survey and Figure 13 displays the data in a 3D bar graph. There were no "dissatisfied" responses this year.

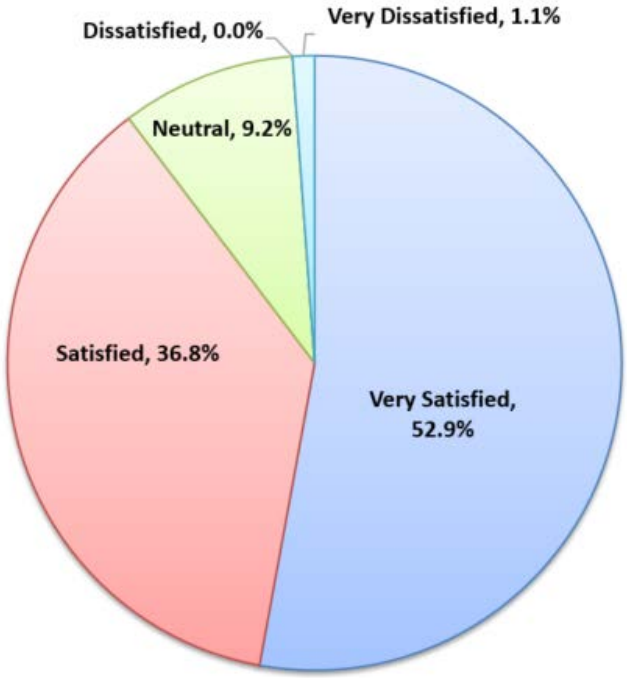
| | Coaches | Site Volunteers (Judges) | Weighted Average |
|---|---|---|---|
| Very Satisfied | 42.1% | 61.2% | 52.9% |
| Satisfied | 47.4% | 28.6% | 36.8% |
| Neutral | 10.5% | 8.2% | 9.2% |
| Dissatisfied | 0.0% | 0.0% | 0.0% |
| Very Dissatisfied | 0.0% | 2.0% | 1.1% |

**(Table 2)** Satisfaction rate from each of 2 surveys

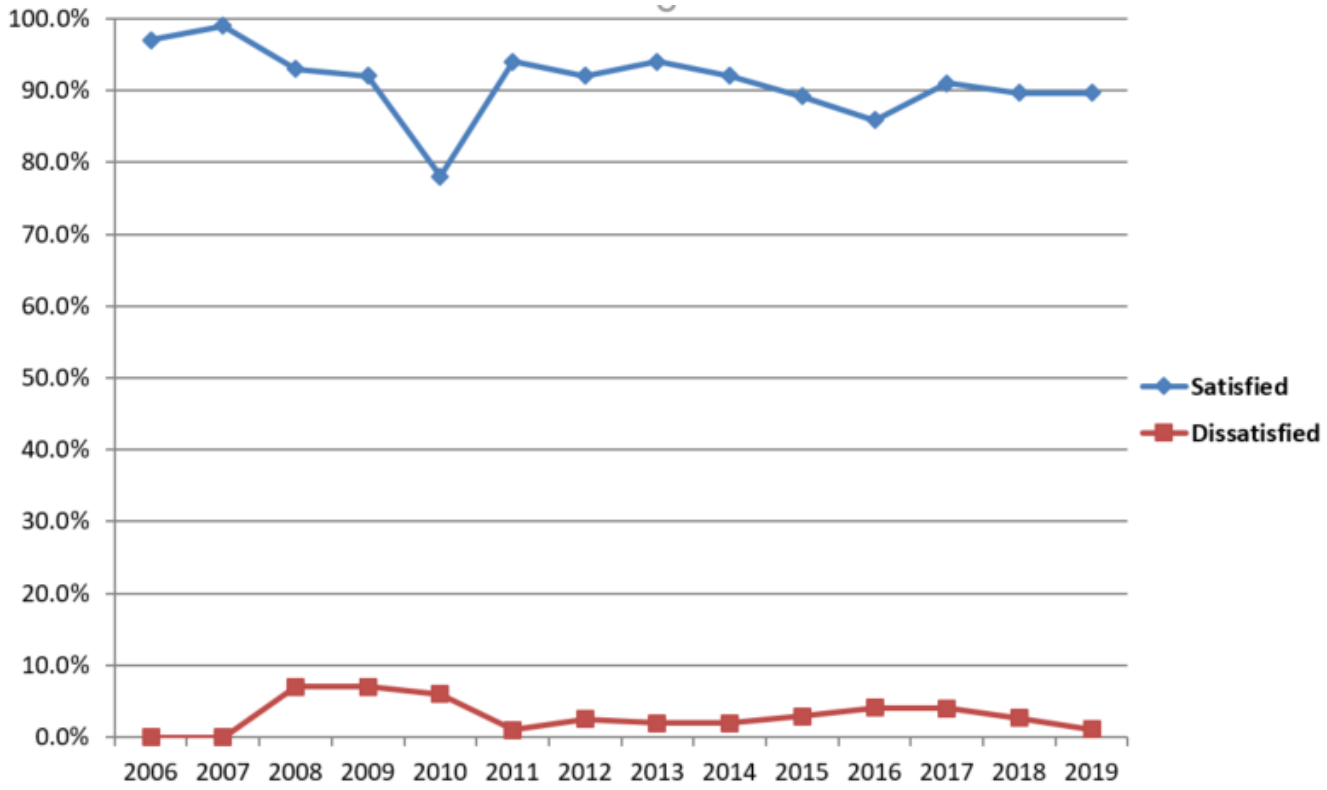
Figure 14 shows average satisfaction rate from the 2 surveys. Considering the satisfaction rate (36.8+52.9=89.7% were satisfied or very satisfied), Robofest 2019 was yet another sucessful year. Figure 15 shows Overall coach/volunteer satisfaction level changes since 2006. It does not show neutral cases.




**(Figure 13)** Satisfaction rate from each of 2 surveys

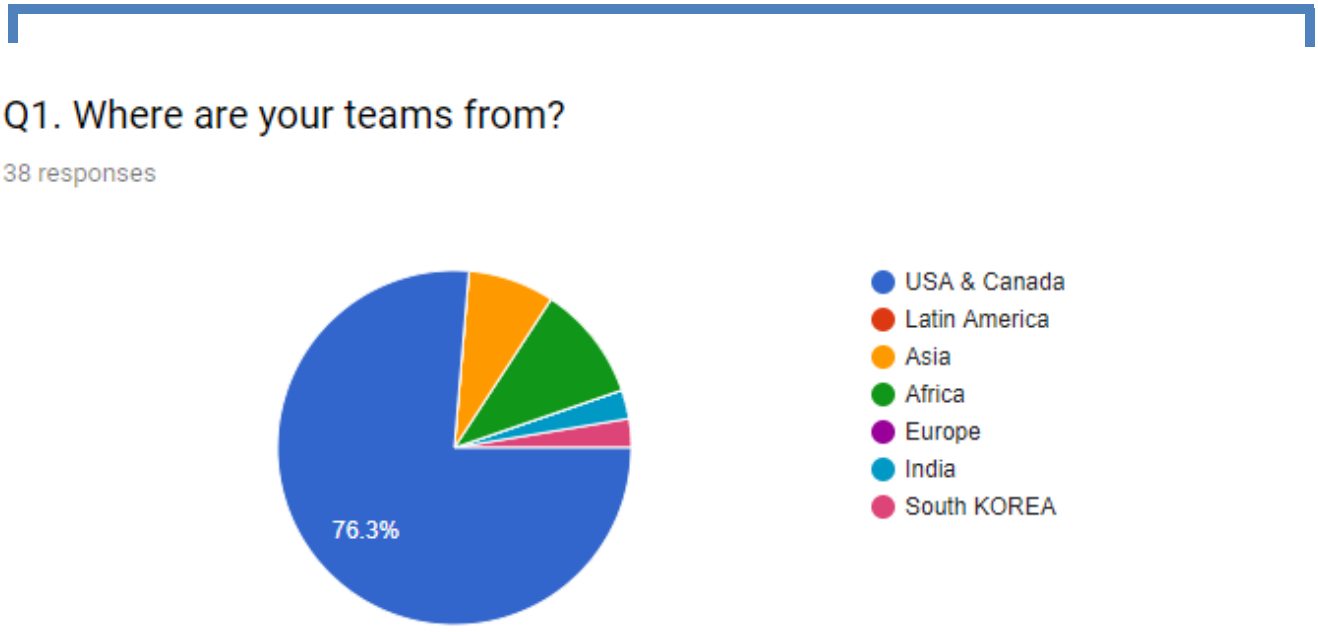



**(Figure 14)** Coach/Volunteer Satisfaction rates

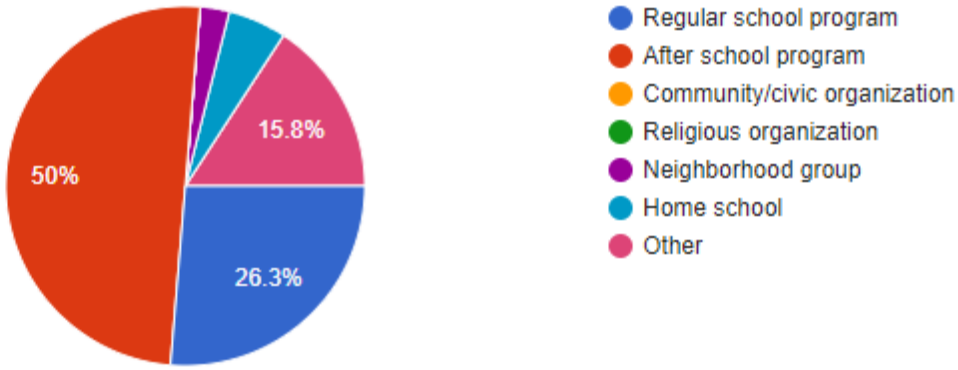



**(Figure 15)** Overall coach/volunteer satisfaction level changes since 2006 (2006~2009, 2014 contain only coach data)

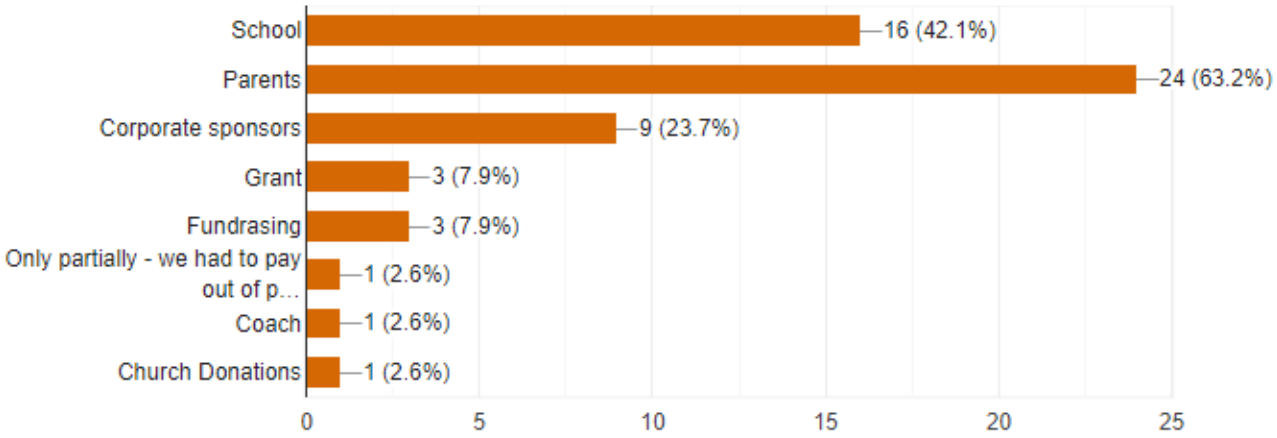
The following (Figure 16a) with 8 questions shows the results of coach surveys.



## Q2. Your team participated in Robofest 2019 through:

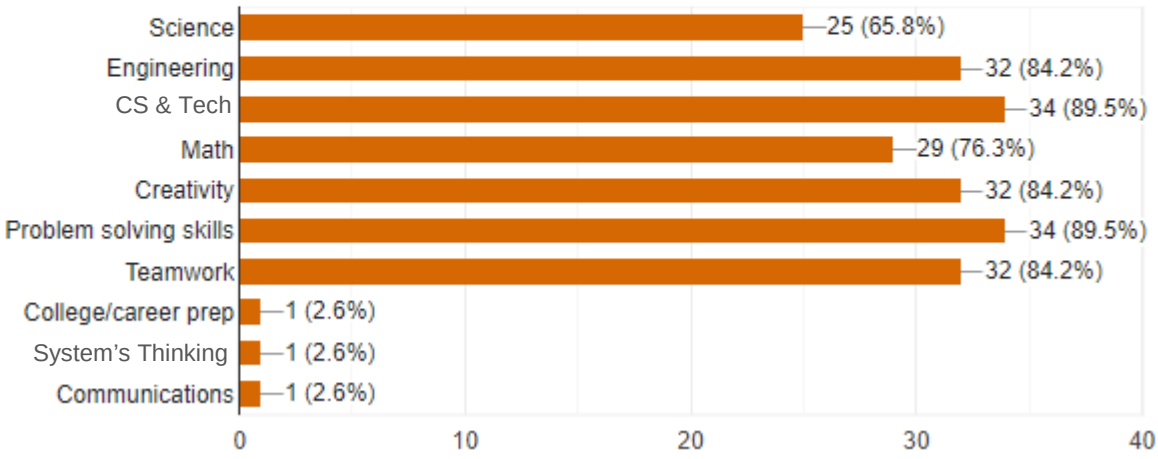



## Q3. From whom did your team receive funding?



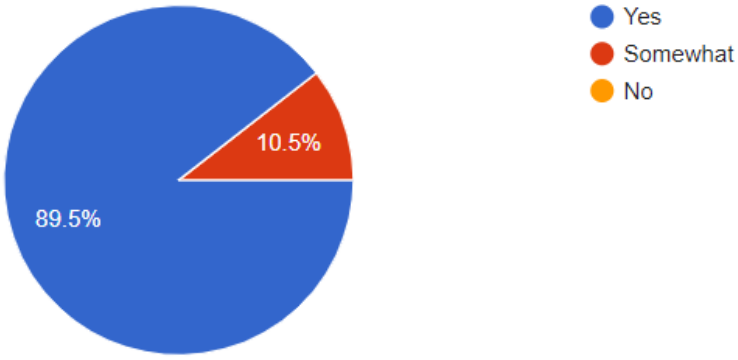

## Q4. What areas do you think are enhanced (or can be enhanced) through Robofest programs?

38 responses

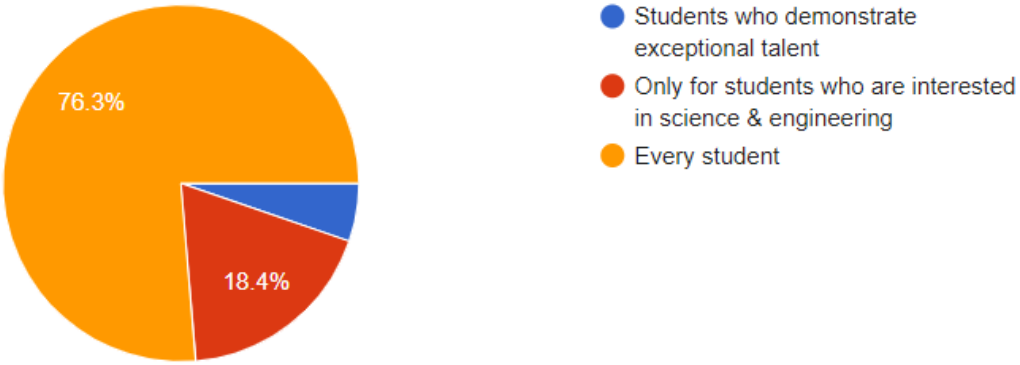


## Q5. Do you think your team members learned and improved science, technology, engineering, and math knowledge (STEM) through Robofest 2019?

38 responses

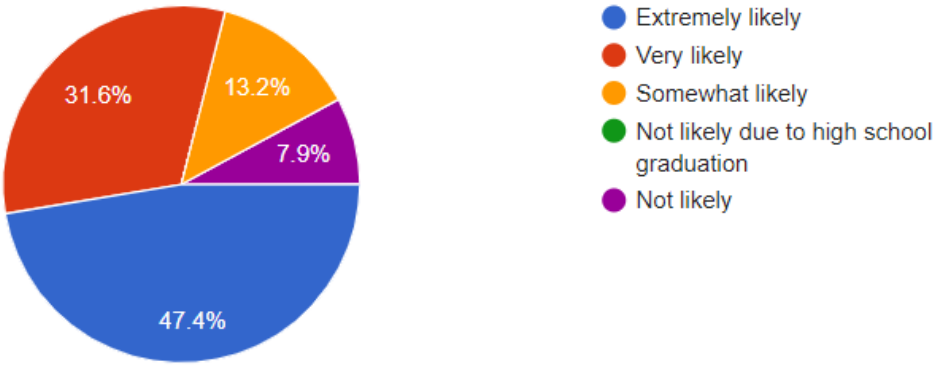


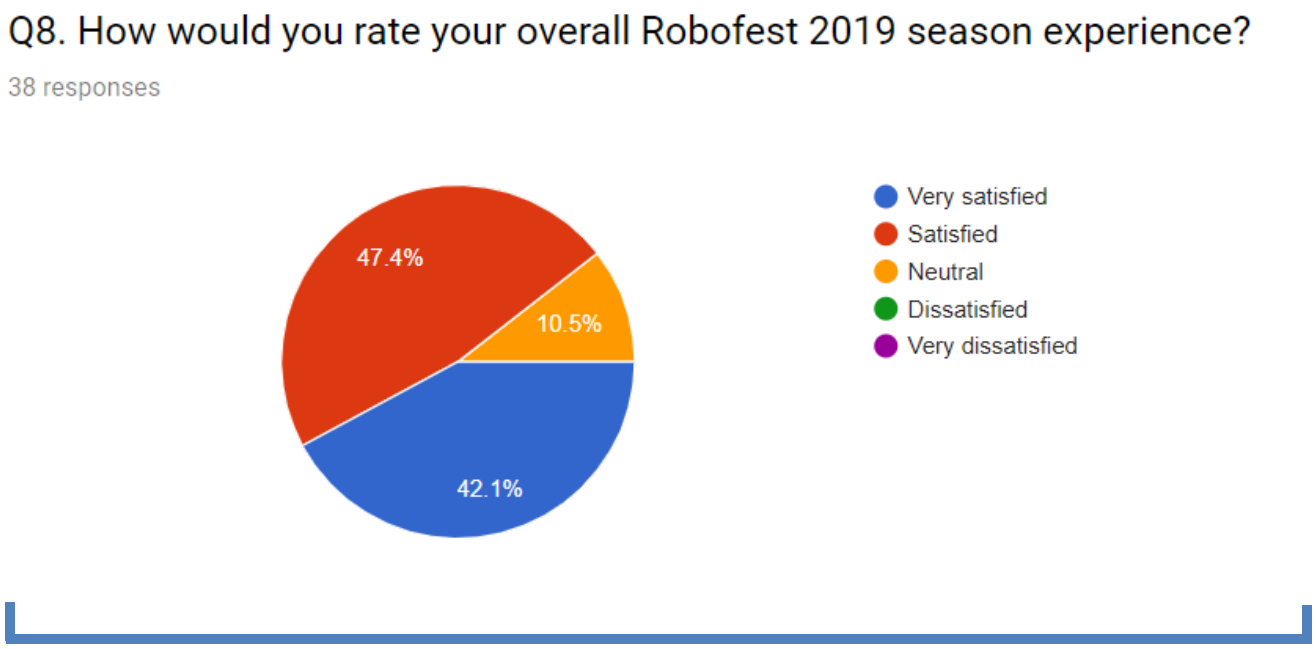

## Q6. For whom do you think the Robofest programs should be designed?




## Q7. How likely are you to participate in Robofest next year?

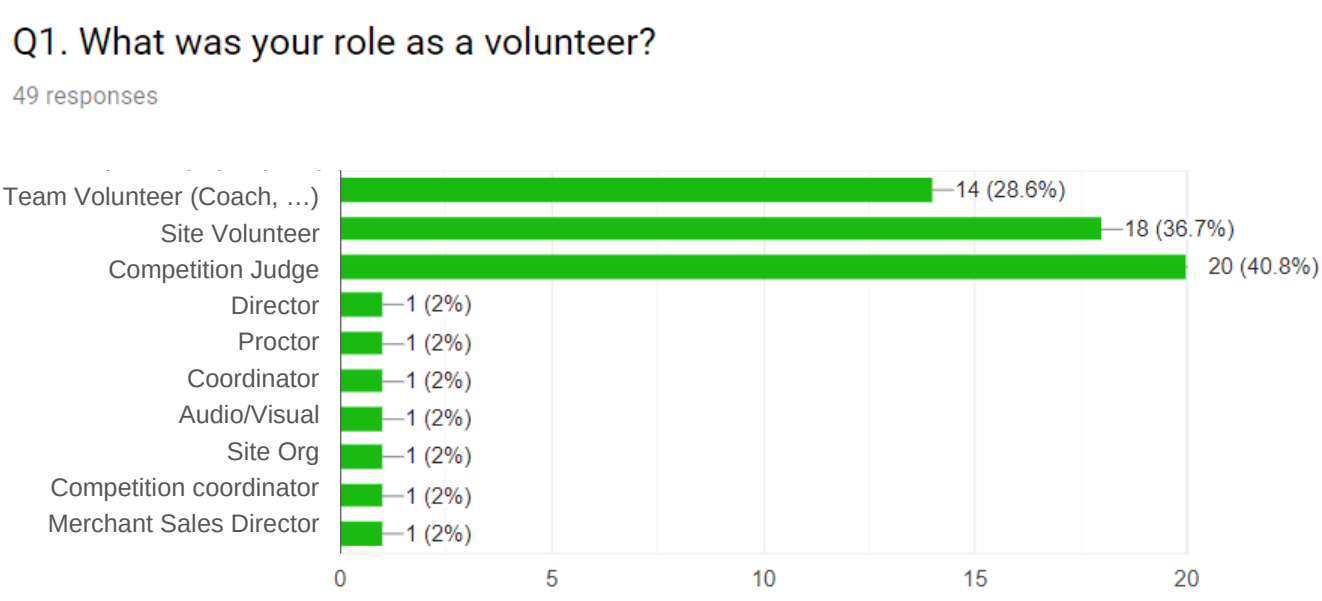
38 responses





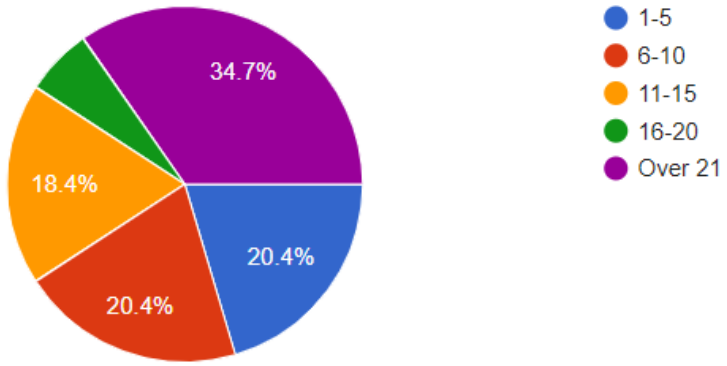

**(Figure 16a)** Coach survey results

The following (Figure 16b) with 4 questions shows the results of volunteer/Judge surveys.

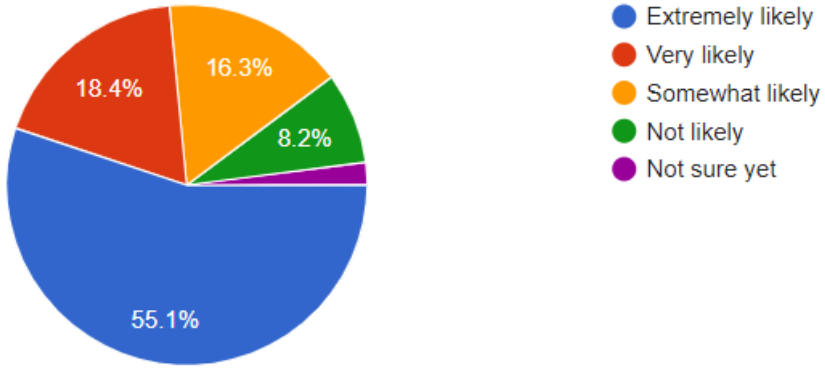


Q2. How many total number of hours did you volunteer for Robofest competitions this season?

49 responses

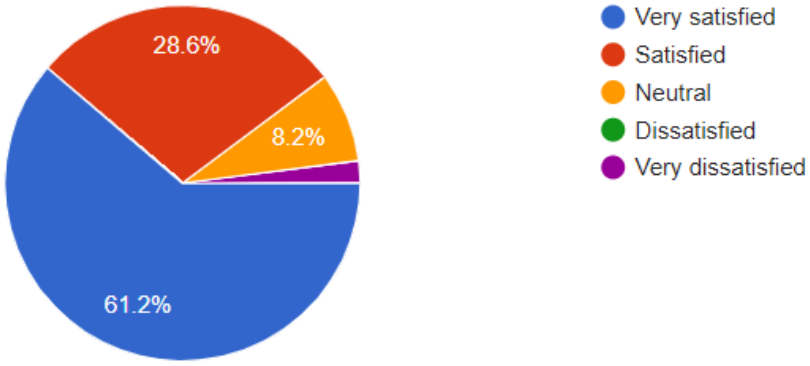



Q3. How likely are you to participate in Robofest next year?




Q4. How would you rate your overall Robofest experience this season?

49 responses




**(Figure 16b)** Volunteer & Judge survey results

The coach survey included an essay (short answer) question: *Q9. Please write any suggestions, comments, criticism, and encouragement to improve the quality of Robofest.* Comments and corresponding Robofest office's responses/comments can be found on the web at: http://www.robofest.net/2019/CoachSurvey.pdf

The surveys for Volunteers & Judges had an essay question: *Q5. Please provide any suggestions/comments which will help us enhance the quality of Robofest.* Volunteers' comments and corresponding Robofest office's comments can be found on the web at: http://www.robofest.net/2019/VolunteerSurvey.pdf

We appreciate everyone who participated in the surveys. Please note that the survey was completely anonymous.

## 3. Workshops and online eAcademy

We held 22 technical hands-on workshop meetings. Table 3 shows eight instructors and their classes during the 2018-2019 academic year. Total number of workshop attendees was 297. We thank all the Robofest official sponsors and the Lawrence Tech helpdesk for providing laptops for the workshops. Most of the workshop materials were posted on the web for on-site and online participants.

| Sate | Time | Workshop Topic | # Attendees | Lead Instructor |
|---|---|---|---|---|
| 10/25/18 | 9am ~ 1pm | Math Music Dance with Scratch (University Prep Science & Math Middle School) | 20 | Mirit Shamir |
| 11/8/18 | 9am ~ 1pm | Math Music Dance with Scratch (University Prep Science & Math Middle School) | 22 | Mirit Shamir |
| 11/10/18 | 9am ~ 1pm | Game with EV3 for students from Canton area | 15 | Joe DeRose |
| 1/9/19 | 6:30pm~9pm | Robotics 101 with EV3 | 17 | Elmer Santos |
| 1/12/19 | 9am~Noon | Game with EV3 | 15 | Joe DeRose |
| 1/19/19 | 9am~Noon | Game with EV3 | 25 | Joe DeRose |
| 1/26/19 | 9am~Noon | Game with Robot Mesh for VEX IQ | 26 | Elmer Santos |
| 1/26/19 | 1pm~4pm | Game with Robot Mesh for VEX IQ | 21 | Elmer Santos |
| Thu, Feb 7 ~ Apr 6 | 4pm~5:30pm | Game with Robot Mesh for VEX IQ at MacArthur School in Southfield (6 meetings) | 25 | Elmer Santos |
| 2/9/19 | 1pm~4pm | Game with EV3 | 22 | Chris Cartwright |
| 2/28/19 | 11:30am~12:30 pm | Introduction to Robofest BB Game at Sampson-Webber Leadership Academy in Detroit | 10 | CJ Chung |
| 3/2/19 | 9am ~ 3pm | EduBot for Vcc using Python Workshop | 8 | Eric Liu |
| 3/2/19 | 2pm ~ 5pm | BottleSumo workshop at Washtenaw Christian Academy in Saline | 13 | Chris Cartwright |
| 4/18/19 and 4/25/19 | 4pm ~ 5:30pm | BottleSumo workshop at Bates Academy in Detroit (2 meetings) | 31 | David Carbery |
| 6/19/19 | 9am ~ Noon | BottleSumo Camp workshop in EV3 software | 17 | Mark Kocherovsky |
| 8/7/19 | 9am ~ Noon | BottleSumo Camp workshop in Robot Mesh | 10 | Elmer Santos |

**(Table 3)** 2018-2019 Workshops

Robofest thanks the generous donation from DENSO, our platinum sponsor. We introduced a new Vision Centric Challenge (Vcc) platform called EduBot this year (see Figure 17a). EduBot is designed using Tetrix and a PRIZM controller. 13 EduBots were built and each of the robots has DENSO logo. The participants took EduBots home in order to work on the Vision Centric 2019 "S-SLAM" challenge after the Vcc workshop on March 2, 2019. Figure 17a shows EduBot workshop participants as well as EduBots on the workshop day. Figures 17b, 17c, and 17d show some other DENSO sponsored workshop participants.


**(Figure 17a**) EduBot workshop participants at LTU, March 2, 2019


**(Figure 17b**) VEX IQ Robot Mesh workshop participants at LTU on Jan 26, 2019


**(Figure 17c**) MacArthur K-8 University Academy students from Southfield Public Schools. They participated in Game workshops from Feb 7 - Apr. 6, 2019 on Thursdays


**(Figure 17d**) Participants of BottleSumo Camp workshop at LTU on June 19, 2019

Other Robofest sponsors helped outreach more students into autonomous robotics. Hyundai MOBIS sponsored BottleSumo workshops at Bates Academy in Detroit on April 18th and 25th. Benjamin Pollatz, Software Engineer for Autonomous Cars visited the school and gave remarks to encourage students into STEM fields. IBM volunteers also assisted the workshops. See Figure 17e.


**(Figure 17e**) Participants of BottleSumo workshop at Bates Academy in Detroit Sponsored by MOBIS on May 2, 2019

Realtime Technologies Inc. has been supporting Robofest as a Bronze level sponsor for 11 years since 2009. This year they sponsored Robofest teams at Sampson-Webber Leadership Academy in Detroit. Jason Francisco, Project Manager and David Bouwkamp, Executive Director of the company visited the school to deliver Lego EV3 kits and give remarks. See Figure 17f.


**(Figure 17f)** Participants of a Robofest workshop at Sampson-Webber Leadership Academy in Detroit on Feb 28, 2019, sponsored by Realtime Technologies, Inc.

Soar Technology Inc. sponsored a BottleSumo workshop at Washtenaw Christian Academy in Saline on March 2, 2019. Artificial Intelligence Engineer Nicholas Paul kicked off the competition on March 30th with an insightful and encouraging opening message to inspire students into STEM and robotics fields. Figure 17g shows workshop participants.


**(Figure 17g)** Participants of BottleSumo workshop at Washtenaw Christian Academy in Saline on March 2, 2019, sponsored by SoarTech

At the beginning of 2019, we announced the launch of Robofest eAcademy a series of online classes developed by Robofest instructors. Course are available for free to Robofest teams through the Schoology Learning Management system of which web address can be found at www.robofest.net. Online Courses include:

- Game using Lego EV3 and EV3 language

- Game using Lego EV3 and RobotC Language
- BottleSumo using Lego EV3 and EV3 Language
- Robofest 101- Introduction to Vex IQ using Robot Mesh Vex IQ Simulator
- Game using Vex IQ and Robot Mesh Language
- RoboParade using Robot Mesh Vex IQ Simulator and RobotMesh
- BottleSumo using Vex IQ and Robot Mesh Language
- Exhibition Projects using EV3 Language

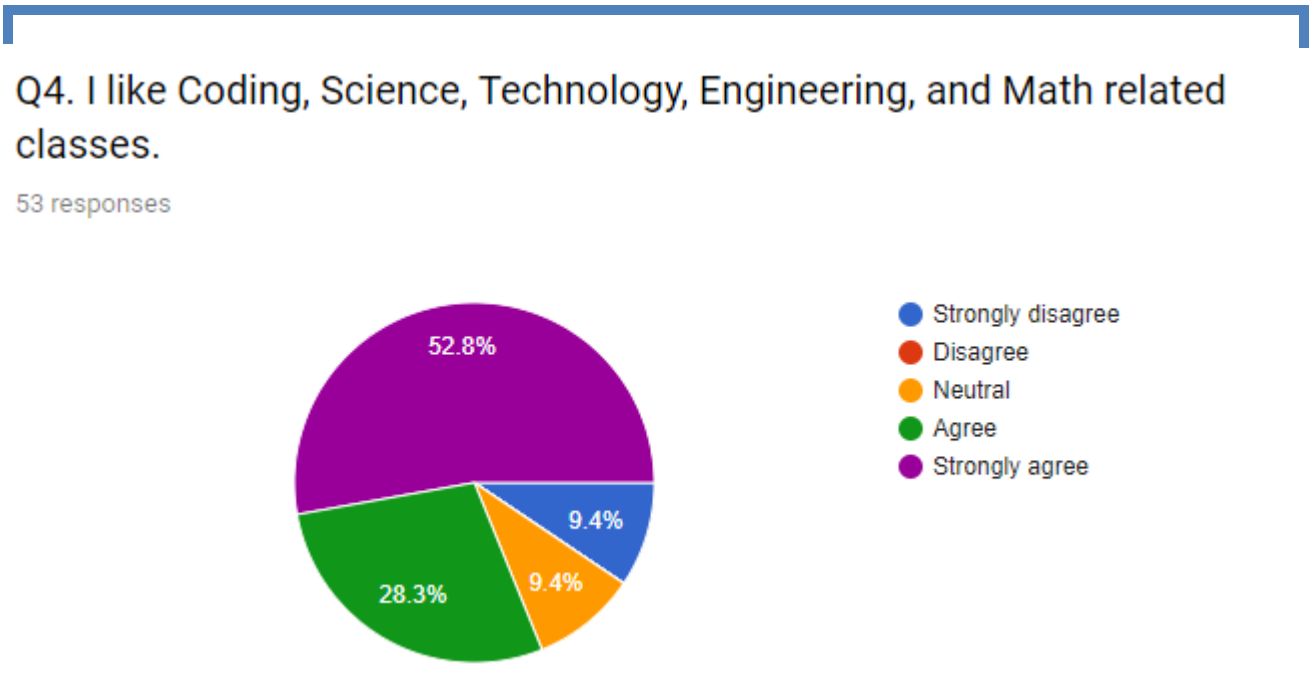
Schoology is a Learning Management System that allows students to take classes on line. They can view course material, get assignments, and take quizzes to test knowledge.

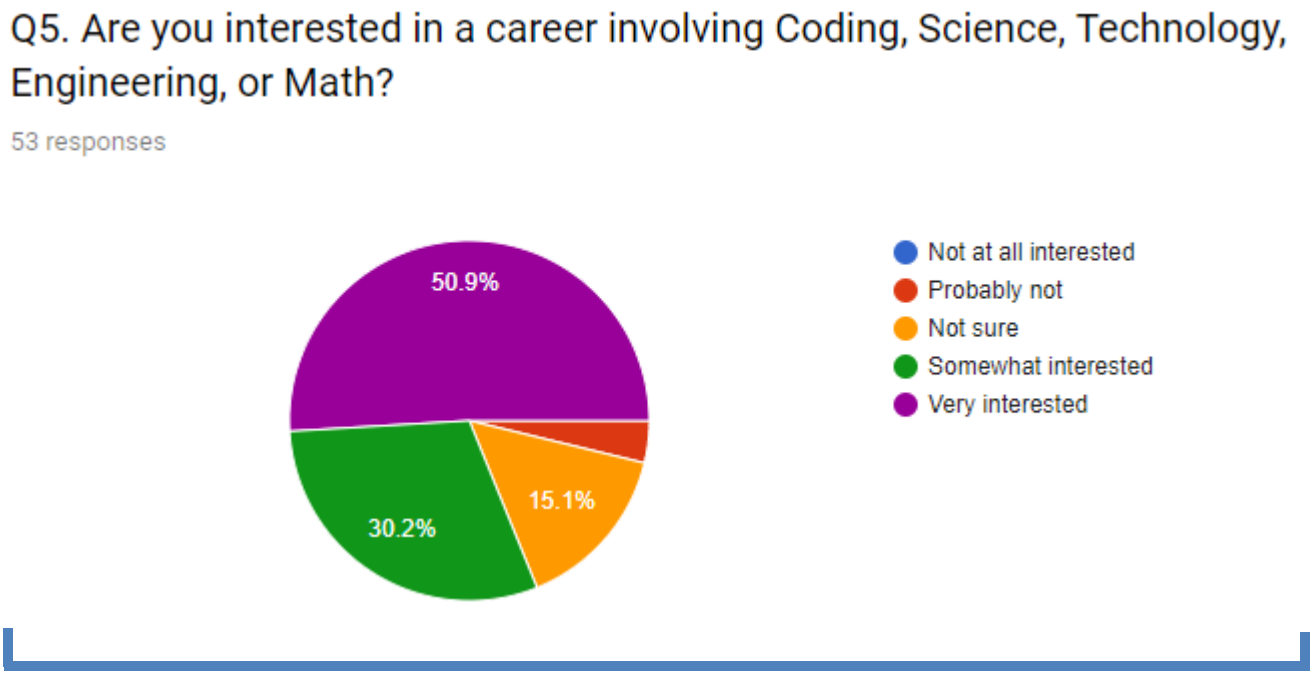
## 4. Assessment

In order to assess the impact of autonomous robotics competitions in STEM education, Robofest students were asked indirectly through coaches to take online anonymous surveys before and after the competition.

### 4.1 2019 Pre-survey

53 students participated in the pre-assessment survey anonymously when teams were registered before starting Robofest work. 81.1% (50.9+30.2) students were very or somewhat interested in career in STEM fields in the beginning. Figure **18** summarizes the results of the student pre-assessment survey.

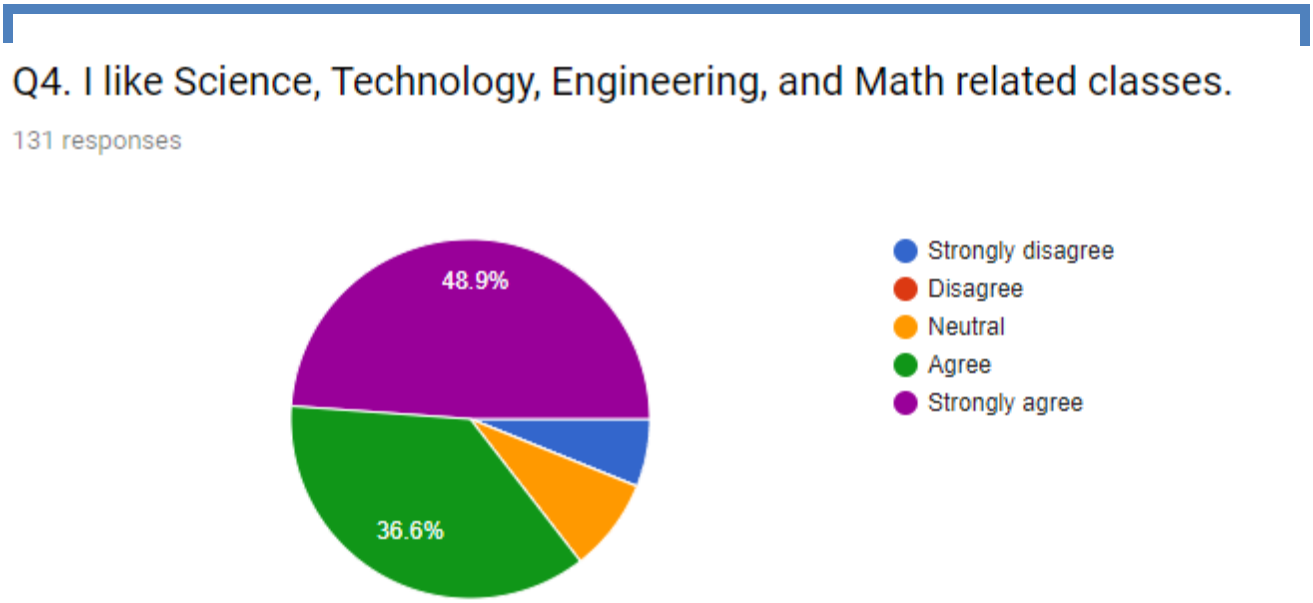


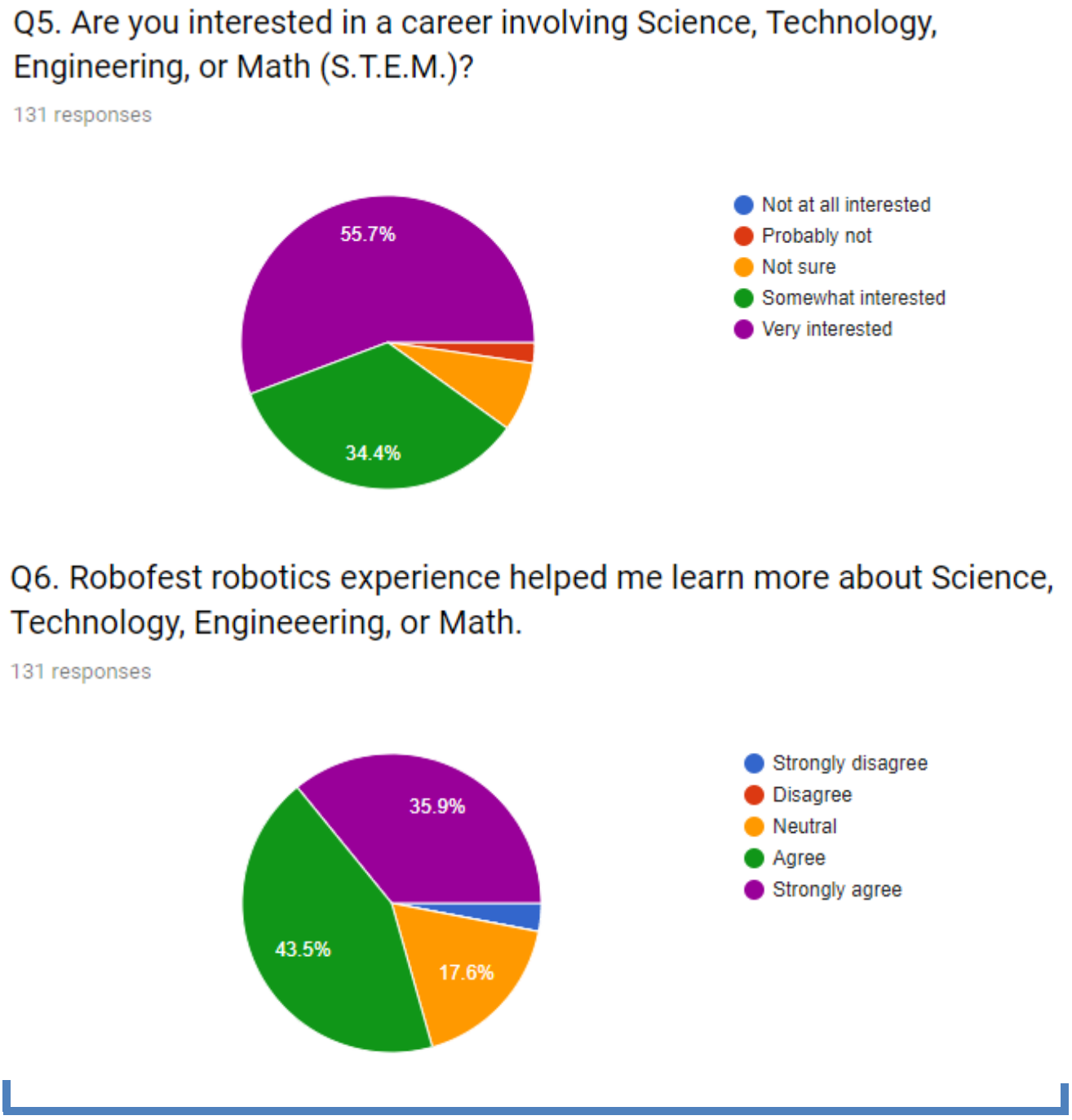



**(Figure 18)** Summary of pre-assessment student survey

### 4.2 2019 Post-survey

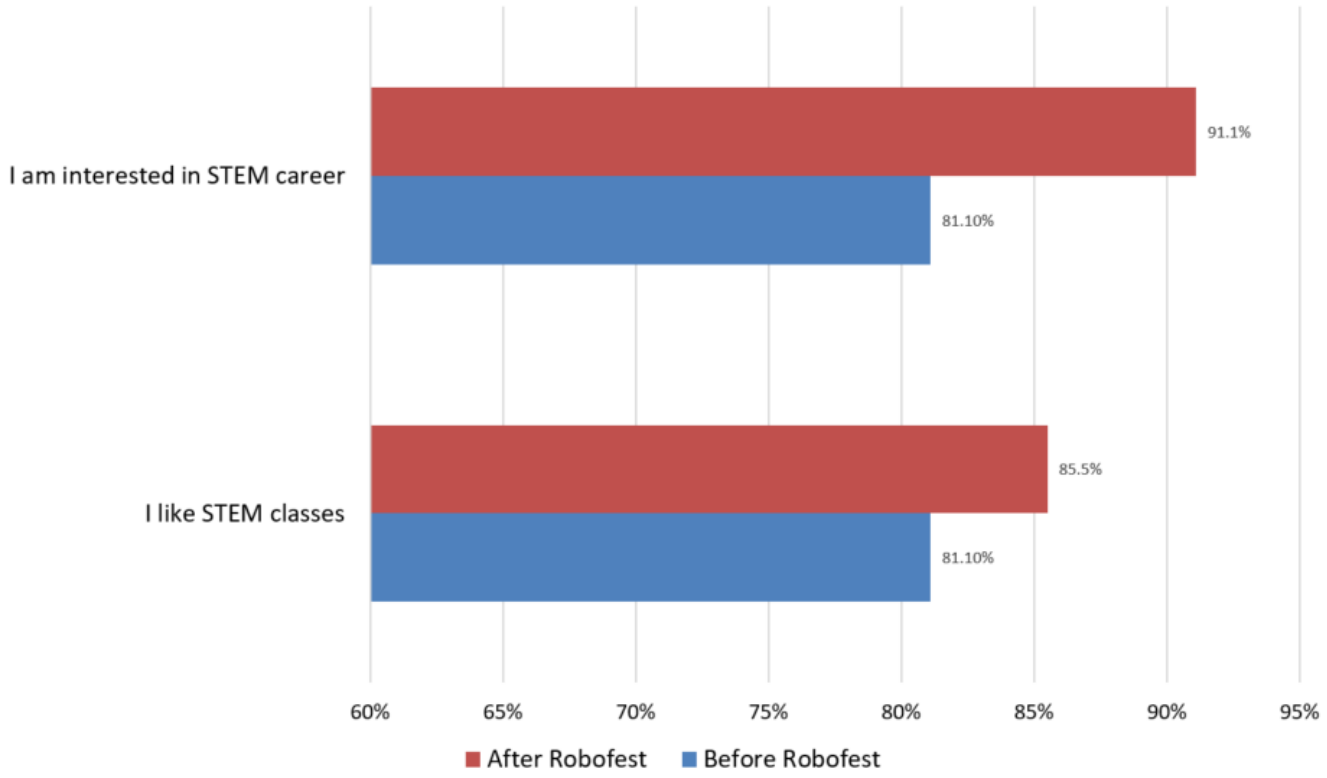
After the World Championship was completed, a post-assessment survey was conducted. 131 students participated in the survey anonymously and the summary is shown in Figure 19 below.






**(Figure 19)** Summary of post-assessment student survey

A majority (35.9+43.5=79.4%) of students indicated that the Robofest robotics experience helped them learn more about Science, Technology, Engineering, or Math (STEM). 85.5% of students liked STEM classes and 91.1% of students also expressed that they would now consider a career involving Science, Technology, Engineering, or Math after their Robofest exposure. After Robofest experience, both ratios were increased as shown in Figure 20.




**(Figure 20)** Assessment Summary

### 4.3 Overall Program Self-Evaluation

Robofest mission statement has 3 main goals:

A) Generate excitement & interest among young people for STEM
B) Develop soft core skills such as teamwork, leadership, creativity, communication and problem solving
C) Prepare them to excel in higher education and technological careers

We defined and collected the following metrics to measure the success of a Robfest academic year.

1) Total number of registered teams during an academic year
2) Dropout rate (% of registered teams that did not compete)
3) Percentage of teams that received over 60% scores for Games
4) Percentage of teams that received over 3.0 out of 5 for Exhibition
5) Percentage of teams that solved the unknown problems without the help from adults. (Robofest has unknown problems like exams unveiled at the beginning of competition.)
6) Overall coach & volunteer (Judge) satisfaction rate
7) Percentage of teams that participate in the 2nd chance Game competition
8) Percentage of teams that improved scores in the 2nd chance competition.
9) Percentage of students who indicate that Robofest robotics experience helped them learn more about STEM
10) Increased percentage of students who like STEM classes after having Robofest experience
11) Increased percentage of students who consider a career involving STEM after their Robofest exposure
12) Percentage of coaches who indicate that Robofest experience helped students in learning soft core skills such as teamwork, leadership, creativity, communication and problem solving

Evaluation of 2019 year for each metric is summarized in Table 4. Overall evaluation of the Robofest 2018-2019 year related to Robofest's goals is anlayzed in Table 5.

| Metric # | Criteria to claim the metric is successful | 2019 Metric Outcome | Evaluation |
|---|---|---|---|
| 1) | Total number of registered teams > 500 | 829 | Successful |
| 2) | Dropout rate < 5% | 4.2% | Successful |
| 3) | % of Game teams with over 60% scores > 30 | 22% | Not successful. 2019's challenge was harder than previous years |
| 4) | % of Exhibition teams with over 3.0 > 50 | 59% | Successful |
| 5) | % of Game teams that solved unknown problems > 40 | 37% | Nearly successful |
| 6) | Overall satisfaction rate > 80% | 89.7% | Successful |
| 7) | % of teams that tried 2nd Chance > 30 | 33% | Successful |
| 8) | % of teams that improved scores in the 2nd chance competition > 60 | 71% | Successful |
| 9) | % of students who indicate that Robofest experience helped them learn more about STEM > 80 | 79.4% | Nearly successful |
| 10) | Increased % of students who like STEM classes after having Robofest experience > 5 | 4.4% | Nearly successful. (Usually students who like STEM classes participate in Robofest) |
| 11) | Increased % of students who consider a career involving STEM after their Robofest exposure > 5 | 10% | Very successful |
| 12) | % of coaches who indicate that Robofest experience helped students in learning soft core skills such as teamwork, leadership, creativity, communication & problem solving > 60 | 100% | Very successful |

**(Table 4)** Evaluation of 2019 year for each metric number

| Goal ID | Metrics used to measure the success of the goal | Successfully or almost successfully achieved metrics in 2019 | Evaluation |
|---|---|---|---|
| A) | 1), 2), 6), 7), 10), and 11) | 1), 2), 6), 7), 10), and 11) | Successful |
| B) | 4) and 12) | 4) and 12) | Successful |
| C) | 3), 4), 5), 8), 9), 10), and 11) | 4), 5), 8), 9), 10), and 11) | Almost successful (6 out of 7) |

**(Table 5)** Overall evaluation based on Analysis of Goals and metrics

## 5. Plans for 2019

We have identified various facets of Robofest needing refinement, enhancement and improvement in the coming years based on LTU administrator's requests, outcomes, anonymous online surveys, private conversations, self-evaluation, and inputs from coaches, parents, students, volunteers, and site hosts. We know that some items summarized below are carried over existing problems from previous years. Please understand that Robofest is managed without any full-time staff and some issues take time and resources to improve. We will eventually resolve the issues.

## 5.1 General Administration

### Competition levels and how to advance to the World Championship

We will continue the "Michigan Invitational Competitions" and give 2nd chances via video submissions to Non-Michigan teams. Robofest will continue to work to improve the balance between difficulty and attainability to maximize students' learning.

As in previous years, we will maintain different competition structure for the following 3 groups: USA Michigan, USA Non-Michigan, and International teams. We plan to continue the Latin American Robofest competition in Mexico. Detailed rules for the World Championship advancement will be announced in the 2020 General rules on the kick-off day.;

### World Championship

For the 2019-2020 academic year, the World Championship will be held at Lawrence Technological University in Southfield, Michigan. A tentative schedule can be found at: https://robofest.net/2020/WC20schedule.pdf Note that Open Category Jr. BottleSumo competitions will be held on two days and final matches will be held on the last day. The Drawing Contest and WISER mini conference will not be held this coming year. The Friendship Talent Show will be discountinued. Instead, we are considering a mini event to promote friendship as a part of the "Welcome Meeting For All" on Thusday morning. We posted "List of Winning Teams With Participant Names" for the first time and we will continue to recognize contestant names of winning teams.

### Site Host Administration

During the 2019 season, in most cases when there were fewer than five (5) teams registered for a specific category/age division of competition, the division or site was cancelled. The decision was usually made three weeks before the actual qualifying date. We suggested displaced teams move to another site or use video submissions.

We will plan again a "Pre-Registration-In-Michigan" Site for teams who do not have preference for Site location & date and for administration flexibility as Sites register. The Robofest office can move the team to a Site later.

As we have done with past years, efforts will be made to proactively schedule dates next year so that there are not as many events on one day. It is suggested that sites outside of Michigan plan for earlier dates, as time is needed to fund travel to the World Championship.

The development of committees for each state to coordinate events is needed, especially when there are multiple site hosts from a region. The hope is to alleviate scheduling conflicts outside of Michigan and to provide geographic distribution as well.

We plan to introduce a Site Host application form online in the fall, 2019.

Due to international shipping problems, winner trophies will not be sent out to competitions outside the USA. Option 1 Site Host must purchase all awarded trophies locally and will receive 20% reimbursement of collected registration fees to assist with cost.

### Registration Fees and Check-In Fees

We are proud of our cost-effectiveness and efficient management to minimize the cost for teams to participate in inexpensive Robofest robotics programs for everyone. We did not charge check-in fees for World Championship in 2019.

### Communications

- Email is the primary communication method in Robofest. Please make sure to keep your email address on your coach and Site Host account updated.
- There is a way for coaches to get information on other teams including the email addresses of

other team coaches at their qualifying site on Robofest coach login account.

- We encourage teams to use Facebook for communicating and networking with other teams. The Robofest Facebook page is at www.facebook.com/robofest. We post photo album links on the page.
- Students' achievements should be well publicized. Please send your teams' achievements to your local newspapers and TV stations. LTU is sending out press releases to major news outlets, as well.
- Our Robofest Director in Ghana, Dr. Yaw Okraku-Yirenkyi has graciously volunteered to set up and monitor a WhatsApp group for teams (mostly international) to share thoughts and ideas and ask questions about the Robofest Game. The name of the group is: "`Robofest -Tech Discussion`".

**Robofest Website**

We are proud of keeping almost all data/information/pictures from the 20 years of our history. However, we are fully aware that the current website is not well structured to navigate. Web pages are not mobile-friendly. There are some broken links. In order to work on improving/revamping the website, we are looking for a professional Joomla designer and developer.

**Online Registration Systems**

- To comply with GDPR (General Data Protection Regulation), our privacy policy is posted at: https://www.robofest.net/2018/LTU-Robofest-Privacy-Policy-v2.1.pdf
- We introduced online consent release form. Coaches are to provide parents' email address. Then our system sends out the online form link to parents. We also provided ways to use traditional paper forms.
- Currently we are facing a problem to find a qualified staff member to maintain/improve the system. We are looking for a professional Joomla, Java Servlets, JSP, Ajax, Tomcat and mySQL programmer who is willing to work part-time.
- A few teams uploaded team pictures this year (2006 – 68%, 2007 – 53%, 2008 – 55%, 2009 – 50%, 2010 – 50%, 2011 – 41%, 2012 – 34%, 2013 – 44%, 2014 – 36%, 2015 – 23%, 2016 – 19%, 2017 – 25%, 2018 – 16%, 2019 – 13%).

**Free Technical Support and Workshops**

Some of the workshops were available on the web through real-time or recorded webinars. Most of the workshop files and codes were posted on the web "Tech Resources" page for free. Instead of syncronized webinars, we introduced online eAcademy classes using Schoology LMS. See section 3 of this document.

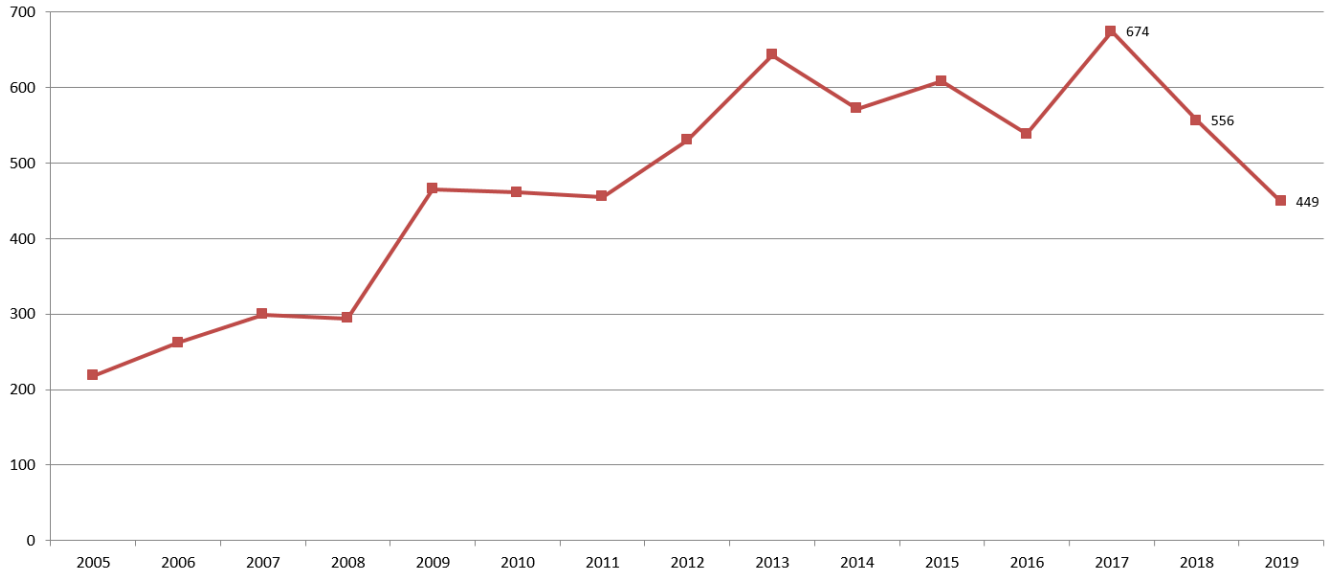
## 5.2 Competition Rules

- We have published and posted rules in Word format as well as PowerPoint Slide formats. In 2019-2020 year, we will create and maintain Slide formats only.
- Regarding the Game category, each Site Host should ask all spectators and coaches to leave the competition and pit area during the 30 min work-time as well as the check-in time. It is imperative to protect the impounding table, since there were incidents of touching/damaging other team's robots.
- We will discontinue the "Surprise" challenge for World Championship game competitions. Instead, we encourage Game teams to participate in the UMC (Unknown Mission Challenge).
- We will make it clear again that the official language of the Exhibition competition is English.
- Categories for beginners like BottleSumo and RoboParade are recommended for sites to host throughout the year across the nation.
- We will refine BottleSumo rules to remove some confusions.

## 5.3 Competition Event Organization

### Volunteer Organization

We had 449 people this year registered on the web database and we deeply thank all the site volunteers. See Figure 21 for the number of registered site volunteers since 2005. Some qualifying sites still did not fully use our online volunteer system again this year. Robofest coordinator Pam Sparks will manage all volunteer recruiment and registration in the 2019-2020 season.




**(Figure 21)** Number of yearly registered site volunteers since 2005

### Hours of Competitions

The timing of the larger qualifying sites / championships has always been an issue. We must work harder to fine tune the schedule to ensure that events end on time. We need to simplify competition & award procedures and be well prepared.

### Playing Fields/Tables

We will continue to use the plastic folding tables for Games in the 2019-2020 season.

### Judging

Judge training must be conducted professionally, since some judges were not familiar with the Robofest 2019 rules. The Chief Judge's role is critical and he/she needs to be trained properly early on. Judging errors occurred in some competitions mainly due to simple human errors or lack of training. Impounding tables must not be accessed by students as mentioned in the previous section. We will continue to publish the bios of Judges at the World Championship.

### Miscellaneous

- LTU's $3,000 scholarship opportunity is available to every student who participated in any Robofest event.
- Strengthening the mentorship program is necessary. We encourage high school students to mentor Jr. Division students.
- We plan a few Game mock competitions in December and January before the warm-up competition in Feb.

## 6. Revenue/Expense Summary

Financial results for the 2018-2019 academic year (Aug. 14, 2018 ~ Aug. 11, 2019) were as follows: **$109,384.91** in cash revenue including the transferred balance from 2017-2018 year. **$91,383.15** in expense of Robofest account, and **$64,098.68** LTU cash support, which resulted in an overall loss of **$46,096.92**. (LTU is asking full self-sustainability as early as possible.) Tables 3 ~ 5 show the summary of cash revenue and expenditure. $18,001.76 will be transferred to Robofest's account for 2019-2020.

| | |
|---|---|
| Transfer from 2017-18 | $30,009.90 |
| Individual donors | $1,100.04 |
| Corporate/Org. *Cash* Sponsorship (*) | $41,210.80 |
| Team registration fees & other income | $37,064.17 |
| Total net cash income without transfer from last year | $79,375.01 |
| Total revenue including transfer from last year | **$109,384.91** |

*(*) In-kind donations not included.*

**(Table 6)** 2018-2018 Cash Revenue

| | |
|---|---|
| Parttime staff & workshop lead instructor wage | $21,125.25 |
| Student assistants' wage | $437.94 |
| 20th anniversary items (Tie, Scarf, Polo, Fleece, and Oxford shirts) | $8,632.58 |
| Bleacher, 48 6ft Lifetime tables for Game, J234 chairs, 5ft tables | $4,586.78 |
| Trophies, individual trophies, and plaques | $7,126.75 |
| Qualifier and Championship Medals | $3,876.72 |
| Supplies (AWS, Game fields, office supp., signs, flags, banners, food, etc.) | $5,367.43 |
| Give away & merchandise items (mugs, tote bags, ice cream scoop, socks) | $2,599.10 |
| Table & chair rental for World Championship | $3,090.25 |
| Poster & Banner printing | $1,197.16 |
| T-shirts for Judges, volunteers, and teams | $2,882.66 |
| Robofest Staff travel; Team & Judge travel support | $2,423.21 |
| Out of State workshop support; CSforAll Support | $2,971.65 |
| Robot kits & parts (VEX IQ, Tetrix, PRIZM, Arduino) | $17,118.37 |
| UPS and USPS mailing | $3,272.68 |
| World Championship food | $4,674.62 |
| **Total** | **$91,383.15** |

**(Table 7)** 2018-2019 Robofest Account Expense Summary

| | |
|---|---|
| Part time staff wage support from College of Arts & Sciences | $46,448.71 |
| Student assistant wage support from College of Arts & Sciences | $17,649.97 |
| **Total LTU Cash Support** | **$64,098.68** |

**(Table 8)** LTU Direct Support Expense Summary in 2018-2019

Note that Table 8 does not include LTU's indirect monetary support (overhead expenses) that includes: marketing, fundraising, and special events support by Univ Advancement; help desk laptop support; audio & visual equipment; teaching release time for Dr. Chung (Robofest Director) and Dr. Christopher Cartwright. MCS Department administrative support; general office supplies; printing & copying, phone; office space; utilities; mailing and USPS postage by Math & Computer Science

department; campus facilities; eLearning Services; use of office computers, laptops, computer network services on campus, etc. Table 9 shows cost per student data history since 2008.

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| **Direct expense** | $158,356.19 | $155,302.73 | $168,784.36 | $146,085.27 | $141,907.89 | $155,481.83 |
| **# Stu. Served** | 1,962 | 2,017 | 2,575 | 2,846 | 2,464 | 2,489 |
| **Cost / Student** | $80.71 | $77.00 | $65.55 | $51.33 | $57.59 | **$62.47** |

**(Table 9)** Cost per student data since 2008

## 7. Recognition & Acknowledgement


**(Figure 22a)**

Figure 1 on the first page of this report shows some of the 400+ students who participated in the World Robofest Championship this year at LTU in Michigan. Each student who partipated in Game, Exhibition, RoboArts, and Vcc on Saturday received a small personalized trophy sponsored by our Platinum sponsor DENSO shown in (Figure 22a) left. World Championship BottleSumo, UMC, and RoboParade contestants received personalized medals sponsored by Hyundai MOBIS, a Gold Sponsor, shown in (Figure 22b). Figure 22c shows Michigan Invitational competition medals sponsored by another Gold Sponsor FUTEK. Especially, we thank IEEE Region 4 PACE and SEM (Southeastern Michigan Section) for their sponsorship of IEEE qualifying competition medals shown in (Figure 22d). IEEE sponsored qualifying medals since 2005 for 15 years. Note that all the individual trophies as well as medals were personalized with the student's names.

All the winning teams of Robofest World Championship competitions can be found on the web at
https://www.robofest.net/images/1819/MainCategoryResults2019.pdf
https://www.robofest.net/images/1819/OpenCategoryResults2019.pdf

List of Winning Teams with Participant Names can be accessed at:
http://www.robofest.net/images/1819/MainCategoryWinnersWithNames.pdf
http://www.robofest.net/images/1819/OpenCategoryResults2019.pdf


**(Figure 22b)**


**(Figure 22c)**


**(Figure 22d)**

It is worthwhile noting that ACROBOT, an all-girls robotics team from Ghana, won the 1st place Sr. Game competition at the World Championship. Multiple media including Ebony covered the news. https://www.ebony.com/news/race-culture/girls-robotic-team-ghana-wins-world-robofest-championship/

Score sheets of each competition category at the World Championship can be found on this web page under the Archive section at: https://www.robofest.net/index.php/current-competitions/world-championship

Especially, we would like to thank all the Championship Exhibition & RoboArts Judges. Their short bios can be found at: https://www.robofest.net/2019/WC19JudgeBios.pdf

Robofest was again very fortunate this year to have 13 corporate/foundation Bronze or higher sponsors and 10 Friends level sponsors. Platinum Sponsor was DENSO. Gold Sponsors were Hyundai MOBIS and FUTEK. Silver Sponsors were Michigan Council of Women in Technology Foundation, Robomatter, Robot Mesh, and Howard Hughes Medical Institute. Bronze Sponsors were National Defense Industrial Association Michigan Chaper, IEEE Region 4 PACE and Southeast Michigan Section, RIIS, Realtime Technologies, TOYOTA, and SoarTech. Friends of Robofest includes ART/DESIGN Group, CJ & Min Chung, Emily Trudell & Nate Johnson, Keith Bozin, Aramark, The Bijou, LLC, BigRentz, Best Western Premier, Robin G. Leclerc, and The Westin Southfield. Without their support, Robofest 2019 would not have been possible. Figure 23 shows all the logos of the corporate/foundation sponsors which were displayed on a large screen during the Championships. The logos or names of the sponsors were also printed on official T-shirts (Figure 24), programs for Warmup, qualifying, Michigan Invitational and championship (Figure 25), and official posters (Figure 26). A list of all the 2019 sponsors can be found at www.robofest.net/2019/sponsors.htm.


**(Figure 24)** Official Robofest 2019 T-Shirt


**(Figure 23)** Official Sponsors of Robofest 2018-2019


**(Figure 25)** Some of official Robofest programs with official sponsor logos

The following 10, 7, and 5 year anniversary coaches were recognized this year. We deeply thank them for their dedication and hard work. If we missed any coach reaching anniversary years, please contact Dr. Chung at cchung@LTU.edu.

<u>10 year:</u>
Connie Eisenhart (MI)
Cameron Lindner (MN)
Justin Walczyk (HI)

<u>7 year</u> (we missed to recognize 2 years ago)
Joe Moseley (FL)

<u>5 year</u>
DJ DeCoste & Chris MacLean (Canada)
Zuher Khalaf (MI)

Tim Mullins (Canada)
Hiten Shah & Devendra Patel (MI)
Ajay Choudhary (MI)
Steven Roberts (FL)
Jong Chae Chung (Korea)


**(Figure 26)** Robofest 2019 official poster

Robofest cannot reach our students without site hosts. We would like to applaud all the work done by our great site host organizers in Table 8. Without their leadership, dedication and sacrifice, the Robofest 2018-2019 season would not have been possible.

| **Site Name** | Site Host Organizer Name(s) |
|---|---|
| Abuja_BaunSTEMRobotics_Nigeria | Femi Fadario |
| Alexandria_SiliconWaha_Egypt | Farid Hussien / Ayman El Kabbany |
| Bangalore_InternationalSchool_India | I. A. Khan |
| Beaverton_Techforkids_OR | Shirley Ma |
| Belleview_Cornerstone_FL | Joe Moseley |
| BloomfieldHills_Cranbrook_MI | Katherine Bis |
| BloomfieldHills_Cranbrook_MI_BottleSumo | Katherine Bis |
| Canton_Achieve_MI | Elizabeth Gaecke |
| Canton_CCA_MI | Lalita Mishra |

| | |
|---|---|
| Canton_Gallimore_MI | Cara Wegrzyn |
| CenterLine_MCS_MI | Anna Raese / Becky Branch |
| Chicago_HolyTrinity_IL | Patrick Kelly |
| Cloquet_MN | Cameron Lindner |
| Detroit_UDJH_MI | Jennifer Wint |
| Detroit_BatesAcademy_MI | Kimberly Finley |
| Dover_IndependenceAcademy_FL | Gavin Coleman / Keith Miller |
| Dubai_CitySchoolInternational_UAE | Jean Soney / Dr. Frank R. Fernandes / I.A. Khan |
| Dubai_AmbassadorSchool_UAE | Sheela Menon / I.A. Khan |
| Hyderabad_SanskritiSchool_India | I.A. Khan |
| Oldsmar_Nielsen_FL | Emma Alaba |
| PearlCity_HIFusionED_HI | Sandy Ahu / Gayle Loui / Lynn Fujioka |
| Saline_WCA_MI | Betty Recker |
| Sharjah_UAE | Kervin Camantoy /Marjorie Fajardo Nazaret / I. A. Khan |
| Southfield_MacArthur_MI | Angela Gloster |
| Troy_Bethany_MI | Brian Kincheloe |
| USA_Video_Qualifier | Robofest Office |
| WestBloomfield_WBHS_MI | Sally Unrath |
| Wolfville_Acadia_Canada | Jenna Watson-Findlay / Gary Walsh |
| China | Zhao Yang |
| Ecuador | David Astudillo Salvdor |
| Ghana | Dr. Yaw Okraku-Yirenkyi |
| Hong Kong | Yau Ka Chun |
| Korea | Stephen Seungdong Baek |
| Macau | Yau Ka Chun |
| Mexico | Dr. Ramiro Marrero |
| South Africa | Pieter Pretorius |
| Warmup, MI Invitational events, and World_Championship | Robofest Office |
| Ghana | Dr. Yaw Okraku-Yirenkyi |
| Taiwan | Fredo Chien |

**(Table 8)** Site Host Organizers

Math & Computer Science Department's Marilyn Wiseman, Administrative Assistant, provided dedicated services for handling purchasing & reimbursement requests, employment related paper work, food coordination, among others. Tracy Kash, CoAS Dean's Office assisted to plan and manage an College of Arts & Sciences budget account.

LTU administrators who directly supported Robofest this year include: Vice President & Provost Maria Vaz (World Championship Opening Remarks), Interim Dean Glen Bauer (College Budget and World Championship Support), Matt Roush (World Chamionship Emcee and Press releases), Nadia Fadel-Bazzi (Sponsorship), Julie Vulaj (Sponsorship), Renee Tambeau & Sofia Lulgjuraj (Official Poster), Charlene Ramos (Helpdesk director – laptop services), Matt Maracle (Campus Facilities, Venue setup for 20 years), Mark Russo (Campus Facilities, Venue setup), Scott Trudeau & Don Gillette (Athletics), Robert Gandolfo (ARC), Brian Breen (Digital Media Specialist at Marketing + Public Affairs), Scott Lehman (Media Production Coordinator at eLearning Services), and Norman Plant & Thomas "Sam" Vukonich (Audio/Visual).

Dr. Yawen Li, Department Chair of Biomedical Engineering supported Robofest operation in multiple areas such as translation services, merchant sales, proof reading, and recruiting volunteers.

Olivia Thompson-Tinsley, Administrative Assistant of Biomedical Engineering Department was the merchant sales director. Robofest deeply appreciates her leadership and achievement. Bethany Balint, BME student also assisted the sales. Olivia also helped with team recruitment and proof reading documents.

Dr. Destiny Anyaiwe continued to assist with RoboParade and RoboArts.

Dr. Chris Cartwright assisted Robofest as Chief Game Judge including Supprise Game. He went to Latin America Robofest in Mexico as a LTU representative to give opening remarks. He also gave a plenary talk on “Teaching mathmatics through programing robots”.

Prof. Gordon Stein who is studying PhD at Vanderbilt University continued the maintenance of our Tomcat & Joomla webserver systems.

Prof. Joe DeRose who works for Ford Motor Company and Adjuct Professor in the Department of Mechanical Engineering at LTU was the chairperson of UMC. He played a great part in many aspect of Robofest rules.

Prof. Mirit Shamir helped with Robofest for important tasks such as legal advising and assisting workshop instruction.

David Carbery, LTU Alum and Robofest part time staff, served as a Chairperson for Sr. BottleSumo Classic divsion.

Nate Johnson and Emily Trudell, LTU alumni, were in charge of Vcc judging.

Katie Bis, former Robofest coordinator, was kind enough to volunteer for multiple World Championship events.

Dr. Lior Shamir, who has been an Exhibition Judge for 10 years, is leaving LTU. We wish him all the best at Kansas State University.

We are so happy to announce that Robofest 2018-2019 season was completed without any full-time staff. Part-time staff members were Elmer Santos (Assistant Director), Shannan Palonis (Coordinator), Pam Sparks (Coordinator), Teresa & Don Dubois, Judith Williams, and David Carbery.

Student assistants include Candace Byrnes, Daniel R. Oliver, Charles Faulkner, Mark Kocherovsky, Gitae “Joe” Jeon, Yancong Nie, Nikitha Subramanian, and Parameshwari Tirupari.

Candace Byrnes, LTU Media Communication major, organized the Friendship Talent Show event successfully again this year.

There are so many other people to recognize, but I must applogize to stop here since this space is not enough to mention all the volunteers and Judges.

It was our 20th anniversary. Figure 27 shows some of Robofest staff and student assistants wearing anniversary apparel, tie, and scarf. Figure 28 is one of 3 cakes shared with World Championship participants on Friday, May 27th. Figure 29 shows a Robofest banner signed by World Champioship particpants. Figure 30 shows 3 “Human Body Lettering Challenge”entries showing “Thank You” or “THX”

**(Figure 27)** Robofest staff wearing anniversary apparel, tie, and scarf


**(Figure 28)** Robofest cake to celebrate 20th anniversary shared on May 17, 2019


**(Figure 29)** Robofest banner signed by World Championship particpants

In summary, as shown in section 4. Assessment, we believe 2018-2019 Robofest has achieved its primary missions: inspring students into STEM fields and supporting them. We are proud that Robofest has been continuously inexpensive since its inception in 2000, while providing proven quality STEM education environments for students. Once again, we deeply thank everyone who has hosted, sponsored, supported, volunteered, worked, participated and learned in the 20th Robofest for

the 2018-2019 year. If you find any errors or have comments on this report, please let me know (cchung@LTU.edu). We are looking forward to seeing you during the 21st annual Robofest 2019-2020 season.

Respectfully,
August 20, 2019

CJ Chung, Ph.D.
Professor of Computer Science and Founder & Director of Robofest

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**(Figure 30)** Three "Human Body Lettering Challenge" entries showing "Thank You" or "THX"