Lawrence Technological University

ROBOFEST 2020 ~ 2021 Annual Report

Contents:

(**Figure 1**) Robofest Online World Championship 2021 participants 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, creative thinking, communication and problem solving, and prepare them to excel in higher education and technological careers.

In the 2020-2021 academic year, extended into October 2021 due to the COVID-19 pandemic, a total of **1,166** students in **473** teams participated from 17 countries/territories: Canada, Colombia, Ecuador, Egypt, Ghana, Greece, Hong Kong, India, Macau, Mexico, Morocco, Nigeria, Saudi Arabia, South Korea, Taiwan, Yemen, and USA. In the USA, Robofest had students from 4 States**:** Florida, Pennsylvania, Michigan, and Texas. 419 site volunteers registered as judges, online local judges, proctors, check-in, setup/cleanup crew, etc.

Site ID in Robofest registration system	Coaches	Teams	Participants	Volunteers	Format
Alexandria_TechnoFuture_Egypt	22	40	184	No data	In-Person
PlantCity_AdvantageAcademy_FL	3	16	43	9	In-Person
Saline_WCS_MI	2	17	29	9	In-Person
Clearwater_FL_OL_Game	2	4	11	17	Online
Cranbrook_MI_OL_Game	4	5	9	6	Online
Mock_Game_Jan23	4	5	11	6	Online
TaoyuanCity_ICDA_Taiwan_Jun5	36	67	145	53	Online
TaoyuanCity_ICDA_Taiwan_Jun6	49	62	97		Online
USA_OL_Exhibition_0429	1	1	4	4	Online
USA_OL_Game_0612	7	11	24	12	Online
Warmup_Game	5	4	9	6	Online
Wolfville_Acadia_Canada	16	30	103	24	Online
USA_Video_Qualifier	7	9	27	4	Video
USA_Video_Qualifier_2	7	10	19	4	Video
USA_Video_Qualifier_3	1	1	3	4	Video
In-Person and Online Qualifiers (A)	166	282	718	158	
WS_GAME_EV3_Feb20	8	15	27	2	Online WS
WS_GAME_RobotMesh_VEXIQ_Feb13	6	7	12	2	Online WS
WS_GAME_Scratch_RobotInventor_SPIKEPrime	3	3	5	2	Online WS
WS_ML_with_Scratch_Jan09	3	3	3	2	Online WS
WS_ML_with_Scratch_Jan16	14	16	24	2	Online WS
SummerCamp_BottleSumo_EV3_AUG11	9	11	22	4	In-P Camp
SummerCamp_BottleSumo_EV3_Jul24	1	6	12	6	In-P Camp
SummerCamp_BottleSumo_VEXIQ_JUN8	1	3	8	4	In-P Camp
Workshops and Camps (B)	45	64	113	24	
ROWC_BSTT_Jr	9	11	24	41	Online WC
ROWC_BSTT_Sr	14	18	43	38	Online WC

ROWC_Exhibition_Jr	11	11	30	8	Online WC
ROWC_Exhibition_Sr	8	9	33	9	Online WC
ROWC_Game_Jr	14	23	46	43	Online WC
ROWC_Game_Sr	18	22	62	45	Online WC
ROWC_RoboArts	10	11	40	6	Online WC
ROWC_RoboMed	3	3	10	7	Online WC
ROWC_UMC_Jr	4	4	8	10	Online WC
ROWC_UMC_Sr	13	15	39	30	Online WC
Robofest Online World Championship (C)	104	127	335	237	

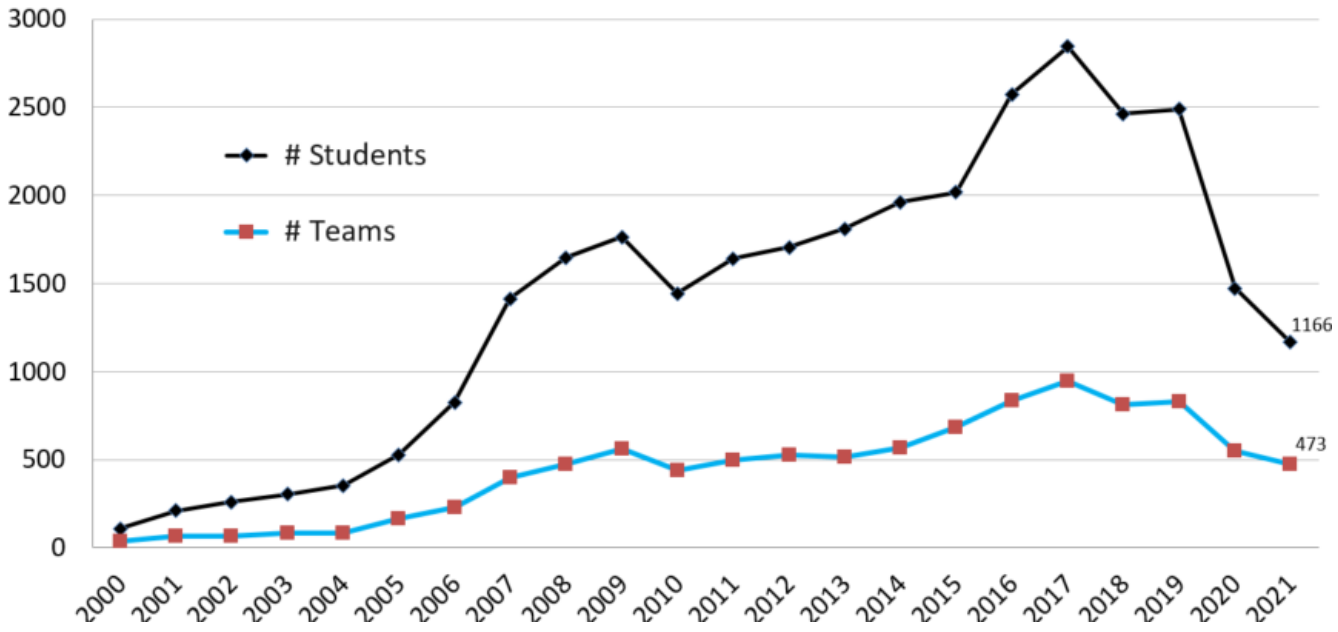
Grand Total (A) + (B) + (C)	315	473	1166	419

(Table 1) Number of Registered Participants at Robofest 2019-2021 Official Competition Sites

Table 1 shows the total number of officially registered coaches, teams, and students for each site for the extended 2020-2021 year. This table shows only the data in the Robofest web database system. Ghana, Hong Kong, India, Latin America, Saudi Arabia and South Korea, used their own registration systems.

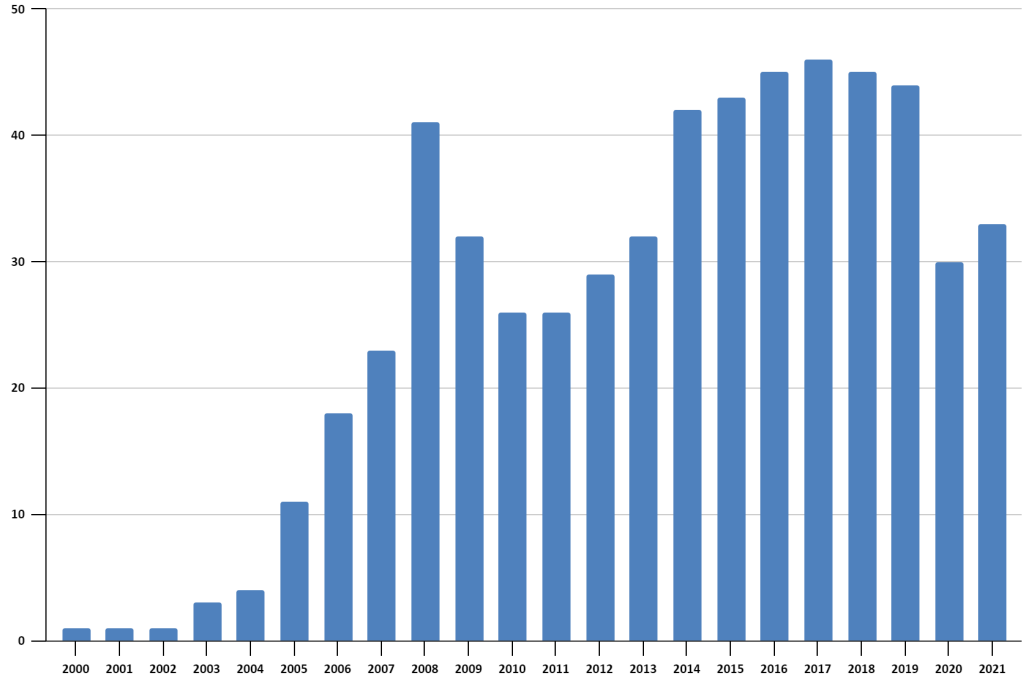
The average Robofest team size in 2021 was 2.5, down from 2.7 in 2020. We suspect the decrease of team size was due to the pandemic and extended season. At Robofest, we believe this small team size is good for effective learning, because each student has more opportunities to contribute to the team's objectives.

Figure 2 shows the number of student participants since 2000. India, Latin America and UAE were historically option 1 sites (included in the totals), which dramatically decreased the numbers for 2021. The cumulative number of registered students and teams in our web database since 2000 has reached 31,005.



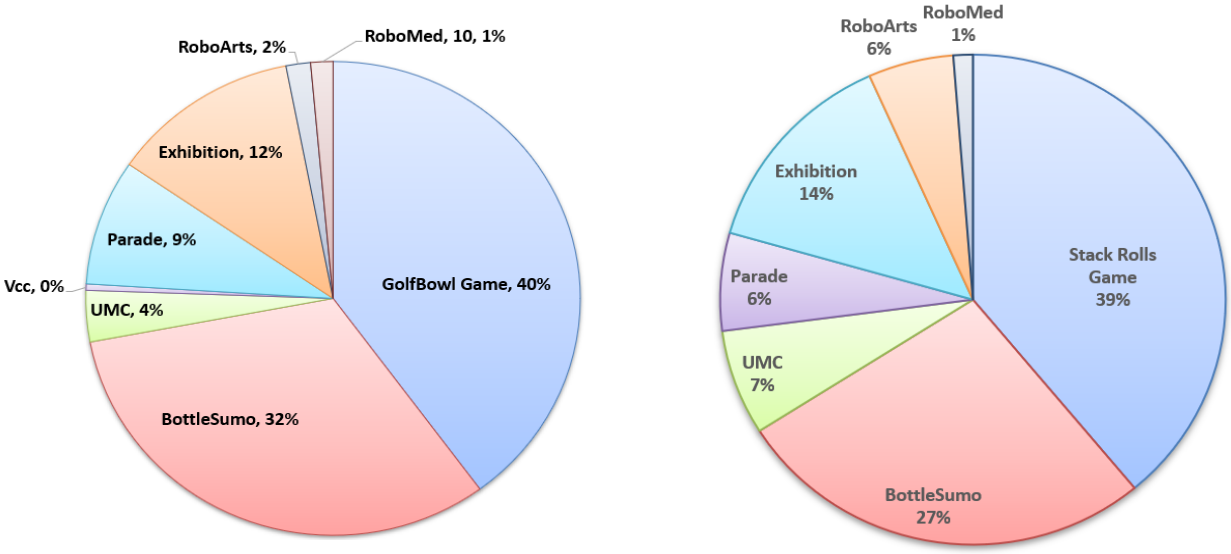
(Figure 2) Number of Robofest student participants and teams since 2000

The total number of Robofest competition site locations listed in Table 1 was 33 in the 2020-2021 year. On average, 35 students and 14 teams participated per competition site that Robofest managed. Figure 3 shows the history of the number of official competition sites since the inception of Robofest.



(Figure 3) Number of official Robofest competition site locations since 2000

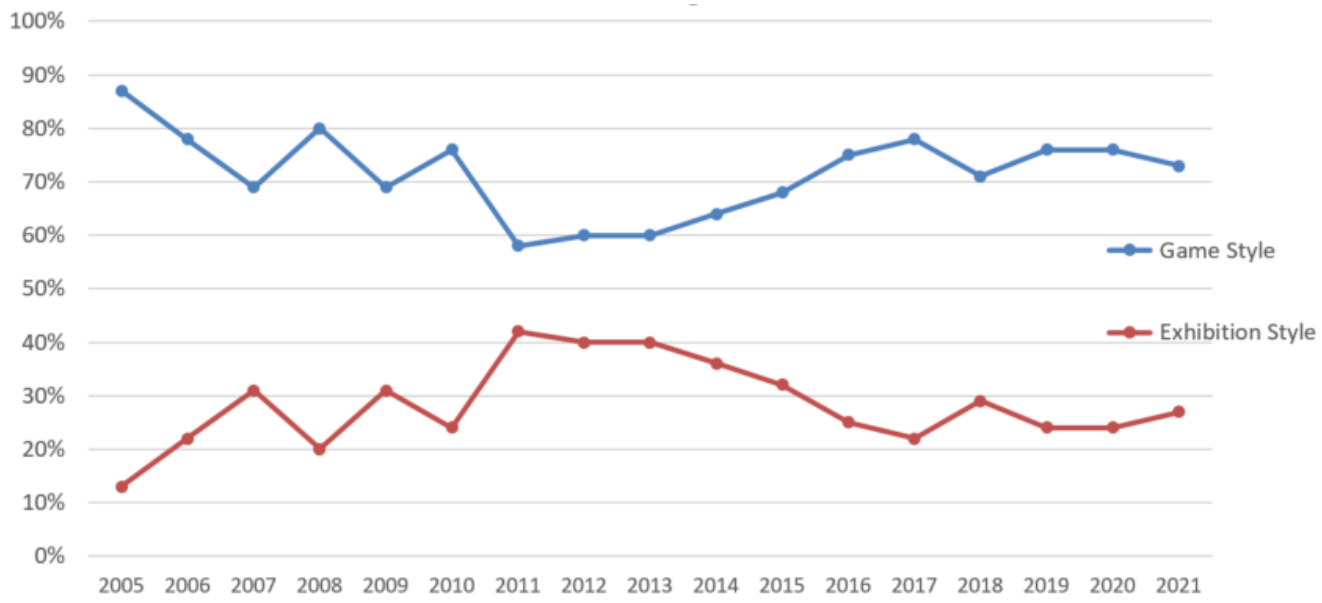
Robofest offers a variety of categories in which to compete. 39% of teams participated in the StackRolls Game. The second most popular category was BottleSumo with 27%, then Exhibition with 14% of teams. Pie charts in Figure 4 below show percentages of teams by competition category.



(Figure 4) Percentages of Teams per Robofest Competition Category in 2020 (left) and 2021 (right)

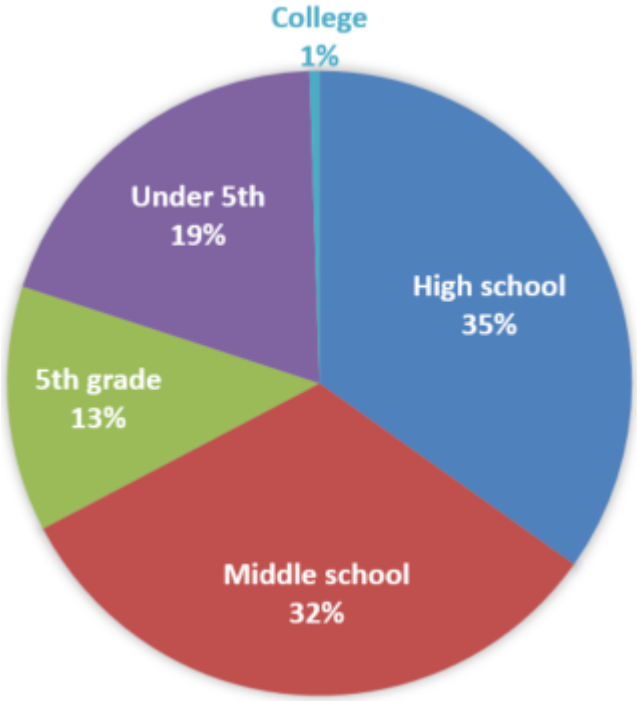
Robofest competitions can be generalized into two categories: (1) Game style that uses fixed rules including Game, BottleSumo, Vision Centric Challenge (not hosted in 2021), and Unknown Mission Challenge and (2) open-ended Exhibition style that has no or a few fixed rules including Exhibition,

RoboParade, RoboArts, and RoboMed. Figure 5 shows the trend of number of teams between Game Style and Exhibition Style since 2005. The percentage of Exhibition Style teams increased slightly from 2020 to 2021 while Game Style percentage decreased.

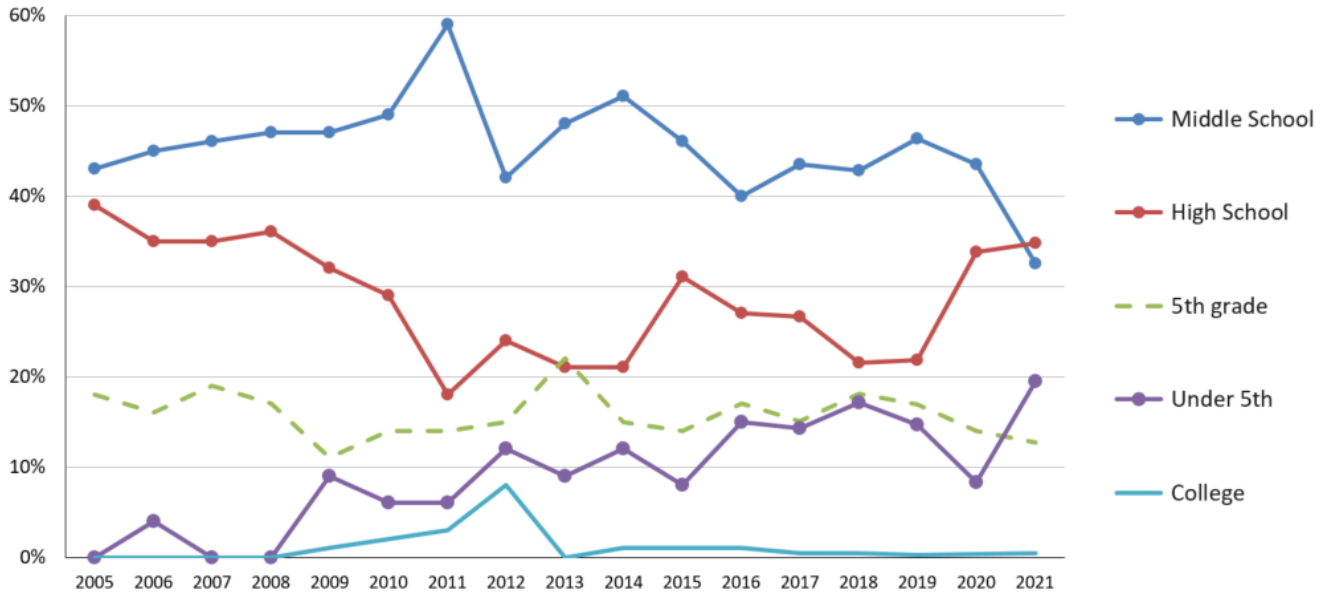


(Figure 5) Percentages of Robofest Game style teams and Exhibition style teams since 2005

Figure 6 shows student participation by academic level; 32% of the students were from middle school (6th through 8th grade) and 35% of the students were from high school (9th through 12th grade). The participation rate of High School students increased again in 2021 and was the group with the highest percentage of participation for the first time since 2005. Figure 7 shows the trend of each age group since 2005.

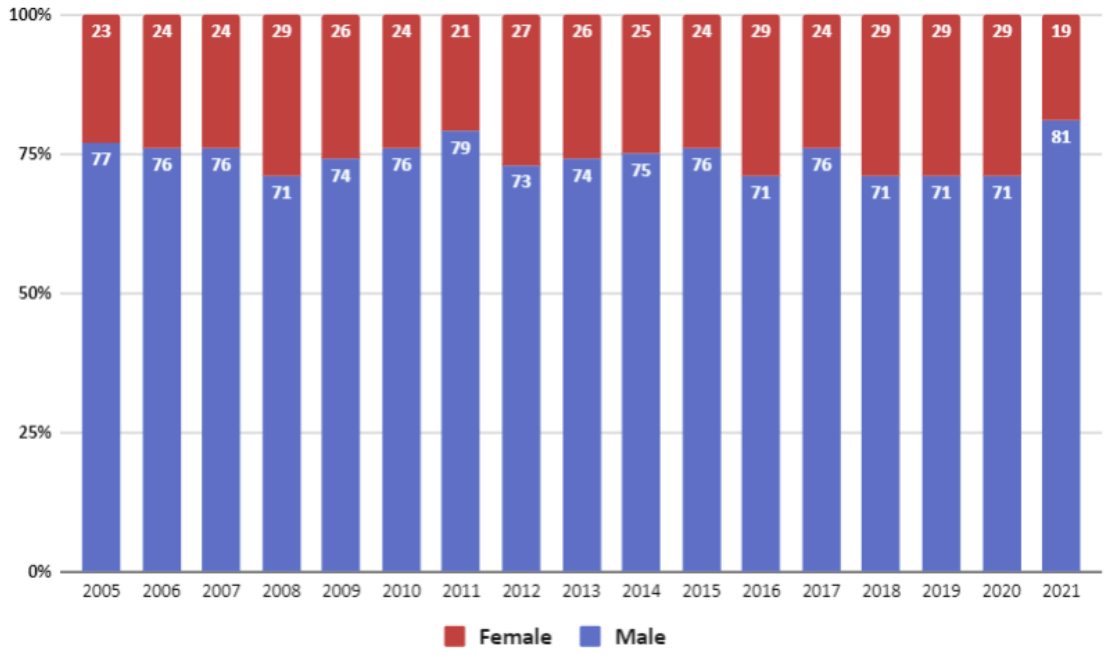


(Figure 6) Percentage of Robofest student participation by age group in 2021



(Figure 7) Percentages of Robofest participants by age group since 2005

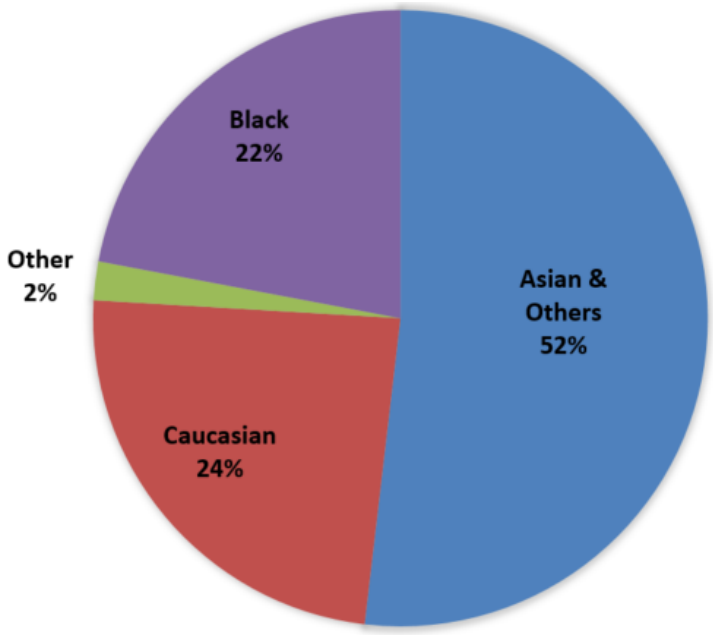
Gender ratios (81% male and 19% female) changed significantly in 2021 after 3 years of consistent levels as shown in Figure 8. Note that the data is taken directly from our registration database. Some international students' data is excluded.



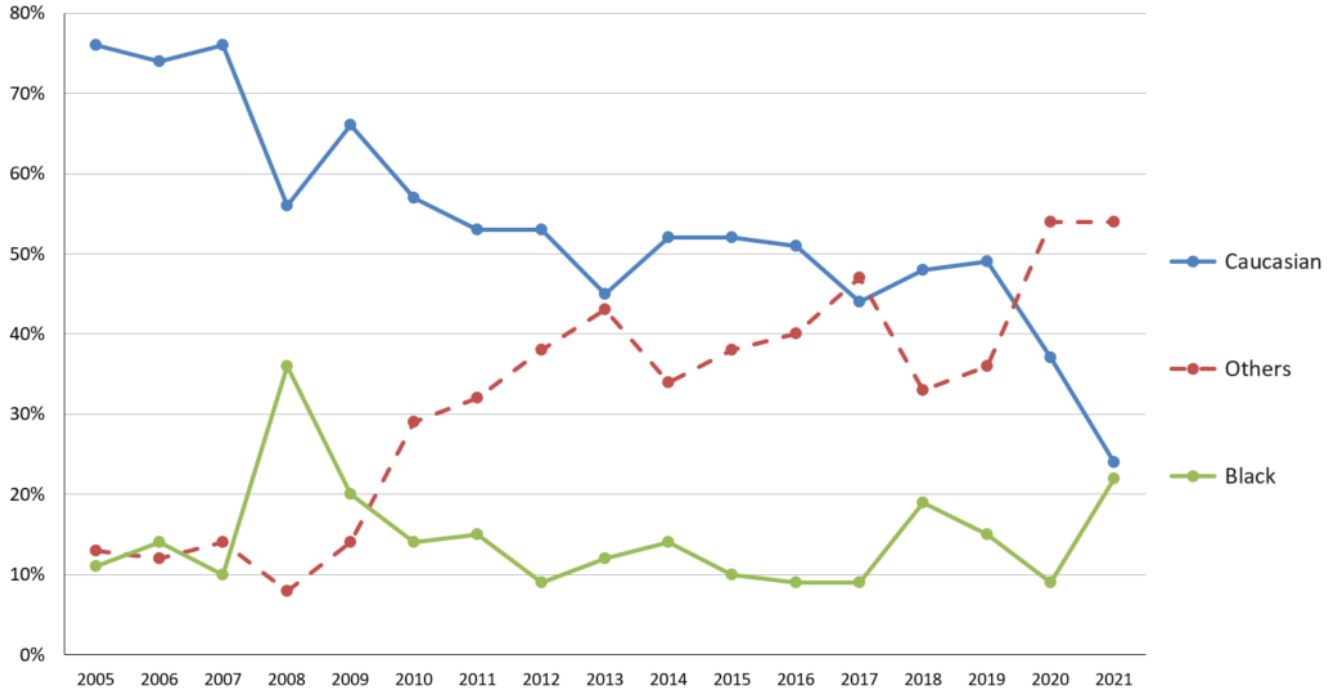
(Figure 8) Ratios of Robofest students by gender since 2005

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 is not required on the online form, a majority of coaches did not provide the students' ethnicity information. The following data is from only 295 (25.3%) of total registered students. 22% of Robofest 2021 students were African/Black as shown in Figure 9. Figure 10 shows the changes since 2005. Asian, Indian-Asian, Indian-AN (Alaskan Native),

Pacific Islander, Pacific-Asian, and other ethnicity classes are grouped into “Other” to show the data in the same categorical format as previous years. Note that the ethnicity data is only from the students registered on our system. Data from some countries are not included.



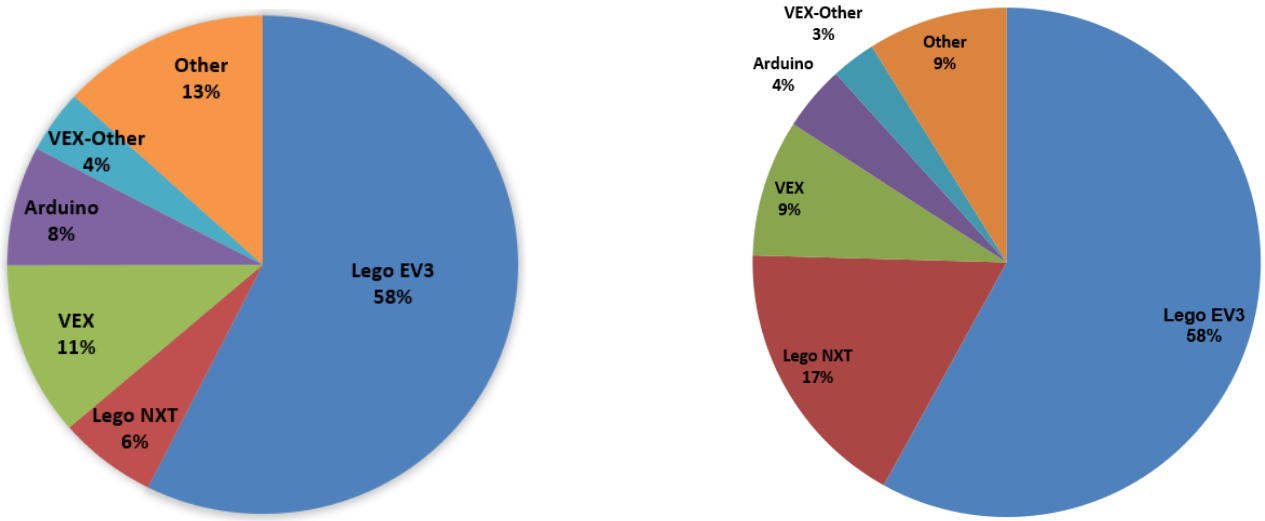
(Figure 9) Percentage of Robofest Student Participation by Ethnicity Data in 2021



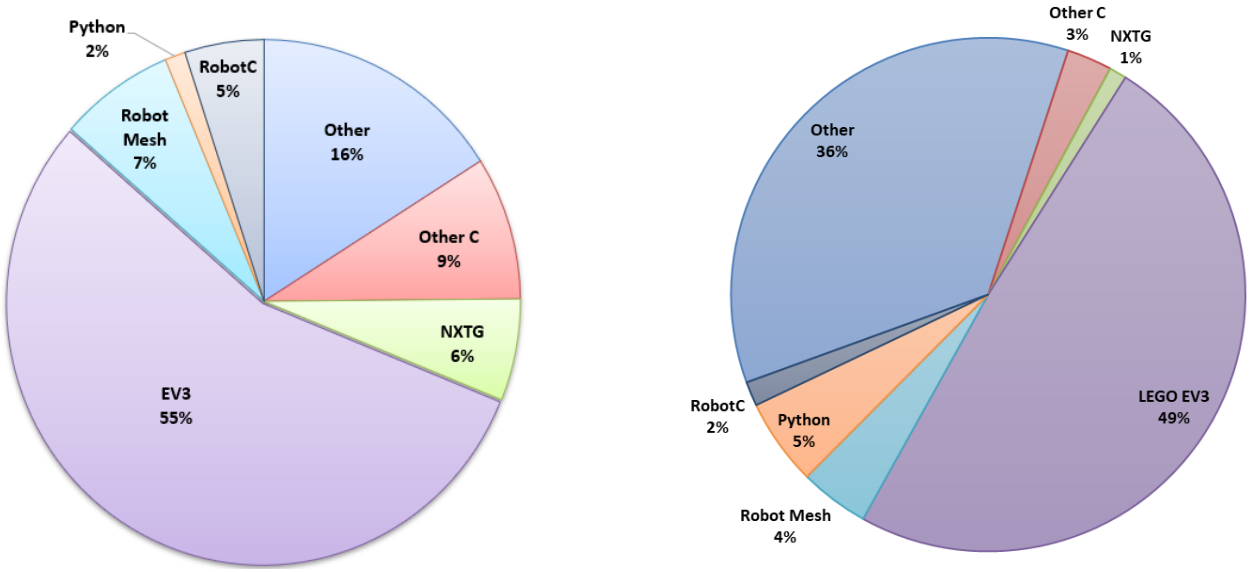
(Figure 10) Robofest Ethnicity Data since 2005 (The surge of African American in 2008 was due to a targeted grant)

Robofest is completely open and allows the use of *any* robotics platform, which is one of its unique features. The chart to the right in Figure 11 shows the data on robotics kits used by the teams in 2021. Still the majority of the teams (58+17=75%) were using LEGO products. 2nd generation Lego NXT kits are still being used (17%). The use of VEX platforms decreased from 15% in 2020 to 12% in 2021. The use of Arduino decreased to 4%. Other kits also decreased from 13% to 9%.

Robofest remains focused on getting student participants to learn STEM through computer programming/coding and testing. The programming languages used in Robofest 2021 are shown on the graph to the right in Figure 12. Student teams continue to use advanced and varied forms of programming languages. Allowing students to use whichever programming language they prefer is one of the unique features of Robofest. “Other C” in the figure includes 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 4.4%. Scratch-like Robot Mesh for VEX IQs was used by 4.4% of teams. “Other” includes Java and other languages. 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 11) Percentages of robotics kits used by teams in 2020 (left) and 2021 (right)



(Figure 12) Percentages of programming languages used in 2020 (left) and 2021 (right)

2. Workshops and Online eAcademy

We hosted five Online technical workshops. Several new languages and platforms were added to the workshop material in 2021 including Spike Prime Scratch, EV3 Scratch, VEXcode for IQ, VEXcode V5, and VEXcode V5 Pro. Table 2 shows two instructors and their classes during the 2020-2021 academic year. Total number of workshop attendees was 71. We thank all the Robofest official sponsors especially DENSO and NDIA Michigan for sponsoring workshops. The Lawrence Tech Help Desk provided laptops for the workshops. Most of the workshop materials were posted on the web for on-site and online participants.

Date	Workshop Topic	# Attendees	# LTU Student assistants	Lead Instructor
Sat Jan 9	AI & Machine Learning with Scratch I	3	0	CJ Chung
Sat Jan 16	AI & Machine Learning with Scratch II	24	0	CJ Chung
Sat Feb 13	VEX IQ Robot Mesh	12	0	Elmer Santos
Sat Feb 20	Spike Prime / Robot Inventor with Scratch	5	0	Elmer Santos
Sat Feb 20	EV3 for Game	27	1	Elmer Santos

(Table 2) 2020-2021 Online Workshops

Robofest eAcademy provides a series of online classes developed by Robofest instructors. Courses are available for free to Robofest teams through the Schoology Learning Management system. New online courses (https://www.robofest.net/index.php/eacademy) developed this year include:

- 2021 Game Using EV3 Scratch Language class code: CR8F-KB2F-XZDBF
- 2021 Game Using Spike Prime/Robot Inventor Scratch Language class code: R8RT-D8PF-MHH43

3. Plans for 2022

Due to the ongoing global pandemic now starting its third year, we are planning to host as many in-person events as possible, knowing that we may need to adjust as the season progresses. We are currently planning to host the World Championship BottleSumo Time Trial events in an Online Format in late April 2022 and the World Championship Game, Exhibition, RoboArts, RoboMed, RoboParade and UMC on LTU Campus on May 12-14, 2022. Plans and any changes will be announced at the Robofest Kickoff Meetings and on the Robofest Website. In response to feedback from our initial announcement, we are surveying the Robofest community for input to best accommodate COVID restrictions.
We also plan to limit the number of teams advancing to the WC events from each site to 1 team per division with the option to expand if space allows.

4. Revenue/Expense Summary

Financial results for the modified 2020-2021 academic year (Oct. 24, 2020 ~ Oct. 23, 2021) due to COVID-19 pandemic situation are as follows: **$25,192.46** in cash revenue including the transferred

balance from 2019-2020 year. Net expense was **$13,811.65** and **$11,380.81** is transferred to the next year. LTU College of Arts and Sciences supported **$52,811.64** to pay full-time, part-time staff, and student assistant hourly wages. The total program direct cost was **$66,623.29**. Tables 3~5 show the summary of cash revenue and expenditure.

Transfer from 2019-2020	$2,902.60
Individual donors	$4,384.86
Corporate/Org. *Cash* Sponsorship (*)	$3,000.00
Team registration fees & other income	$14,905.00
Total net cash income without transfer from last year	$22,289.86
Total revenue including transfer from last year	**$25,192.46**

(*) In-kind donations not included.

(Table 3) 2020-2021 Cash Revenue

Workshop instructor, PT faculty, faculty summer, and AWS admin hours.	$150.00
Student assistants' wage (All were supported by CoAS)	$0.00
Buying out faculty release time	$0.00
Trophies, individual trophies, and plaques	$3,078.50
Qualifier and Championship Medals	$2,199.42
Supplies (Amazon web services, Cloudflare, playing fields, office supplies, signs, workshop food, USPS postage, UPS, etc.)	$5,146.45
Give away & merchandise items	$0.00
Table & chair rental for World Championship	$0.00
Poster & Banner printing; Office copier & printing	$237.28
T-shirts for Judges, volunteers, and teams	$0.00
Robofest staff travel; Team & Judge travel support	$0.00
Out of State workshop support; Sponsored site support	$0.00
Robot parts for ACTor vehicle (DENSO's ACTor project support via Robofest)	$3,000.00
Zoom webinar account fee	$0.00
World Championship food	$0.00
Net direct expenses	**$13,811.654**

(Table 4) 2020-2021 Robofest Account Expense Summary

Staff (full-time and part-time) wage support from College of Arts & Sciences	$52,709.78
Student assistant wage support from College of Arts & Sciences	$101.86
Total LTU Cash Support	**$52,811.64**

(Table 5) LTU Direct Support Expense Summary in 2020-2021

Note that Table 5 does not include LTU's indirect overhead cost. Table 6 shows cost per student data history since 2015.

	2015	2016	2017	2018	2019	2020	2021
Direct cost	$155,303	$168,784	$146,085	$141,908	$155,482	$115,177	$66,623
# Stu. Served	2,017	2,575	2,846	2,464	2,489	1,471	1,166
Cost / Student	$77.00	$65.55	$51.33	$57.59	$62.47	$78.30	$57.14

(Table 6) Cost per student data since 2015

5. Recognition & Acknowledgement

(**Figure 13**) IEEE Sponsored Medals

Each student who participated at an in-person qualifying competition received a medal sponsored by IEEE SEM (Southeastern Michigan Section); see Figure 13. Team members of online qualifiers and of ROWC (lower registration fee) were able to order the medals from the Robofest Office.

List of Winning Teams with participant names can be accessed at: https://robofest.net/images/2021/2021_Winners_All.pdf

Table 7 summarizes Robofest Online World Championship (ROWC) with web links for award winners, score sheet, highlight video, judge bios/lists, and program of each competition category.

We would like to thank all the Robofest Online World Championship UMC, Exhibition, RoboArts, RoboMed, BottleSumo Time Trial, and Game Judges. Their information can be found in the Table 7 “Event Judges” column.

Category	Award Winners	Score Sheet	Highlight Video	Event Judges	Event Program
Jr UMC	UMC Awards	Jr UMC Scores	Jr UMC Video	Jr UMC Judges	Jr UMC Program
Sr UMC		Sr UMC Scores	Sr UMC Video	Sr UMC Judges	Sr UMC Program
RoboMed	RoboMed Awards	Sr RoboMed Scores	RoboMed Video	RoboMed Judges	RoboMed Program
		Coll RoboMed Scores			
RoboArts	RoboArts Awards	Jr RoboArts Scores	RoboArts Video	RoboArts Judges	RoboArts Program
		Sr RoboArts Scores			
Jr Exhibition	Exhibition Awards	Jr Exhibition Scores	Jr Exhibition Vid	Jr Ex Judges	Jr Ex Program
Sr Exhibition		Sr Exhibition Scores	Sr Exhibition Vid	Sr Ex Judges	Sr Ex Program
Jr BottleSumo Time Trial	BSTT Awards	Jr BSTT Scores	Jr BSTT Video	Jr BSTT Judges	Jr BSTT Program
Sr BottleSumo Time Trial		Sr BSTT Classic Scores	Sr BST Video	Sr BSTT Judges	Sr BSTT Program
		Sr BSTT Unlimited Scores			
Jr Game: StackRolls	StackRolls Awards	Jr Game Scores	Jr Game StackRolls Vid	Jr Game Judges	Jr Game Program
Sr Game: StackRolls		Sr Game Scores	Sr StackRolls Vid	Sr Game Judges	Sr Game Program

(Table 7) Robofest Online World Championship (ROWC) 2021 Summary Table with Links

Robofest was again very fortunate this year to have 8 corporate/foundation Bronze or higher sponsors and 12 Friends level sponsors as shown in Figure 14. Without their support, Robofest & ROWC 2021 would not have been possible. Sponsor logos were shown on programs for warm up, qualifying, and ROWC competitions as well as all the highlight videos. A list of all the 2021 sponsors can be found at www.robofest.net/2021/sponsors.htm.

Partners

Friends of Robofest

Dein-Maehroboter.de (Leading Lawn Robot Mower Site)

Buckfire Law Firm

Deshawn Johnson

Robin G. Leclerc

E. Trudell

CJ & Min Chung

ART/DESIGN Group, Clawson, MI

John Arnold

Best Western Premier

Executive Residency by Best Western

ValPak

Shannan Palonis

(Figure 14) Official Robofest Sponsors for 2020-2021

During the ROWC award ceremony on October 2, 2021, Robofest recognized the following coaches with an Anniversary award:

- Connie Eisenhart, Clawson, MI (Coach ID 1058): 12 years
- Becky Branch, Warren, MI (Coach ID 2446): 5 years
- LEUNG KAI FAN, Hong Kong (Coach ID 2606): 5 years
- Jeff Hafting, Annapolis Royal, Nova Scotia (Coach ID 2668): 5 years
- Erik Rosvold, Rochester, MI (Coach ID 2705): 5 years
- Stacey Collins, Canton, MI (Coach ID 2717): 5 years
- Danielle Pusilo Canton, MI (Coach 2720): 5 years
- Marcy Marrero, Atlacomulco, Mexico (Coach ID 2833): 5 years
- Rodrigo Rodriguez Rodriguez, Toluca, Mexico (Coach ID 2895): 5 years
- TAM JIN LONG JEROME, Hong Kong (Coach ID 2881): 5 years

We deeply thank them all for their dedication and hard work for STEM education through robotics in their communities.

Since the 2021 competitions were mainly online, only the ROWC event dates are listed on the 2021 Robofest poster shown in Figure 15, however, 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 2020-2021 season would not have been possible. Table 9 lists National Directors who organized competitions in their countries not using the Robofest registration system and/or sent teams to ROWC.

Site Name in RMS*	Site Host Organizer Name(s)
Alexandria_TechnoFuture_Egypt	Farid Hussien / Ayman El Kabbany
Clearwater_FL_OL_Game	Emma Alaba
Cranbrook_MI_OL_Game	Katie Bis
PlantCity_AdvantageAcademy_FL	Gavin Coleman
Saline_WCS_MI	Betty Recker
TaoyuanCity_ICDA_Taiwan_Jun5	Richard ChienChih Lo / Jason ChienTai Lo
TaoyuanCity_ICDA_Taiwan_Jun5	Richard ChienChih Lo / Jason ChienTai Lo
USA_OL_Exhibition_0429	Robofest Staff
USA_OL_Game_0612	Robofest Staff
USA_Video_Qualifier	Robofest Staff
USA_Video_Qualifier_2	Robofest Staff
Wolfville_Acadia_Canada	Jenna Watson-Findley

(*) RMS: Robofest Management System

(Table 8) Site Host Organizers using Robofest Management System

(Figure 15) Robofest 2021 poster

Country	National Director
Ghana	Dr. Yaw Okraku-Yirenkyi, GRAF
Hong Kong / Macau	Yau Ka Chun, RIHK
Korea	Stephen Seungdong Baek, RECA
Mexico / Latin America	Dr. Ramiro Marrero, CENIPAD
Saudi Arabia / Morocco	Eng. Mohammed Elhassan, BenaaEDU
India / UAE	I. A. Khan, Novatech Robo

(Table 9) National Directors who organized competitions not using RMS and/or sent teams to ROWC

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

LTU administrators who *directly* supported Robofest this year include: President & CEO Dr. Virinder Moudgil (video remarks for ROWC), Vice President & Provost Dr. Tarek Sobh (ROWC award ceremony), Dr. Srini Kambhampati, Dean of College of Arts and Sciences (Budget support), Matt Roush (Press releases), Mike Wallace, (Sponsorship), Renee Tambeau & Sofia Lulgjuraj (Poster), Charlene Ramos (Helpdesk director – laptop services), Brian Breen (Digital Media Specialist at Marketing + Public Affairs), Norman Plant & Thomas "Sam" Vukonich (Audio/Visual), and MCS Department Chair Dr. Patrick Nelson (FT position & transition).

Scott Lehman (Media Production Coordinator at eLearning Services) provided technical support for Zoom Webinars as well as the video production of opening & closing remarks.

Dr. Yawen Li, Department Chair of Biomedical Engineering served as a Judge and helped recruit Judges for the RoboMed competition.

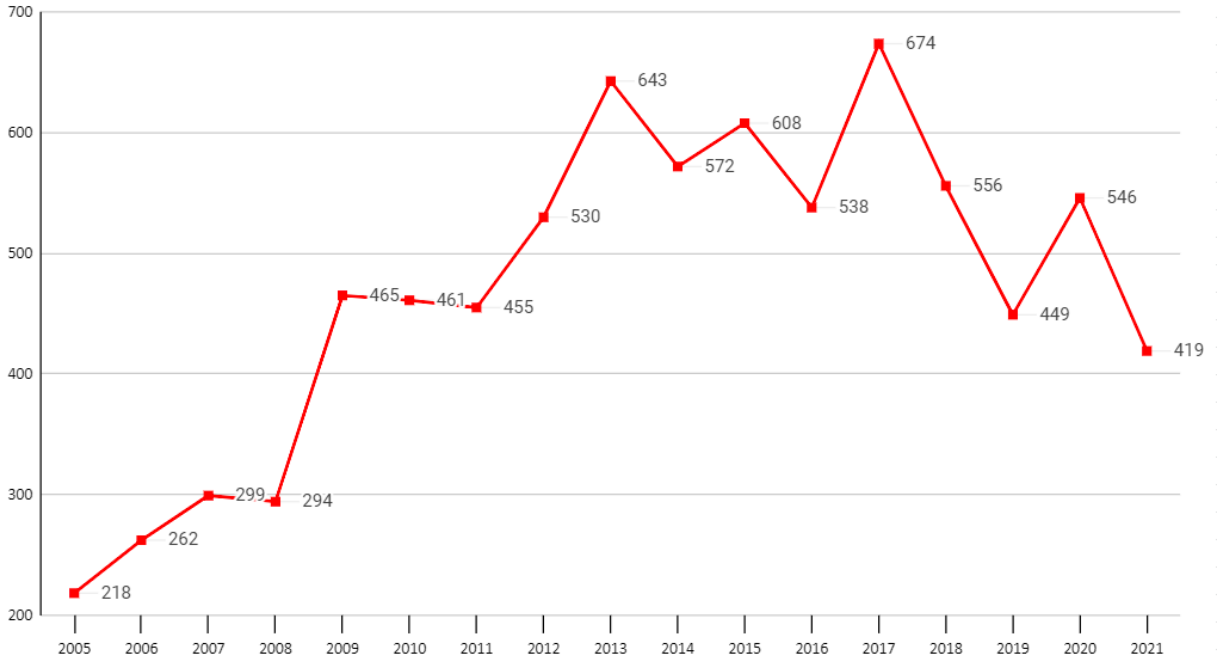
Prof. Gordon Stein who is studying PhD at Vanderbilt University continued the maintenance of our Tomcat & Joomla web server systems.

Steven Kryskalla was hired to support the Robofest Management System (RMS)

David Reeves developed the online match timer used for all the Online events
https://robofestoss.azurewebsites.net/team/timerdemo

We are happy to announce that Shannan Palonis (Coordinator) was transferred from Part-time to Full-time staff during the Robofest 2020-2021 season. Part-time staff members are Elmer Santos (Assistant Director), Pam Sparks (Coordinator), and David Carbery (Technical Advisor), and Daniel Oliver (Student Assistant until May, 2021).

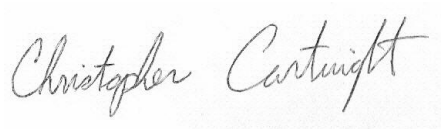
We had 419 site & location volunteers registered this year and we deeply thank all of them. See Figure 16 for the number of registered site volunteers since 2005. Lists of all the ROWC Judges and short bios of Exhibition Style ROWC Judges can be accessed in the Table 10 "Event Judges" column.



(Figure 16) Number of yearly registered Robofest site volunteers since 2005

In summary, we believe 2020-2021 Robofest has achieved its primary missions: inspiring students into STEM fields and supporting them even in this second year of the Coronavirus pandemic. 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 22nd Robofest for the 2020-2021 year. If you find any errors or have comments on this report, please let me know (ccartwrig@LTU.edu). We are looking forward to seeing you during the 23rd annual Robofest 2022 season. I would like to thank Dr. CJ Chung for his continued support through my transition to Robofest Director as we look ahead to 2022.

Respectfully,
December 9, 2021



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