RoboCupJunior — Four Years Later.

Elizabeth Sklar[1] and Amy Eguchi[2]

[1] Department of Computer Science
Columbia University
1214 Amsterdam Avenue, New York, NY 10027, USA
sklar@cs.columbia.edu

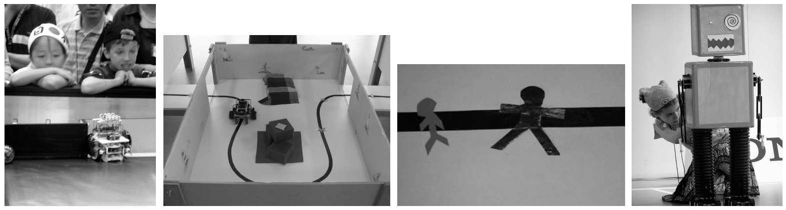
[2] School of Education, University of Cambridge
17 Trumpington Street
Cambridge, CB2 1QA UK
eae24@hermes.cam.ac.uk

Abstract. In this paper, we report on the status of the RoboCupJunior league, four years after it was founded. Since its inception in 2000, we have been surveying and/or interviewing students and mentors who participate in the international event. Here we present a high-level overview of this data. We discuss demographics of participants, characteristics of preparation and educational value. We highlight trends and identify needs for the future, in terms of event organization, educational assessment and community-building.

1 Introduction

RoboCupJunior (RCJ), the division of RoboCup geared toward primary and secondary school students, was founded in 2000. The focus in the Junior league is on *education*. RCJ offers three challenges (see figure 1) — **soccer**, **rescue** and **dance** — each emphasizing both cooperative and competitive aspects. The stated mission of RoboCupJunior is: “to create a learning environment for today, and to foster understanding among humans and technology for tomorrow”. RCJ provides an exciting introduction to the field of robotics, a new way to develop technical abilities through hands-on experience with computing machinery and programming, and a highly motivating opportunity to learn about teamwork while sharing technology with friends. In contrast to the one-child-one-computer scenario typically seen today, RCJ provides a unique opportunity for participants with a variety of interests and strengths to work together as a team to achieve a common goal.

The idea for RoboCupJunior was demonstrated in 1998, with a demonstration at RoboCup-98 in Paris [1]. The first international competition was held in 2000 in Melbourne, Australia at RoboCup-2000, with 25 teams from 3 countries participating [2]. In 2001, in Seattle, USA, there were 25 teams from 4 countries (83 students plus 17 mentors) [3]. In the following year, the initiative exploded and 59 teams from 12 countries came to RoboCupJunior-2002 in Fukuoka, Japan (183 students plus 51 mentors) [4]. Most recently, 67 teams from 15 countries participated at RoboCupJunior-2003 in Padova Italy (233 students plus 56 mentors). The fifth annual international RoboCupJunior event will be held in Lisbon, Portugal in early July 2004 and a similar rate of expansion is expected.



(a) soccer (b) rescue (c) rescue “victims” (d) dance

Fig. 1. RoboCupJunior challenges.

This paper focuses on reporting on the status of the RoboCupJunior league from several standpoints. Since its inception, we have been involved in evaluating RCJ for the dual purpose of tracking its growth in terms of members and internationalization and examining what it is about RCJ (and robotics in general) that is so exciting and motivating for students and what intrigues mentors and keeps them involved from one year to the next. We have conducted interviews and surveys of students and mentors since the first RCJ event in Melbourne. Our initial report was a pilot study, based on interviews of mentors [2]. A follow-up study was reported in 2002 that included input from students and compared the trends identified in 2000 to data collected in 2001 [3]. The data indicated the possibility of exciting results, if a more comprehensive study were conducted with more participants over a longer time period. This report attempts to take a step in that direction.

Since the initiative exploded in popularity in 2002, we have collected more than three times as much data as in the first two years. Here, we analyze that data and compare it with the initial years. Additionally, we report the demographic statistics and increase in participation world-wide. We describe developments within the RCJ league and close with a brief summary and future plans.

It is important to keep in mind when reading this report that the data was collected at an annual international event hosted by a different country each year. The host regions typically account for approximately 40% of RCJ teams, so as a result, the trends are highly subjective to the norms and characteristics of each region. The interesting piece is to find trends that breach the cultural divide and some are identified below.

2 Participation

We examine rates of participation in terms of the number of teams and the number of students and mentors who have attended each event. Three years are compared: 2001-2003. All the data presented for subsequent years both in terms of registration and evaluation statistics was not collected in 2000, so we consider 2000 to be a pilot year and here restrict our comparisons to 2001-2003. We view the data in three ways, looking at the population distribution across countries, challenges and gender.

We examine the international distribution of teams over the three years. In 2001, teams from 4 countries participated. This rose to 12 countries in 2002 and 15 in 2003.

	2001	2002	2003
Australasia			
Australia	10 (40%)	8 (14%)	5 (7%)
China		2 (3%)	4 (6%)
Japan		**29 (49%)**	12 (18%)
Korea		5 (8%)	
Singapore			4 (6%)
Taiwan			2 (3%)
Thailand		4 (7%)	
North America			
Canada		1 (2%)	2 (3%)
USA	**8 (32%)**	1 (2%)	4 (6%)

	2001	2002	2003
Europe			
Denmark		1 (2%)	
Finland		1 (2%)	1 (1%)
Germany	5 (20%)	5 (8%)	15 (22%)
Italy			**7 (10%)**
Norway		1 (2%)	1 (1%)
Portugal			1 (1%)
Slovakia		1 (2%)	3 (4%)
UK	2 (8%)		3 (4%)
Middle East			
Iran			3 (4%)

Table 1. Distribution of teams from different countries.

Countries are grouped by region and listed in alphabetical order. Entries contain the number of teams that participated that year. The number in parenthesis indicates what percentage of total participation was represented by that country. Blank entries indicate that a country did not participate in the corresponding year. Bold entries highlight the host country each year.

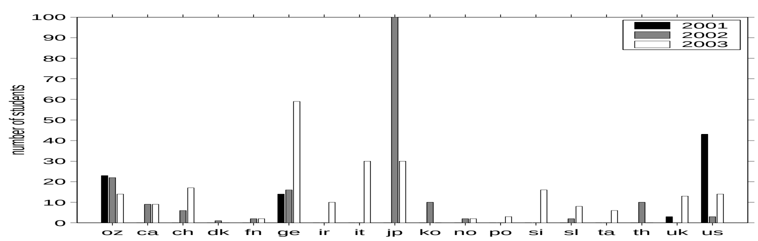


Fig. 2. Distribution each year of students from different countries.

key: oz = Australia; ca = Canada; ch = China; dk = Denmark; fn = Finland; ge = Germany; ir = Iran; it = Italy; jp = Japan; ko = Korea; no = Norway; po = Portugal; si = Singapore; sl = Slovakia; ta = Taiwan; th = Thailand; uk = UK; us = USA.

Statistics on teams are shown in table 1. The corresponding statistics counting students (instead of teams) is illustrated graphically in figure 2.

Table 2 shows the distribution of participants entering each of the four challenges: 1-on-1 soccer, 2-on-2 soccer, rescue and dance. Note that 1-on-1 soccer was not held in 2001 and rescue was not held in 2002. These were the decisions of local organizers [3]. It is interesting to note that 2-on-2 soccer remains the most popular challenge, involving from about two-thirds to three-quarters of participants. Dance attracts about one-third of participants. Rescue, revamped in 2003, draws just under 20% of participants; however it is anticipated that this percentage will rise (see section 4.2).

[3] Subsequently, through efforts to provide a more formal structure for RCJ, these crucial types of decisions were placed in the hands of an international technical committee which includes two members of the RoboCup Federation Executive Committee.

	2001		2002		2003	
	teams	students	teams	students	teams	students
dance	7 (28%)	29 (35%)	12 (20%)	63 (34%)	18 (27%)	67 (29%)
rescue	4 (16%)	16 (19%)			12 (18%)	39 (17%)
1-on-1 soccer			4 (7%)	10 (5%)	14 (21%)	49 (21%)
2-on-2 soccer	22 (88%)	68 (82%)	45 (76%)	125 (68%)	45 (67%)	166 (71%)

Table 2. Challenges.

	2001	2002	2003
total	10 (12%)	30 (16%)	37 (16%)
dance	5 (17%)	16 (25%)	22 **(33%)**
rescue	0 (0%)		7 (18%)
1x1soccer		0 (0%)	3 (6%)
2x2soccer	7 (10%)	16 (13%)	13 (8%)

Table 3. Percentage of female student participants, per year and by challenge.

We are also interested in studying the gender balance, across years and challenges, for both students and mentors. Here, we present data on rates of female participation within the student population. Note that we are not including mentors because the data we have is sparse and inaccurate. One planned improvement for the immediate future is standardization and centralization of data collection for all RCJ participants (students and mentors).

In table 3, we show the percentage of female student participants over all three years. The total number is presented and is also broken down by challenge. Note that some students participate in more than one challenge, which explains why the sum of the values broken down by challenge exceeds the total number in the top row. Also note that the challenge percentages are the rates of female participation calculated over all students who participated in that challenge (not over all participants).

RoboCupJunior has seen strong growth in the number of female participants. We highlight the fact that the dance challenge, which provides a unique outlet for creativity, attracted 33% female participants in 2003, double the rate of just two years earlier, and also well above typical rates for computer science and most engineering fields, which generally range from 10-20% female. This trend has been duplicated in all of the national open events held thus far, most notably in Australia where over half the RCJ dance participants in 2003 were female. This is impressive, as the scale of the Australian RoboCupJunior effort is such that each state has its own regional championship and on the order of five hundred students participate in the country's national RoboCupJunior event each year.

3 Evaluation

In 2000, we conducted video-taped interviews of mentors with the intent of beginning a longterm study of the effects of RCJ across a wide spectrum of technical, academic and social areas. We transcribed and analyzed this data, which is presented in [2]. The experience informed the creation of a set of surveys for both students and mentors, which we administered in 2001. These were analyzed and presented in [3]. We used these results to modify our survey methodology, shifting from mostly open-ended, qualitative questions to a closed, quantitative questionnaire for 2002 and 2003. In this section, we detail our findings from these last two years, comparing them to the results of 2001. Note that since our data collection methodology from 2000 differed so significantly from the subsequent years, we do not attempt to make any direct comparisons to this data.

It is also worth mentioning that we conducted video-taped interviews of students in 2001 and 2002. Analysis of this data is problematic for several reasons. The data collection methodology was inconsistent, primarily because interviews were conducted by volunteers who were not trained interviewers and so many interviews became conversations and deviated from the prescribed set of questions. This was compounded by language issues (both at the time of the interviews and later, during transcription). In addition, accurate transcription is extremely time-consuming and error-prone. Thus we cannot draw statistical conclusions from these interviews, although they have served a useful purpose in developing the surveys. We did not conduct interviews in 2003 and do not plan any for 2004. Future evaluations may include more structured interviews conducted by researchers in areas such as education and human development.

Table 4 shows the rate of return on the surveys for all three years (2001-2003). Totals are shown; as well, the data is subdivided by gender and country. Except for the totals, the percentages are calculated as the rate of return of all people who responded (not over all participants). The percentages reported for “country” are the percentage of the total responses that were from each nation. This gives an indication of the extent to which overall trends might be attributed to a particular country. This is not the same as the response rate from each country, i.e., the percentage of participants from a particular country who complete the surveys. That is shown in table 5 and gives an indication of to what extent a collective country’s response is representative of that country.

3.1 Students’ responses.

A total of 192 students participated in the survey (2001, 39 students; 2002, 104 students; 2003, 49 students). Out of these, 84% were male and 16% were female (162 males and 29 females in total; 2001, 34 males, 5 females; 2002, 86 males, 17 females; 2003, 42 males, 7 females). Here we present analysis of their responses to four questions.

How was your team organized? We collected valid answers to this question only in 2002 and 2003. In 2001, the question was phrased with open-ended responses rather than multiple choice answers, and many students misunderstood the question (for example, some answered “well”). So we changed the format of the question to multiple-choice in 2002. Based on the 2002 and 2003 data, many students responded that their teams were organized at after school programs (2002, 46%; 2003, 39%). About one

	2001		2002		2003	
	students	mentors	students	mentors	students	mentors
total responses	39 (48%)	16 (94%)	104 (57%)	16 (29%)	49 (21%)	27 (53%)
breakdown by gender						
male	34 (87%)	13 (81%)	86 (83%)	24 (89%)	42 (86%)	10 (63%)
female	5 (13%)	3 (19%)	17 (16%)	3 (11%)	7 (14%)	4 (25%)
breakdown by country						
Australia	11 (28%)	2 (13%)	17 (16%)	4 (15%)	0 (0%)	1 (6%)
Canada			5 (5%)	0 (0%)	0 (0%)	0 (0%)
China			0 (0%)	0 (0%)	0 (0%)	0 (0%)
Denmark			1 (1%)	1 (4%)	0 (0%)	
Finland			2 (2%)	1 (4%)	0 (0%)	0 (0%)
Germany	11 (28%)	6 (38%)	9 (9%)	2 (7%)	13 (27%)	1 (6%)
Iran					7 (14%)	2 (13%)
Italy					0 (0%)	0 (0%)
Japan			57 (55%)	15 (56%)	16 (33%)	3 (19%)
Korea			0 (0%)	0 (0%)		
Norway			2 (2%)	1 (4%)	1 (2%)	1 (6%)
Portugal					0 (0%)	0 (0%)
Singapore					9 (18%)	5 (31%)
Slovakia			2 (2%)	1 (4%)	3 (6%)	3 (19%)
Taiwan					0 (0%)	0 (0%)
Thailand			6 (6%)	2 (7%)		
UK	1 (3%)	1 (6%)			0 (0%)	0 (0%)
USA	16 (41%)	7 (44%)	3 (3%)	0 (0%)	0 (0%)	0 (0%)

Table 4. Return rates on surveys, 2001-2003.

Note that in 2003, 2 mentors (12%) did not answer the gender question.

fifth of teams were organized by one of the team members (2002, 18%; 2003, 22%). In both years, 14% of the students responded that their teams were organized by community youth groups or organizations. However, in 2002, 13% of the student participants reported that their teams were organized in class as part of their normal school day (as opposed to 2% in 2003. But in 2002, about half of the teams were Japanese teams and the event was organized by the local city government. Because the local city government recruited teams from the city public district, many participating teams from the local area were organized at school.

How did you find out about RoboCupJunior? In 2001 and 2002, many students reported that they learned about RCJ from their school teachers (2001, 74%; 2002, 61%; 2003 24%). On the other hand, in 2003, the most popular informant was a local robotics society (35%), which was 0% in 2001 and 11% in 2002. This difference can be attributed to local influences in the host region.

What robot platform did your team use? The most popular robot platform used by RCJ teams is the Lego Mindstorms Robotics Invention Kit (2001, 72% of the student participants; 2002, 46%; 2003, 43%). This could be because Lego Mindstorms is also

	2001		2002		2003	
	students	mentors	students	mentors	students	mentors
Australia	48%	67%	77%	57%	0%	25%
Canada			56%	0%	0%	0%
China			0%	0%	0%	0%
Denmark			100%	50%		
Finland			100%	0%	0%	0%
Germany	79%	120%	56%	50%	22%	11%
Iran					70%	67%
Italy					0%	0%
Japan			57%	71%	53%	30%
Korea			0%	0%		
Norway			100%	100%	50%	100%
Portugal					0%	0%
Singapore					56%	125%
Slovakia			100%	100%	38%	100%
Taiwan					0%	0%
Thailand			60%	50%		
UK	33%	50%			0%	0%
USA	37%	100%	100%	0%	0%	0%

Table 5. Survey return rates for students and mentors, by year and country.

the most widely available robot platform around the world. One interesting trend to point out is that in 2002, 41% of student participants reported that their teams used the Elekit SoccerRobo. This is because RCJ-2002 was held in the city in Japan where the Elekit company is headquartered. Another trend to point out is, in recent years, more and more teams are adding components of their own. In 2001, no student participants reported that they added components not included in the original kit. But 16% students in 2002 and 31% in 2003 reported that they added components.

How much time did you spend preparing for RCJ? Students were asked to specify when they began preparation for the event, how often their team met and how long each meeting lasted. Most teams spend 1-3 months preparing (36% in 2001, 30% in 2002 and 39% in 2003); however responses ranging from 3-12 months are only slightly lower. Very few teams spend less than 1 month preparing. Most teams meet once per week, although this data is hard to tally, since many students wrote in the margins of the survey that they started meeting once a week, and then met more frequently as the event drew closer. Overwhelmingly, teams spend more than 90 minutes at each meeting. All of these trends regarding preparation time are very similar from one year to the next, not deviating for different regions. It is interesting to note the length of meeting time. Since class periods in schools are typically shorter than 90 minutes, this points out that it is hard to find sufficient preparation time for RCJ only through classroom work.

3.2 Mentors' responses

A total of 59 mentors participated in the survey (2001, 16 mentors; 2002, 27 mentors; 2003, 16 mentors). Out of the 59 mentor survey participants, 80% were male and 17% were female[4]. Here we present analysis of their responses to four questions.

What was your role in the team? Out of all the mentor participants, 33 are school teachers, 13 are parents of the student participants, 10 are community group organizers, 3 are science museum/center staff, and 6 are from some type of organization. Every year, about half of the mentors are teachers (2001, 41%; 2002, 67%; 2003, 50%). In 2001, more parents (50% of the respondents) and fewer teachers got involved in than other years. Since RCJ typically occurs in July, many schools around the world are on summer holiday, so finding teachers to participate can be problematic. This was highlighted at RCJ-2001, when the event was held in the USA, because the summer school holidays are long and students tend to go to camp or get jobs.

What type of school and community does your team come from? Many teams are affiliated with public schools (2001, 63%; 2002, 41%; 2003, 69%). This shows that educational robotics is not limited for those who go to private schools with high-end technologies. Most of them are from either urban or suburban areas (2001, 38% in urban and 38% in suburban; 2002, 44% in urban and 44% in suburban; 2003, 38% in urban and 6% in suburban). This could be because of a lack of RoboCupJunior-related events and/or activities in rural areas in general. Many RCJ local competitions tend to be held in large cities. This suggests that the organizers of RCJ events need to examine ways to extend local events to more rural areas in the future.

How did your team fund its effort? Mentors reported that about 70% or more teams received money from their schools, sponsors, local government, or/and fundraising activities (2001, 75%; 2002, 68%; 2003, 88%). In 2001, half the teams received funding from sponsors. 19% of the teams did fundraising activities and 13% received support from their school. 31% of teams had their parents pay for them. On the other hand, in 2002, more teams had their parents pay (41%) and were less successful for receiving sponsorship (33%). Also, teams received more funding from their schools (30%) and local government/board of education (11%). However, some teams had to have the team members and/or mentors pay to participate (teacher, 2 teams; members, 1 team). In 2003, half of the teams received sponsorship including RoboCupJunior travel support, and 25% of them receive support from their school. However, parental support was still one of the main resources for the teams.

On the other hand, more than 75% of the mentors did not receive any direct funding (2001, 75%; 2002, 89%; 2003, 75%) (i.e., payment for their time, e.g., as after-school teachers). Some of them were able to get paid through their schools or from grants, but it is obvious that the mentors need avenues for financial support. Yet this statistic is astounding — as overworked as most schoolteachers are, the vast majority of them are motivated enough by RCJ to volunteer their time and participate, sometimes even spending their own money. Despite of the financial hardships, most mentors indicate their intention to participate the International competition again (2001, 63%; 2002, 89%; 2003, 88%).

[4] 47 males and 10 females in total; 2001, 13 males, 3 females; 2002, 24 males, 3 females; 2003, 10 males, 4 females, 2 did not provide gender data.

Do you use robotics in your school curriculum, and if yes, how? Out of 33 teacher-mentors, 31 teacher-participants provided information about their schools. All of them teach middle (11-14 year-old) and/or high (older than 15) school age students. Only four teach elementary (5-10 year old) school age students (some of them also teach older students). This suggests that educational robotics is used more with students who are older than 10. The future questions will be finding out the reason why RCJ does not attract elementary school teachers and how to make it more accessible for these teachers; although we can speculate on two points. First, it is more difficult to travel with younger children than with older students[5]; so it may be that, as a result, RCJ is perceived as an event for older participants. Second, younger children typically have trouble concentrating for extended periods of time. Given that the large majority of teams spend over 90 minutes at each meeting time, it may be that many younger children do not have the focus to stay involved for a sustained period of time, over a number of months.

About half of the mentors teach technology. Other commonly taught subjects are chemistry (6 teachers), general science (6 teachers), and physics (5 teachers). Despite the fact that educational robotics can be used to illustrate a variety math concepts, only three mentors are math teachers (all three participated in 2001).

Eighteen teachers responded that they use robotics in their curriculum and 13 teachers do not use it in the curriculum but do use it in after school programs. However, 13 teachers out of the 18 teachers organized their RCJ teams after school, not within their class room period. This suggests that we should investigate in the future what are the obstacles for teachers using robotics in their curriculum to organize their teams as part of classroom activities.

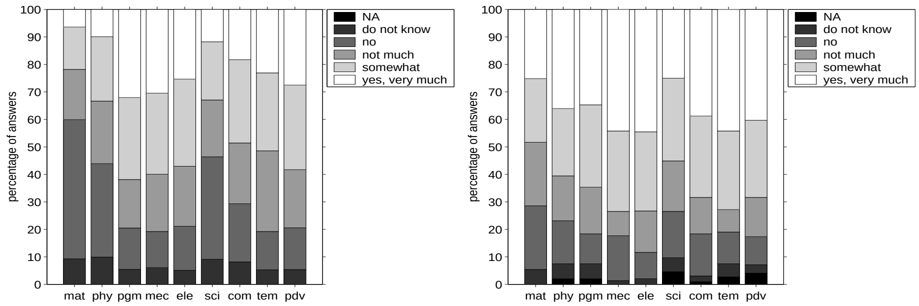
We are working on developing materials to help teachers take an integrated approach to educational robotics and RCJ. Students should be encouraged to write lab reports, journaling their efforts in engineering and programming. They can create posters and oral presentations about their developments. As indicated above, robotics can be used to demonstrate a wide variety of math skills; and some of our work involves creating curriculum to do this.

3.3 Educational value

A large part of the evaluation is dedicated to trying to identify what students are actually learning from participating in RCJ. The surveys administered in 2002 and 2003 include a series of statements (such as, "I am better in math because of working with robots.") to which respondents indicated agreement or disagreement on 5-point scale. Figure 3 shows how students responded.

In order to get more of a snapshot view, we took this data plus the responses to similar questions from 2001 and interpreted each response as to whether the students and mentors thought each aspect was positively affected by involvement in RoboCupJunior. The results are shown in figure 4.

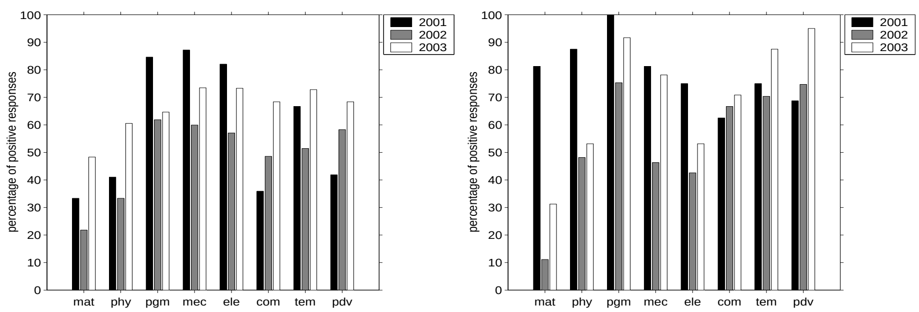
[5] Less supervision and parental involvement is required.



2002 2003

Fig. 3. Students' self-assessment.

key: mat = math; phy = physics; pgm = computer programming; mec = mechanical engineering; ele = electronics; sci = general science; com = communication skills; tem = teamwork; pdv = personal development (such as organization). NA means that the question was not answered.



(a) according to students (self-assessment)

(b) according to mentors

Fig. 4. Which aspects were positively affected by students' participation in RCJ?

Finally, it is interesting to note that students assess themselves and their experience differently from mentors observing the effects. Figure 5 shows the difference, for each year, in student versus mentor opinion.

4 Development

As the league has grown, it has changed. Here, we highlight two recent changes.

4.1 E-League

The newest initiative within RoboCup is a new entry-level league developed and exhibited for the first time in 2003 [5]. This league is designed to provide an easy en-

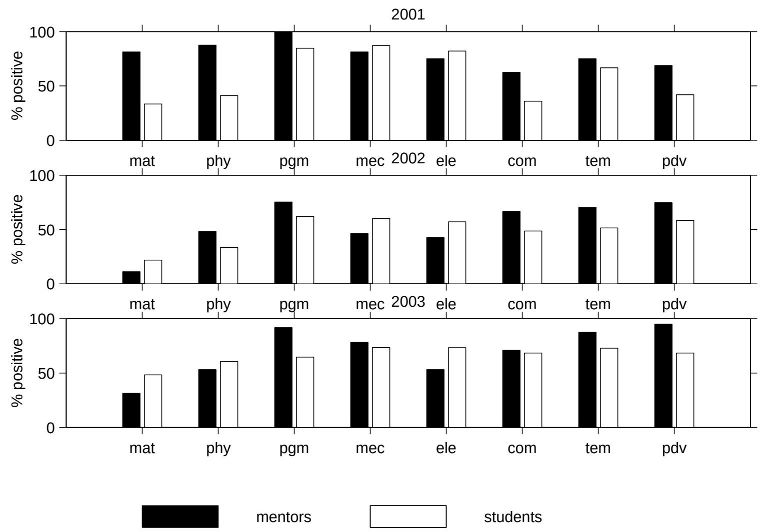


Fig. 5. Comparisons between students' self-assessment and mentors' observations.

try into RoboCup involving more undergraduate students, as a means for RoboCupJunior "graduates" to continue with the project between high school and graduate school (where most RoboCup senior league participants come from). The league is also intended to serve as an accessible entry-point for undergraduates who have not participated in RoboCupJunior. The league is inexpensive (compared to the other RoboCup senior leagues).

4.2 Rescue

In 2003, we designed and constructed a miniature, modular version of the NIST standard USAR test bed especially for RoboCupJunior [6]. The design features a varying number of "rooms", connected by hallways and ramps (see figure 1b). Two doorways are located at standard points in each room so that multiple rooms (modules) can be linked together easily. Modules can be stacked, to provide additional challenge; lighting conditions in lower rooms with a "roof" are different than in rooms with an open top. The number of modules in an arena is not fixed; we used four modules at RCJ-2003 in Padova.

The floor of each room is a light color (typically white). The surface could be smooth, like wood, or textured, such as a low-pile carpet. The rooms can be furnished or bare; the walls can be decorated or left empty. This allows teams to enhance their modules with decorations of their own design. One idea is to let teams bring "wallpaper" to events as a means for sharing team spirit and local culture.

A black line, made with standard black electrical tape, runs along the floor through each room, entering in one doorway and exiting through the other. Along the black line, “victims” are placed randomly throughout the arena. The victims are like paper doll cut-outs, made of either green electrical tape or reflective silver material (see figure 1c). As in the senior rescue game, teams receive points for detecting victims. They are penalized for missing existing victims and for mis-classifying victims (i.e., finding victims that are not really there). When the robot locates a victim, it is supposed to pause on its path and also make an audible beeping sound.

5 Summary

We have presented a report on the status of RoboCupJunior, four years after its birth. We have provided statistical data on the demographics of participants, highlighting gender differences and a broadening range of internationalization. Further, we have offered results and analyses of evaluation surveys collected at RoboCupJunior international events since 2000. New developments were described, and we identified areas of improvement for the future.

One aspect of evaluating only the annual RCJ international event is that there is a concentration of teams from the local, host region. This presents a challenge from a research standpoint, since the cohort differs somewhat from year to year. However, it also helps highlight particular characteristics of these regions. Expanding our data collection to local and regional events world-wide will help identify broader effects that are (and are not) sensitive to cultural differences.

As RCJ expands worldwide, there is an increasing need to establish a better organizational foundation and structure for information dissemination and community-building. We have recently received significant support from the Association for Computing Machinery (ACM) to maintain and grow the initiative on an international basis. This support will help us improve the RCJ web-site and offer improved channels for information, communication and resources.

http://www.robocupjunior.org

References

1. Lund, H.H., Pagliarini, L.: Robot Soccer with LEGO Mindstorms. In: RoboCup-98: Robot Soccer World Cup II, Lecture Notes in Artificial Intelligence (LNAI). Volume 1604., Springer Verlag (1998)
2. Sklar, E., Johnson, J., Lund, H.H.: Children Learning from Team Robotics: RoboCup Junior 2000 Educational Research Report. Technical report, The Open University, Milton Keynes, UK (2000)
3. Sklar, E., Eguchi, A., Johnson, J.: RoboCupJunior: learning with educational robotics. In: Proceedings of RoboCup-2002: Robot Soccer World Cup VI. (2002)
4. Sklar, E.: RoboCupJunior 2002: League Description. In: Proceedings of RoboCup-2002: Robot Soccer World Cup VI. (2002)
5. Anderson, J., Baltes, J., Livingston, D., Sklar, E., Tower, J.: Toward an Undergraduate League for RoboCup. In: Proceedings of RoboCup-2003: Robot Soccer World Cup VII. (2003)
6. Sklar, E.: A long-term approach to improving human-robot interaction: RoboCupJunior Rescue. In: Proceedings of the International Conference on Robotics and Automation (ICRA-04). (2004)