Technovation 2018 Evaluation

Methods Supplement

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Introduction

WestEd conducted a formative evaluation of Iridescent Learning's Technovation 2018. Formative evaluation primarily serves to identify a program's strengths and weaknesses and to provide feedback that can lead to improvements. We employed a mixed-method approach drawing from both qualitative and quantitative data to evaluate college and career readiness, computer science (CS) academic achievement, and mentor training. Data were gathered from surveys, observations, focus groups, interviews, alignment analysis, and artifact analysis. This document describes the data sources used, how they were collected, and any limitations related to their analysis.

Surveys

Student and Mentor Surveys

Iridescent Learning administers surveys at the beginning and end of each Technovation season to students and mentors through their online platform. Prior to the 2018 season, WestEd reviewed these surveys to suggest edits for existing items and to provide additional questions to address the evaluation priorities. Pre-surveys were collected between November 2017 and March 2018. Post-surveys were collected between March 2018 and July 2018. Table 1 shows the number of participants completing each survey. Between 7% to 19% of participating students and between 13% to 38% of participating mentors completed pre- and post-surveys. Below we describe our survey additions, selection of subsamples for coding open-ended items, and limits of the survey analysis.

TABLE 1

Number of Participants Completing Pre-season and Post-season Surveys

Survey	No. Responses at Pre	No. Responses at Post	No. Technovation Participants[1]
Students	2,865	1,076	15,475
Mentors	1,369	477	3,611

[1] Registration numbers as of March 23, 2018.

Addition of College and Career Readiness Items. Part of our scope of work included an examination of how Technovation may impact participants' college and career readiness. Often, measures of this outcome relate to standards established by educational authorities within a given country and can vary across countries. Given the large number of countries and cultures represented by Technovation participants, WestEd conducted a brief literature review of college readiness to better understand how it might be measured in the international context. A full list of the sources reviewed can be found in Appendix A. Based on this literature review, college and career readiness was stratified into four main areas: key cognitive strategies (e.g., inquisitiveness, analysis, critical thinking, problem solving); academic content (e.g., writing and expression, academic subject areas, academic self-efficacy); academic behaviors (e.g., study skills, taking notes, communicating with teachers and advisors, ability to participate in a study group); and contextual skills and awareness (e.g., college admissions, college options, entry requirements). To reduce participant burden and create a relatively short student survey, we narrowed our focus to areas that were most likely to be impacted by participation in Technovation, including time management and planning skills, communication with adults, problem solving, and academic self-efficacy. Items included:

- What strategies do you use to manage your time or organize your work (e.g., keep a list of the things you need to do)?
- How confident are you that you can successfully complete the following tasks?
  - Manage time effectively
  - Talk to your teachers
  - Break down complex problems into simpler ones
- How often do you do the following?
  - I set deadlines for myself when I set out to accomplish a task.
  - I keep a list of the things I have to do each day.
  - I have a clear idea of what I want to accomplish during the next week.
- Compared to the average student, I would rate my overall academic ability as: Very Poor, Poor, Average, Good, or Excellent
- Do you plan to go to college?
- If you plan to go to college, list up to three fields you might study.
- Do you plan to work after you finish all of your schooling?
- If you plan to work after finishing your schooling, list up to three careers you might pursue.
- Knowing how to run a business is important in meeting my career objectives. [Yes/Maybe/No]
- Knowing how to code is important in meeting my career objectives. [Yes/Maybe/No]

Addition of Mentor Training Items. Mentoring is a multifaceted role that involves more than just knowledge of content (e.g., app development, business development) and knowledge of ways to motivate and encourage students. Other factors, such as beliefs about teaching and learning, also influence how one decides to mentor. Research into these epistemological beliefs have categorized viewpoints on a spectrum ranging from more teacher-focused, didactic beliefs to more student-focused, constructivist beliefs. Didactic beliefs tend to view teachers as conveyors of knowledge and students as receptacles of that knowledge. Constructivist beliefs view students as constructors of their knowledge and teachers as facilitators of this process. Constructivist beliefs align with Iridescent Learning's vision for their impact on students. Understanding the beliefs mentors bring into their Technovation experiences can inform decisions around the supports and training Technovation develops for them.

To gauge mentors' beliefs, we asked them to rank a set of statements on the post-survey related to their role as a mentor and a set of statements related to how they determine when students are understanding. Statements were modified from Luft and Roehrig's *Teacher Beliefs Interview*[1] and identified as one of five categories presented in Table 2. For easy reference, we provide an identifier between E1 and E5 for each category. The lower the identifier, the more the category is aligned with didactic beliefs. The higher the identifier, the more the category is aligned with constructivist beliefs.

TABLE 2

Teaching Belief Categories

ID	Category	Description
E1	Traditional	Focus is on teacher providing information and resources in a structured manner and environment
E2	Instructive	Teacher decides experiences and reacts based on subjective evaluation of student actions and performance
E3	Transitional	Emphasis on teacher–student relationship that includes subjective and affective components that does not necessarily focus on teaching or learning of [computer] science
E4	Interactive[a]	Centers on opportunities and value of collaboration between students and teacher, as well as between students as peers. Focus is on development of [computer] science learning and content knowledge
E5	Responsive[b]	Focus on individualized and student-centered methods of learning that considers student responses, interests, and abilities. Promotes a collaborative environment in which students apply skills and knowledge to novel situations

Source: Wong, S. S., & Luft, J. A. (2015). Secondary Science Teachers' Beliefs and Persistence: A Longitudinal Mixed-Methods Study. Journal of Science Teacher Education, 26(7), 619–645. https://doi.org/10.1007/s10972-015-9441-4
Note: Wong and Luft originally used the terms *responsive*[a] (instead of interactive) and *reform-based*[b] (instead of responsive) in their scheme.

[1] Luft, J. A., & Roehrig, G. H. (2007). Capturing Science Teachers' Epistemological Beliefs: The Development of the Teacher Beliefs Interview. Electronic Journal of Science Education, 11(2). Retrieved from http://ejse.southwestern.edu/article/view/7794

Mentors responded to the following items. The belief category for each statement is indicated in brackets:

- How would you describe your role as a mentor? Rank the following statements from most agree (1) to least agree (4):
  - My role is to deliver information to my team and provide instruction. [E1]
  - My role is to provide my team with experiences in coding and entrepreneurship. [E2]
  - My role is to develop a good relationship with my team so that they feel comfortable participating. [E3]
  - My role is to create an environment for my team to take charge of their own learning. [E4]
- How do you know when your team(s) understands the Technovation curriculum? Rank the following statements from most agree (1) to least agree (5):
  - When they are paying close attention to the lessons. [E1]
  - When I ask questions and see if they are getting it. [E2]
  - When they ask questions or make connections to other parts of the curriculum. [E3]
  - When they are helping or teaching each other. [E4]
  - When they can create something new without my help. [E5]

Subsamples for Open-Ended Survey Items. Due to the large number of survey responses, WestEd narrowed its qualitative analysis of open-ended survey responses to a subsample of respondents for both the student and mentor surveys. For the student pre-survey, 560 surveys (approximately 20% of respondents) were selected for analysis. An approximately equal number of students were selected to represent the junior division (i.e., aged 13 and under) and the senior division (i.e., aged 14 and over). A purposeful selection was created to represent opinions from participants in the following country groups: 1) United States; 2) Spain; 3) Canada, Mexico, Brazil, India; and 4) all other countries. These country groups were selected based on mentor registration data as of March 2018. The U.S. had over 500 mentors. Spain had over 400 mentors. Each country in group 3 had over 200 mentors. Each country in group 4 had 143 or fewer mentors. When possible, an equal number of students were selected from each country group. In cases where an insufficient number of participants existed for a particular group, additional respondents were oversampled from the other groups to ensure that the total number of participants analyzed remained at 560. The same selection method was used with the post-survey. Because fewer post-survey were submitted, the sub-sample selected for analysis in the post represented 52% of the total survey responses.

A subsample of mentor responses was selected in a similar manner. We aimed to select 35 mentors per country group to represent approximately 10% of pre-survey respondents and 30% of post-survey respondents. On the pre-survey, 135 mentors where selected (i.e., 32 from the U.S., 35 from Spain, and 34 each from country groups 3 and 4). On the post-survey, 125 mentors were selected (i.e., 29 each from the U.S. and Spain, 37 from country group 3, and 30 from country group 4).

Survey Limitations. We conducted a descriptive analysis of the surveys with the intention of using paired sample t-tests to conduct a statistical analysis of pre-to-post differences of a subset of the close-ended survey items. However, paired t-tests require participants to complete both the pre-survey and the post-survey and for those responses to be linked. Ultimately, this analysis was not possible for the student survey because student names were missing from the post-survey, and it was not possible to link the pre-survey responses to the post-survey responses.

Instead, we used independent sample t-tests to examine differences in responses to the pre-survey and the post-survey. This analysis answers a slightly different question than a paired sample t-test, which is: “Do participants who responded to the post-survey have different responses than participants who responded to the pre-survey?” The independent samples t-test also assumes the pre-survey and post-survey responses are from entirely different sets of people. But, in reality, some number of participants completed the survey both times. So, caution is needed when interpreting the statistical results of the survey since it was not possible to quantify how many people completed both the pre-survey and the post-survey.

A related issue is that the post-survey, by nature, does not include submissions from people who did not complete Technovation 2018. Therefore, it is likely that there are systematic differences between participants who completed the post-survey and those who did not. Participants who made it to the end of the season may have been more motivated, had a stronger CS background, or just had a better experience in the program than those who did not complete the season. Any differences observed in the responses to the pre-survey and the post-survey could potentially be attributed to these differences in the participants.

Regional Ambassador Survey

A Regional Ambassador (RA) survey was also administered by Iridescent Learning during the summer of 2018. WestEd provided additional questions to include in the survey, with the goal of better understanding contextual factors related to college and career readiness in countries around the world. These questions primarily focused on student characteristics that are important for success in college, as well as the types of obstacles that impact girls’ ability to attend college. In total, 18 RA surveys were submitted to Iridescent Learning. We planned to use this information as part of the statistical analysis of students’ survey responses related to college and career readiness. However, due to the low response rate, there was insufficient diversity or power to examine the data quantitatively. Instead, we focused our review on the open-ended survey responses related to the ways in which Technovation could better support participants to prepare for college in the future.

Observations, Focus Groups, and Interviews

Student Observations, Focus Groups, and Interviews

Several observations and focus groups were conducted by WestEd researchers during the 2018 season to explore students' college and career readiness and their CS academic achievement. Due to budget limitations, observations were primarily held in the San Francisco Bay Area. One researcher was able to capitalize on a personal vacation to conduct a focus group with students, mentors, and a regional ambassador in Yaoundé, Cameroon (see Appendix C). These observations and focus groups were organized opportunistically with assistance from Iridescent Learning staff. We also collected response cards from participants at a junior division and senior division pitch event. Students responded to the question, "*What was the biggest support to you during the season?*" Information drawn from these data is not meant to be representative of the larger Technovation Challenge. Instead, these activities offer a portrait of a subset of Technovation participants, which were used to provide additional context for the evaluation. The following observations and focus groups were conducted with participants during the 2017-18 season:

TABLE 3

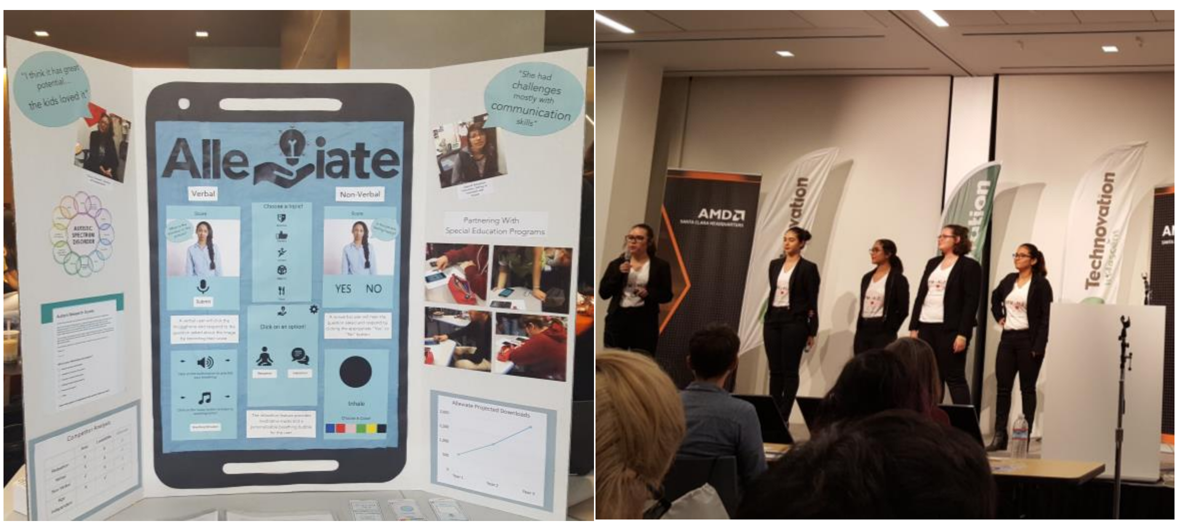
Student Observations, Focus Groups, and Interviews

Date	Format	Description
01/05/18	Focus group	**Joint focus group, Yaoundé, Cameroon:** A joint focus group with one regional ambassador, three mentors, three girls who participated in the 2017 season, and four girls participating in the 2018 season was conducted in Yaoundé, Cameroon. Participants shared reflections on several topics, including: Internet and computer access, the Cameroonian educational system, sustaining and expanding efforts within Cameroon, Technovation's impact on girls, suggestions and future plans.
01/27/18	Observation	**South Bay Technovation 2018 Launch Workshop, Redwood City, CA**: Launch event attended by approximately 48 Technovation participants across 10 teams, as well as a regional ambassador, two student ambassadors, and a few Iridescent staff members.
03/20/18	Observation and Focus Group	**Junior team observation, San Francisco, CA:** Junior team observation with three students and three mentors (one present via Skype). After the team observation, a focus group was held with the students, followed by a group interview with the team's mentors.
04/15/18	Observation	**Ask the Expert Event, Sunnyvale, CA:** Event that provided participants with the opportunity to ask questions of a volunteer related to coding and/or entrepreneurship. The event was divided into three sessions lasting 20 minutes long, providing girls with the opportunity to ask multiple questions.

Date	Format	Description
04/07/18	Observation and Focus Group	**Senior team observation, Concord, CA:** Senior team observation with two students and one mentor. After the team observation, a focus group was held with the students. The team's mentor was later interviewed by phone.
05/04/18	Observation	**South Bay Junior Division Event, Palo Alto, CA:** Observation of a regional pitch event where thirteen teams presented their projects at a poster fair and on stage to a panel of five judges. An informal parent interview was conducted with one attendee.
05/17/18	Interviews	**Student and Parent Interview:** A student participating in a San Francisco Bay Area Technovation team and her mother were interviewed at a local library. The student, a returning Technovation participant, and her mother were interviewed separately.
08/09/18	Observation	**World Pitch Night, San Jose, CA:** Observation of the World Pitch Night where finalists from ten different countries presented their projects at a poster fair and on stage to a panel of six judges.

FIGURE 1

Photos from World Pitch Night



Source: Aleata Hubbard

Student Ambassador Focus Group

A virtual focus group was conducted via Zoom with a group of 10 Technovation student ambassadors (SAs). This focus group was held during a typical Technovation meeting time for SAs. Due to the time of day (4pm PT/7pm ET), the students participating in the focus group were predominantly from the U.S. and Canada. The following countries were represented by focus group participants: United States (Pittsburgh, PA; Boston, MA; Cupertino, CA; Redwood City, CA; Chicago, IL; Seattle, WA); Canada

(Toronto); Tunisia, and Nigeria. Discussion topics ranged from elements of the Technovation program that support the development of time management and organizational skills, to the impact of Technovation on the girls' confidence in speaking with teachers and making presentations, to plans for college and careers.

Interviews with Mentors

WestEd conducted eight interviews with mentors from the 2018 Technovation season. Iridescent Learning selected the mentors and connected them with WestEd. We requested a sample of mentors that included both junior and senior division teams, mentors serving independently as well as co-mentors, new and returning mentors, and mentors from a variety of countries, with priority given to mentors from the U.S., Spain, Canada, Mexico, Brazil and India. The interviews primarily focused on supports offered to and accessed by mentors during the season, mentors' perspectives of their roles, and their interaction with their team members. All interviews were conducted by phone or video conference with a WestEd research staff member. Table 4 provides further demographic information about the mentors interviewed:

TABLE 4

Mentor Interviews

Mentor	Location	Technovation Experience	Mentor Type	Division	Profession Type
Mentor #1	U.S. (NC)	New	Solo	Junior	Non-educator
Mentor #2	U.S. (NY)	New	Solo	Junior	N/A
Mentor #3	U.S. (Washington, D.C.)	New	Co-mentor	Junior	Student
Mentor #4	U.S. (Washington, D.C.)	New	Co-mentor	Junior	Non-educator
Mentor #5	India	Returning	Co-mentor	Senior	Educator
Mentor #6	Mexico	New	Co-mentor	Senior	Non-educator
Mentor #7	Uzbekistan	New	Solo	Senior	Educator
Mentor #8	Sweden	New	Co-mentor/Solo	unknown	Educator

Alignment Analysis

To evaluate mentor training offerings, we conducted an alignment analysis of the Technovation training curriculum. The original goal of this analysis was to gauge the training's alignment with research on effective professional learning programs. We developed a rubric (see next page) to assess the training courses based on three assumptions:

- ***Opportunities to learn.*** We acknowledge that mentors have a variety of opportunities for training in Technovation. Possible training venues include online mentor training courses, the mentor Slack community, regional workshops, and exchanges with other mentors and regional ambassadors. In this rubric, we focused on the training courses and Slack community. The training courses were evaluated on the degree to which they met each critical feature of professional learning. Surveys and interviews were used to probe about other training opportunities.
- ***Critical features of professional learning****.* Desimone[2] identified five critical features of professional learning included in the rubric: content focus, active learning, coherence, duration, and collective participation. These features reflect the research community's consensus on *some* of the features critical to improving teacher knowledge, skill, and practice. We acknowledge these features are derived from research on teachers working within educational institutions whose goals and contexts differ from mentors working within an informal learning environment like Technovation.
- ***Other factors influencing learning.*** The development of teacher (i.e., mentor) knowledge is less well understood in the research community, but there is consensus that both individual and external factors mediate this complex process[3,4]. In our rubric, we attend to one individual factor (i.e., beliefs of teaching and learning), but consider this a secondary area of focus as it can be difficult to assess from training materials alone.

We then reviewed and completed each course, attending to each criterion listed on the rubric. Early into the evaluation process, it became apparent that the training courses focused less on developing content knowledge related to programming, business, ideation, or pitching, and more on the skill of mentoring. So, the *content focus* criterion of the rubric was given less attention in our analysis.

[2] Desimone, L. M. (2009). Improving Impact Studies of Teachers' Professional Development: Toward Better Conceptualizations and Measures. Educational Researcher, 38(3), 181–199.

[3] Avalos, B. (2011). Teacher Professional Development in Teaching and Teacher Education over ten years. Teaching and Teacher Education: An International Journal of Research and Studies, 27(1), 10–20.

[4] Opfer, V. D., & Pedder, D. (2011). Conceptualizing Teacher Professional Learning. Review of Educational Research, 81(3), 376–407.

Alignment Analysis Rubric

Criteria	Level of Alignment for Courses		
	Low	Medium	High
Content focus: training materials focus on Technovation subject matter content (i.e., programming and entrepreneurship) and how students learn that content	Materials cover little of Technovation curriculum; Courses do not include examples of student work, common (mis)conceptions	Materials cover >50% of Technovation curriculum; Some courses include examples of student work, common (mis)conceptions	Materials cover nearly all Technovation curriculum; Each course includes multiple examples of student work, common (mis)conceptions
Active learning: opportunities are available for mentors to get involved (e.g., observing expert mentors or being observed; reviewing student work; and leading discussions)	No courses provide active learning opportunities	At least 50% of courses provide active learning opportunities	Nearly all courses provide one or more active learning opportunities
Coherence[1]: mentor training is consistent with Iridescent's goals (i.e., curiosity, creativity, perseverance, problem solving, communication, collaboration)	Training attends to no competencies/characteristics in Technovation's goals	Training attends to some competencies/characteristics in Technovation's goals	Training attends to all competencies/characteristics in Technovation's goals
Duration[2]: training activities are of sufficient duration, including both span of time over which the activity is spread (e.g., one semester) and the number of hours spent in the activity (e.g., 20 hours)	Activity spread <3 wks; Hrs of training <5 hrs	Activity spread ~3 wks; Hrs training ~10 hrs	Activity spread ~6 wks; Hrs of training ~20 hrs
Collective participation: groups of mentors from similar contexts (e.g., region, division) participate together and build an interactive learning community	Training includes little or no interaction between mentors	Training includes some interaction between any mentors	Training includes interaction between mentors working in similar contexts
Beliefs about teaching/learning: opportunities are available for mentors to reflect on their ideas about how best to support students and how students learn; student-centered beliefs about teaching/learning are promoted	No courses provide opportunity to reflect on beliefs about teaching/learning; Training promotes traditional, teacher-centered ideas about teaching/learning	Some courses provide opportunity to reflect on beliefs about teaching/learning; Training promotes a blend of traditional & student-centered ideas about teaching/learning	Most courses provide opportunity to reflect on beliefs about teaching/learning; Training promotes student-centered ideas about teaching/learning

Notes:
[1] Coherence also relates consistency with mentor's knowledge and beliefs and with other training opportunities. These aspects of coherence will be evaluated through surveys and interviews.
[2] Research literature suggest training for teachers span at least one semester and include 20 hours of contact time. Activity spread will be adjusted to reflect the length of the Technovation competition (i.e., comparing it against 12 weeks instead of a typical 180-day school year in

the U.S.)

Artifact Analysis

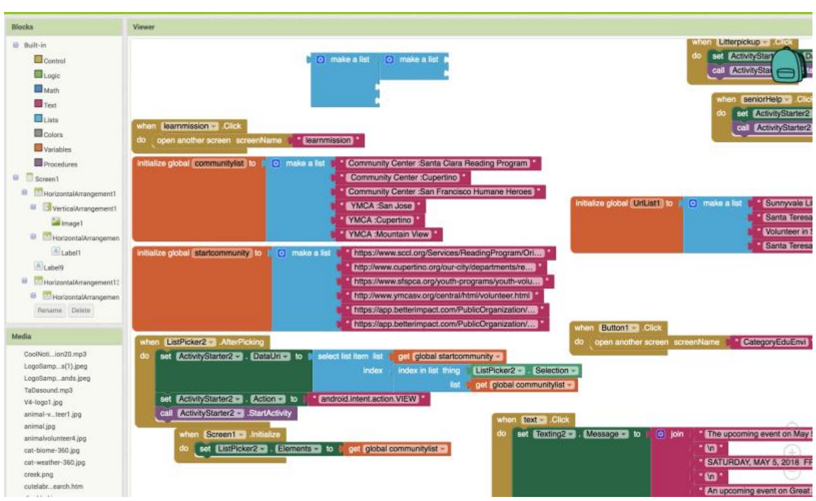
Computer science academic achievement was another area of focus for this evaluation. We originally planned to extend the work of *the 2016 3-year Technovation App Analysis* by (a) reviewing a subset of projects from the 2018 season to see how girls made use of foundational computing concepts and (b) comparing a subset of 2017 and 2018 projects completed by returning participants to see how use of foundational computing concepts changed across years. However, in the early stages of the evaluation, Iridescent Learning began talks with researchers at M.I.T. to analyze the ways in which teams interacted with App Inventor. As such, we shifted our focus to (a) a brief literature review of methods used to assess projects created in educational programming environments like App Inventor and (b) a pilot of these methods with a handful of projects from the 2017 and 2018 seasons. A list of references reviewed for this artifact analysis are provided in Appendix B.

Iridescent Learning provided us with seven App Inventor projects to review. One project could not be analyzed because we were only provided with an executable version of the project. Four of the projects analyzed were created by returning teams; two from the senior division and two from the junior division. Another two projects were created by first-time teams; one from the senior division and one from the junior division. Teams represented four countries: Kenya, Cambodia, India, and the U.S.

To provide an example of how CS academic achievement might be assessed, we ran each project through CodeMaster[5] – a web application that assesses App Inventor projects against fifteen criteria and assigns a coding complexity score (see rubric on the next page). We summarized patterns in the CodeMaster scores and compared them against the Technovation Checklist scores. Given the limited sample, it does not warrant any generalization to the larger group of Technovation participants.

FIGURE 2

Code Snippet from App Inventor Project



[5] CodeMaster Homepage: http://apps.computacaonaescola.ufsc.br:8080/

CodeMaster Assessment Rubric

Criteria	0 Points	1 Point	2 Points	3 Points
Screens	Single screen with visual components that do not programmatically change state.	Single screen with visual components that do programmatically change state.	Two screens with visual components and one screen with visual components that do programmatically change state.	Two or more screens with visual components and two or more screens with visual components that do programmatically change state.
User Interface	Uses one visual component without arrangement.	Uses two or more visual components without arrangement.	Uses five or more visual components with one type of arrangement.	Uses five or more visual components with two or more types of arrangement.
Naming: Components, Variables, Procedures	Few or no names were changed from their defaults.	10 to 25% of the names were changed from their defaults.	26 to 75% of the names were changed from their defaults.	More than 75% of the names were changed from their defaults.
Events	No use of any type of event handlers.	Uses one type of event handlers.	Uses two or three types of event handlers.	Uses more than three types of event handlers.
Procedural Abstraction	No use of procedures.	There is exactly one procedure, and it is called.	There is more than one procedure.	There are procedures for code organization and re-use (with more procedure calls than procedures).
Loops	No use of loops.	Uses simple loops (“while”).	Uses “for each” loops with simple variables.	Uses “for each” loops with list items.
Conditional	No use of conditionals.	Uses “if”.	Uses one “if then else”.	Uses more than one “if then else”.

Criteria	0 Points	1 Point	2 Points	3 Points
Math and Logic Operations	No use of any operators blocks.	Uses one type of operator blocks.	Uses two types of operator blocks.	Uses more than two types of operator blocks.
Lists	No use of lists.	Uses one single-dimensional list.	Use more than one single-dimensional list.	Uses lists of tuples.
Data persistence	Data are only stored in variables or UI component properties, and do not persist when app is closed.	Data is stored in files (File or FusionTables).	Uses local databases (TinyDB).	Uses web databases (tinywebdb or Firebase).
Sensors	No use of sensors.	Uses one type of sensor.	Uses two types of sensors.	Uses more than two types of sensors.
Media	No use of media components.	Uses one type of media components.	Uses two types of media components.	Uses more than two types of media components.
Social	No use of social components.	Uses one type of social components.	Uses two types of social components.	Uses more than two types of social components.
Connectivity	No use of connectivity components.	Uses activity starter.	Uses bluetooth connection.	Uses low level web connection.
Drawing and Animation	No use of drawing and animation components.	Uses canvas component.	Uses ball component.	Uses image sprite component.

Source: http://apps.computacaonaescola.ufsc.br:8080/rubrica_appinventor.jsp

Appendix A: College and Career Readiness References

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Appendix B: App Inventor Assessment References

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Appendix C: Cameroon Focus Group Report

On Friday, January 5, 2018, a WestEd evaluator met with Technovation participants in Yaoundé, Cameroon to discuss their experiences with the program. The focus group consisted of one regional ambassador, three mentors, three girls who participated in the 2017 season, and four girls participating in the 2018 season. In this report, we summarize reflections shared by participants focused on five themes that emerged during the group interview. This focus group was organized opportunistically and the findings presented here are not meant to be representative of the larger Technovation Challenge. Instead, the findings offer a portrait of a subset of Technovation participants, which can be used to provide additional context for the Technovation evaluation.

Theme 1: Internet and Computer Access

During the focus group, the evaluator focused on gathering formative feedback about difficulties encountered by participants during the Technovation Challenge. The barrier participants mostly frequently discussed was limited access to the Internet and to computers.

MIT App Inventor, the platform used to create mobile apps for the Technovation Challenge, requires WiFi access and a Google email account. Participants discussed how students access App Inventor at schools, home, churches, and Internet cafes, all of which vary in their availability and quality of computers/Internet. For example, while some schools might have a computer lab, they may have a slow Internet connection or limited hours where students and mentors can access the lab. One mentor discussed spending an entire session helping students set up email accounts.

To address some of these issues, mentors discussed buying girls Internet time at local cafes, bringing modems to schools, and registering in October well before the official start of the season. One mentor also commended Technovation's project workbook. He said that having a workbook he could print and distribute to girls helped overcome sometimes spotty Internet connections or the need to have entire teams hover around one computer to read the lesson materials.

Theme 2: Cameroonian Educational System

Some factors of the Cameroonian educational system that influence participation in Technovation also surfaced during the focus group. While these factors may be specific to Cameroon, they might suggest characteristics of educational systems in other countries that are worth attending to in understanding how girls participate in the Technovation Challenge.

National Exams. The Cameroonian educational system requires students to sit for national exams at certain stages in their academic career. These exams, called General Certificate of Education (G.C.E) take place in May-June and influence students' entrance into the next level of education. Given the importance of these exams, the Regional Ambassadors dissuade girls from participating in the Technovation Challenge during the years they take the exams. Three of the focus group participants who competed in the 2017 season are not participating in the current season because of these national exams. However, a small number of girls insist on joining the Technovation Challenge while also preparing for their exams.

Meeting Times. A focus group participant discussed how students in Cameroon have one free period during the school day and they encourage teams to use this time to work on the Technovation Challenge. Where this is not possible, girls are encouraged to work on Technovation after school or on Saturdays. Meeting on Saturdays can present challenges for some girls who might have to do chores or who do not have extra money to pay for commuting to sites on the weekends.

Theme 3: Sustaining and Expanding Efforts within Cameroon

The Technovation Challenge operates in six regions in Cameroon (i.e., Centre, Littoral, North West, Adamawa, North and Far North) with activities operated from the centralized regional towns of Yaoundé, Douala, Bamenda and Garoua. There are plans to expand the competition to the South West region, particularly the towns of Limbe and Buea. The regional ambassadors work collaboratively so that Technovation activities across Cameroon are aligned. One regional ambassador discussed multiple efforts underway to sustain and expand Technovation within the country.

Soliciting Support from Local Companies. Although the Technovation Challenge is a free competition, it does require a variety of resources for successful participation. While participants acknowledged supports provided by Technovation, they noted that these supports were not guaranteed (e.g., a limited number of regions are selected each year for regional support). To supplement supports provided by Technovation and with an eye towards sustaining tech training opportunities for girls well into the future, regional ambassadors have reached out to local companies in Cameroon to support their efforts. These efforts have led, for example, to companies providing supplies and swag used at regional pitch events. Regional ambassadors have faced some challenges in their pursuit of external supports. For example, after introducing the Technovation Challenge to a local telecommunications company, the company decided not to support the competition but rather to create their own competition.

Supporting Mentors. Regional ambassadors organize workshops for mentors twice per season. The first workshop, held prior to the season, introduces mentors to the curriculum, allows for new mentors to learn from returning mentors, and focuses on mentoring teams. A second, follow-up workshop is held just prior to the submission deadline to handle any difficulties mentors might be facing with MIT App Inventor. The regional ambassadors have also created a WhatsApp group to support communication across mentors during the season, which is in addition to the Slack group offered by Technovation. Some participants also discussed Technovation's Master Educator Program, which they thought would be useful to restart, as it could provide Cameroon with an additional coach to the lone Master Educator who could provide additional pedagogical support to mentors.

Theme 4: Technovation's Impact on Girls

The Technovation Challenge appears to be having a positive impact on girls in Cameroon. Mentors discussed a variety of skills and attitudes developed by girls beyond learning how to code, including:

- Greater communication skills and the ability to address a wide audience
- Increased self-confidence
- Digital literacy skills (e.g., email, Word)

- Survey design
- Identifying problems
- Working in teams
- Improved English skills

Some indicators of the long-term impact of participation in Technovation were also mentioned. Girls who participated in the 2017 Technovation season, but are not currently involved due to their national exams, discussed plans to learn HTML on their own. A regional ambassador shared a story of a former participant who is now studying computer engineering in college.

The girls participating in the focus group talked about their experiences in Technovation and shared advice for other girls interested in the competition. Their reflections are paraphrased here:

- *You benefit from participating in Technovation even if you do not win, because you learn how to code and how to communicate with others.*
- *Learning to code and how to merge ideas together was the hardest part of the competition.*
- *Sometimes it is hard to make time for Technovation because I'm taking five classes in school.*
- *We had some disagreements in our team (e.g., some girls did not want to survey strangers about our app), but we eventually solved them.*
- *I joined Technovation to learn new things and meet new people.*
- *I would tell girls new to the competition (a) be bold and be ready to work, (b) do your work on time, and (c) remain in the same group during the season— when groups change everything falls apart.*

For some girls, the Technovation program is challenging. Mentors discussed how many students drop out of the competition when the curriculum becomes difficult. However, those who persist seem to benefit greatly from their participation. One regional ambassador discussed how teams will stay up late at night at the end of the season to make sure their materials are submitted on time. Mentors also discussed the motivation girls receive from sharing their apps and video pitches with family and friends.

Theme 5: Suggestions and Future Plans

Participants offered the following suggestions to improve the Technovation Challenge:

- Motivate girls by offering rewards for those competing at the national level and allowing them to share their apps in a public venue (e.g., Google Play).
- Increase retention in the season by providing girls with reminders to complete lessons and notifications when they are behind on their lessons (similar to the deliverables tracker provided by Technovation).

- Address issues with Internet and computer access by providing an offline version of App Inventor.
- Support continued participation by allowing girls to further develop their app ideas in a post-season event.

A regional ambassador also discussed ideas she would like to pursue in the future to further support tech education for girls in Cameroon. These ideas included: creating an incubator where girls can continue to develop their ideas, creating a workspace where girls can go to access computers even if mentors are not present, and working with companies who can donate computers that can be distributed to girls or used to furnish the aforementioned workspace.

Summary

Participants' appreciation of Technovation was evident during the focus group interview. Girls talked about the many skills they developed because of the competition and their plans to continue to pursue tech related interests. Mentors spoke enthusiastically about the impact of the program on girls and ways to increase and sustain the girls' motivation in tech. Regional ambassadors discussed passionately their efforts to coordinate Technovation in Cameroon and their ideas for building more opportunities for girls to pursue tech in the country. The focus group surfaced two ideas Iridescent might consider in improving Technovation in the future:

Provide access to an offline version of App Inventor. For teams with limited Internet access, an offline version of App Inventor can provide greater opportunity to complete the Technovation lessons and develop a better understanding of the programming concepts presented in the curriculum. If use of an offline version of App Inventor is feasible for the Technovation Challenge, details about such platforms created by developers outside of MIT are available here: https://groups.google.com/forum/#!topic/ai4a/ajG4Q6UrRR8

Create a space for girls to share their apps publicly. A mentor in the focus group discussed how sharing apps with family and friends was a great motivator for girls. Creating and sharing artifacts is a cornerstone of the constructivist learning theory upon which App Inventor was built.[6] This idea can be expanded within Technovation by creating a space for teams across the globe to share their apps with each other and with those outside the competition. App Inventor's gallery of 'App of the Month' winners provides an example of such a platform (http://appinventor.mit.edu/explore/app-month-gallery.html).

Author

This report was prepared by Aleata Hubbard, Ph.D. on January 10, 2018. Dr. Hubbard is a research associate in the STEM program at WestEd.

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FIGURE 3

Photos of Focus Group Participants