Crisis In K-12 STEM Education

A national problem creates an opportunity for Local Communities

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Conclusions

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“Today, the store of human knowledge doubles every five years.

Soon, every child will be able to stretch a hand across a computer keyboard and reach every book ever written, every painting ever painted, every symphony ever composed”

President William Clinton
Address to the 150th Anniversary
American Association for the Advancement of Science
1995

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"Internationally recorded discipline-based knowledge took 1,750 years to double for the first time, counting from the start of the Christian era;

it then doubled in volume every 150 years and then every 50.

It now doubles every five years…

and it is projected that by 2020 knowledge will double every 73 days."

According to figures supplied by James Appleberry,
cited by José Joaquín Brunner
UNESCO Forum Regional Scientific Committee for Latin America and the Caribbean

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K-12 Education Evolution

As a region…

- **We must find ways to cope with the scope and rate of change in the body of information in STEM fields.**
  - Keeping teachers and the professors that teach them current and focused on preparing students for the real world.
  - The printed text book model will no longer keep pace with the rate of information change.
- **The vast majority of our population needs STEM skills.**
  - We have relied on a logical – mathematical approach to teaching STEM. For students who favor that learning style it works well…but it is a relatively small percent of the total population.
  - We must learn how to package STEM course content in a manner that adapts to student learning styles. The Kahn Academy is an example of a resource that allows students to access the information they want/need exactly when where and how they want it.
- **Our schools must present course content in a manner that teaches students 21st century job skills (problem solving, critical thinking, teamwork, coping with failure, etc.)**
- **For all of this to succeed, the student must find the course content interesting, engaging and potentially useful.**
  - Relevance is critically important.
  - We must find a way to incorporate real-world examples from the business world of how the information they are learning is used every day to solve difficult real world problem.
- **All of this must happen in a way that creates a delightful teaching experience and enables businesses to provide real world examples and provide mentors with minimal disruption to teacher and business partner's schedules.**

Based on 92 interviews, 4 areas of Focus were identified from conversations with the experts

- **Real-World Examples of Using STEM principles to Solve Problems** are essential to give relevance to the need to learn the principle and provides an opportunity to see the exciting STEM careers available in the Piedmont Region.
- **Problem/Project Based Learning** is an important tool for energizing the learning process and improving ability to retain the knowledge.
- **Mentors** are important in their ability to provide K-12 students the opportunity to interact with technology professionals.
  - For at risk students, mentors who look like the student can provide a role model and reassurance that their situation can change.
  - The interactions can be a combination of brief presentations (solving real-world problems using STEM principles) or longer interactions as coaches/mentors on STEM afterschool teams and tutors.
- **Communicating the need for a STEM education** among K-12 Students, their parents, their teachers and professors that teach their teachers is critically important. The most important people in the student's life, their parents and teachers, need to be aware of the exciting opportunities and life changing possibilities a STEM education offers. Only then will they be able to provide the knowledge and guidance to enable the student to be successful.

Short term action plan

- Afterschool STEM Teams are the low hanging fruit
- Identify K-12 STEM education programs that are proven to cause a passion for learning STEM while instilling 21st century job skills (problem solving, critical thinking, ability to work as a team, coping with failure, etc.).
  - Select from the best proven STEM education programs and implement on a small scale in selected STEM Magnet schools across the Piedmont Triad Region.
  - Test results against a control group of students
- Implement tours, job shadowing, internships for students and teachers to expose and immerse them in exciting STEM careers
- **Determine how to attract the best teachers and principals to want to be on the leading edge of the change process**

Afterschool STEM teams

Low hanging fruit opportunity

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“My mission in founding FIRST was to trick kids into loving science and math”

Dean Kamen
Serial Inventor
Founder of FIRST Lego League & First robotics Challenge

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Afterschool STEM teams get results

- 2009 Quantitative Study conducted by Brandeis University based on end-of-program surveys distributed to FLL team members, their parents, and team coaches in a national sample of 440 teams in the U.S. and Canada.
  - The 2008 participant surveys indicate that FLL provides an engaging, high quality hands-on robotics experience for boys and girls ages 9 to 12.
  - More than 80% of team members reported participating in the full range of FLL tasks, including designing, building, and programming the robot, working on the Science Project, and playing an active role at the tournaments.
  - Most (77%) also reported having an opportunity to work with an adult with technical expertise
  - Almost all (93%) attended at least one tournament, and 86% rated their tournament experience positively.
  - Nearly 90% of the coaches thought that the Science Project was an important part of FLL and that the real-world focus of the project made it more fun and exciting for team members.
  - Data from the team member surveys also point to a high quality program experience
    - 90% of the team members reported
      - that they made important decisions on their team;
      - had important responsibilities;
      - felt they belonged
      - and were an important part of their team;
      - got the attention they needed from adults,
      - felt safe;
      - and had fun working on their team
  - Ninety five percent of team members rated their experience as “Good” (35%) or “Excellent” (60%).
- Informal afterschool STEM education through STEM Competitive Teams use Problem/Project Based Learning to instill the life skills the CEOs say that they want to see developed while the students develop a passion for science.

High school STEM teams shape critical attitudes

The FIRST Robotics Competition, which is the high school student program, had a positive impact on student attitudes…

- 95% increased understanding of the value of teamwork
- 89% increased understanding of the role of science and technology in everyday life
- 89% Increased self-confidence
- 86% increased interest in science and technology
- 70% increased motivation to do well in school
- **69% increased interest in science and technology careers**

- Brandeis University quantitative national survey of FIRST Robotics Competition participants

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