

Math

	Very Important	Somewhat Important	Not Important
Whole Numbers	100%	0%	0%
Fractions	100%	0%	0%
Mixed Numbers	67%	33%	0%
Improper Fractions	67%	33%	0%
Binary Numbers	33%	17%	50%
Octal Numbers	33%	17%	50%
Hexadecimal Numbers	33%	17%	50%

1. Boys and Girls Club

The Boys and Girls Club's role is essential in preparing students early on, so they can succeed in the community college program and beyond. These results can guide your tutoring and mentoring efforts:

- **Fundamentals Matter:** Basic arithmetic skills such as **whole numbers and fractions** are unanimously rated as very important (100%), highlighting the foundational skills students need to master early.
- **Advanced Fractions:** Skills like **mixed numbers and improper fractions** are important for about two-thirds of respondents (67%), indicating that these should be a focus area for high school students preparing for technical fields.
- **Basic Computer Science Concepts:** Though more advanced number systems like **binary, octal, and hexadecimal** are seen as less critical overall (50% rated them as "Not Important"), it is still essential to expose students to these concepts, especially for those interested in computer-related fields.
- **Algebra and Geometry:** While algebra itself is not viewed as "very important" by most industry partners, **geometry** is mentioned explicitly in the open-ended responses for practical applications such as calculating surface areas, volumes, and working with angles in welding and fabrication. This aligns well with hands-on activities at the Club, especially for students interested in technical careers.

This information helps focus tutoring on foundational math skills while exposing students to more advanced concepts that may become critical as they advance.

2. Community College

For the community college, this survey data indicates where to focus curriculum development and how to guide students in their education:

- **Core Math Skills:** The unanimous importance of skills like **whole numbers, fractions, and measurement/estimation** (100% "Very Important") makes it clear that these areas should be emphasized in the curriculum for entry-level technicians.
- **Additional Preparation:** While **algebra** is not highly ranked (0% said it was "very important"), skills like **trigonometry** (33%) and **data analysis** (33%) are essential in certain industries. Therefore, offering courses or modules in these areas would be helpful for students interested in fields like engineering or quality control.
- **Geometry:** The open-ended responses about geometry's practical use in welding and fabrication emphasize the need to incorporate **applied geometry** into technical programs, focusing on real-world applications like calculating volumes, angles, and surface areas.

The college should continue aligning its curriculum with local industry needs while ensuring students master both the foundational and specialized math skills they will need.

3. Industry Partners

For the industry partners, this survey helps articulate the specific skills that will prepare students to meet job requirements:

- **Foundational Skills:** Respondents unanimously agreed on the importance of skills like **whole numbers and fractions** (100% "Very Important"). This reinforces the need for students to master these basics before entering the workforce.
- **Measurement and Estimation Skills:** Also highly valued (100% "Very Important"), these skills are critical for technicians to be able to perform accurate work in many industrial settings.
- **Trigonometry and Geometry in Practice:** Although only a third of respondents rated **trigonometry and geometry** as "Very Important," the open-ended responses emphasize that these skills are essential in specific roles, such as welding and fabrication. This insight should guide industry partners to support educational programs that focus on these specialized areas.
- **Data Analysis:** About one-third of respondents said **data analysis skills** are "Very Important," indicating that this skill set is becoming increasingly critical as industries adopt more data-driven processes, such as quality control and automation.

Industry partners can use this data to further refine their partnerships with educational institutions, ensuring that their workforce pipeline is equipped with both the basic and advanced skills required in their sectors.

Conclusion:

Across all stakeholder groups, the importance of **fundamental math skills** (whole numbers, fractions, measurement) is clear. While **binary and advanced number systems** are less emphasized overall, certain specialized skills, such as **geometry and data analysis**, remain critical for specific career paths. These insights can help each group—mentors, educators, and industry—target their efforts to prepare students effectively for the technical workforce.

Recommendations:

Research-Based Math Lessons for Strengthening Conceptual Understanding

These math lessons (<https://www.edstaranalytics.com/high-stakes-testing/>) were developed based on a multi-year research project that aimed to address significant gaps in mathematical understanding among high school graduates. The research revealed that students entering post-secondary education with weak math skills often struggled with traditional remediation methods, which failed to produce long-term results. However, rigorous, conceptually focused lessons were found to be highly effective in helping these students succeed.

The study showed that even students with very weak math skills were capable of mastering core mathematical concepts when exposed to targeted, conceptual instruction. Traditional remediation approaches were often ineffective, but the use of carefully structured lessons, designed to build deep understanding, resulted in significant improvements. Over 90% of students who engaged with these lessons went on to pass their required courses, and many continued to succeed in math-intensive programs.

We recommend incorporating these research-based lessons into your tutoring and instructional practices. They are particularly valuable for students who feel hindered by gaps in their math knowledge but are capable of excelling when given the right tools. The lessons are organized sequentially, ensuring that each concept builds on the previous one. Even students who believe they understand a topic are encouraged to engage with all lessons, as they offer new perspectives that can simplify more advanced concepts.

By using these lessons, educators and mentors can support students in overcoming the barriers that often hold them back in math, setting them on a path to success in their academic and career pursuits.

1. Boys and Girls Club

For your tutoring and mentoring programs, here are key insights:

- **Safety and Tools:** The importance of personal protective equipment (PPE) and safety procedures (e.g., confined space, material handling) is consistently rated as very important (100%), highlighting the need to familiarize students with safety protocols early.
- **Basic Electrical and Mechanical Skills:** Understanding motor theory, soldering, wiring, and calculating electrical values is crucial, as 67% to 100% of respondents rate these skills as "Very Important." Incorporating hands-on activities and real-world applications into tutoring could help students grasp these concepts.
- **Soft Skills:** Open-ended responses emphasize that qualities like reliability, teamwork, and self-motivation are critical. Mentors should reinforce these attributes as equally important to technical skills.

2. Community College

For curriculum development and instructional focus:

- **Core Electrical Skills:** Topics such as **wiring receptacles, motor installation and alignment, and using multimeters** are rated as very important (83-100%). Incorporating these into hands-on labs and emphasizing their practical applications will ensure students are prepared for industry needs.
- **Advanced Skills:** While more advanced topics, such as **transistor types, SCRs, and Diacs**, are not rated as critical by most respondents (50-67% rated them as "Not Important"), offering these as electives or specialized modules would still be beneficial for students in certain career paths.
- **Programming and PLC Skills:** Creating basic PLC diagrams and integrating function blocks is only moderately rated as important, with only 17-33% of respondents marking these as "Very Important." However, offering this as a specialized option for students interested in automation and controls could be advantageous.

3. Industry Partners

For workforce readiness:

- **Practical Electrical Skills:** The importance of **wiring, motor setup, overcurrent protection devices, and raceway sizing** is strongly supported, with 83-100% of respondents rating these as very important. These are core competencies for new technicians and should be prioritized in training and recruitment.
- **Advanced Theory:** While the fundamental understanding of **AC/DC theory and transformer basics** is emphasized, advanced calculations (RMS, impedance, reactance) are less critical (33% rated them as "Not Important"). Training should balance theory with practical application.
- **Mechanical Skills:** Mechanical tasks like **bearing maintenance, gearboxes, belt drives, and fluid systems** remain important (67-83%). New hires should be well-versed in both electrical and mechanical systems to be versatile technicians.
- **Safety Protocols:** High ratings for **HAZCOM, PPE, and safety procedures** underscore the need for strong safety training. This should be reinforced continuously through both education and on-the-job training.

By focusing on these skills and ensuring students are well-prepared, the program can better align with the expectations of industry partners and ensure that graduates are fully equipped to meet workforce demands.

Conclusion

The survey results underscore the critical importance of foundational technical skills for entry-level technicians, particularly in areas like electrical systems, safety protocols, and basic mechanical operations. Across the board, industry partners highlighted the necessity of proficiency in tasks such as wiring, motor installation, and the use of personal protective equipment (PPE). While certain advanced skills, such as transistor identification and specific programming tasks, were less

frequently rated as very important, they remain valuable in specialized roles and advanced career paths.

Safety was a resounding priority, with consistent ratings emphasizing the need for strong knowledge of safety procedures, including confined space entry, machine guarding, and the use of PPE. Additionally, soft skills like punctuality, teamwork, and a willingness to continually improve were mentioned as critical traits for success in the workforce.

Overall Recommendation

Based on the survey findings, we recommend a dual approach to preparing students for entry-level technical roles:

1. **Focus on Core Skills:** Prioritize curriculum and training in high-importance areas such as electrical wiring, motor installation, and multimeter use, ensuring all students are proficient in these foundational skills. Emphasize safety training and ensure students are well-versed in key safety procedures and the proper use of PPE.
2. **Offer Advanced Training Modules:** For students interested in specialized roles, provide optional modules or electives that cover advanced topics like transistor types, SCRs, and PLC programming. This will allow students to tailor their learning paths while ensuring all graduates have the foundational skills required for success.
3. **Integrate Soft Skills Development:** Given the industry's emphasis on personal responsibility and teamwork, mentoring programs should continue to focus on soft skill development alongside technical training. Encourage students to cultivate qualities such as reliability, a positive work ethic, and the ability to work well in teams.

By aligning training and curriculum with these survey insights, the program will better meet the needs of local industries and prepare students to thrive in technical roles, contributing to a skilled and adaptable workforce.

Teaching Soft Skills in Technical Education

Soft skills are critical for success in any technical role and should be integrated into the educational process just as rigorously as technical skills. Here's an approach for effectively teaching soft skills:

1. **Incorporate Soft Skills into the Curriculum**
 - **Project-Based Learning:** Assign group projects that require teamwork, communication, and collaboration. This helps students develop interpersonal skills while working toward a common goal.
 - **Real-World Scenarios:** Create case studies or role-playing activities where students must demonstrate conflict resolution, time management, and decision-making under pressure.

- **Soft Skills Modules:** Offer dedicated lessons or workshops on topics like communication, leadership, adaptability, and time management. These can be tied to technical tasks, such as presenting a project or leading a group effort.

2. Mentorship and Coaching

- **Pair Students with Industry Mentors:** Mentorship programs can provide guidance in both technical skills and soft skills development. Mentors can offer feedback on areas like professional communication, work ethic, and problem-solving strategies.
- **Peer Feedback Sessions:** Encourage students to provide constructive feedback to each other on teamwork and collaboration, fostering self-awareness and continuous improvement.

3. Workplace Simulations and Internships

- **Simulate Workplace Dynamics:** Through internships or simulated work environments, students can practice soft skills such as punctuality, following directions, managing tasks, and interacting with superiors and peers.
- **Internship Reflection Assignments:** After internships or simulated experiences, require students to reflect on how they handled workplace situations, focusing on communication, collaboration, and adaptability.

4. Assessment and Feedback

- **Soft Skills Assessment:** Develop rubrics or feedback forms that allow both instructors and peers to assess performance on soft skills. These should include metrics for communication, teamwork, leadership, adaptability, and time management.
- **Frequent Feedback Loops:** Provide regular feedback on soft skills alongside technical feedback. Constructive feedback helps students identify areas for improvement and track their progress over time.

5. Modeling by Faculty and Staff

- **Faculty as Role Models:** Instructors and mentors should demonstrate soft skills in their interactions with students. Clear communication, active listening, and punctuality modeled by faculty will reinforce their importance.
- **Guest Speakers and Industry Visits:** Invite industry professionals to share real-world examples of how soft skills impact success in the workplace. This connects soft skills to career advancement and professional development.

6. Encouraging Self-Reflection and Self-Improvement

- **Personal Development Plans:** Have students create personal development plans that identify their strengths and areas for improvement in soft skills. Regularly review and update these plans.

- **Goal Setting:** Teach students how to set personal and professional goals, track their progress, and adjust their approach based on feedback and experiences.

Conclusion

Teaching soft skills requires intentionality and should be woven into the fabric of technical education. By integrating soft skills development into the curriculum, offering real-world experiences, and providing continuous feedback, students will be better prepared to succeed in their careers and contribute effectively in team-oriented, dynamic workplaces.

Effective soft skills are personal attributes that enable individuals to interact harmoniously with others and adapt to their environments. These skills are crucial in the workplace, especially in technical and collaborative roles. Here are some key examples of effective soft skills:

1. Communication Skills

- **Verbal Communication:** The ability to clearly express ideas and information in conversations or presentations. Effective verbal communication is essential for collaborating with teammates, explaining technical details, or speaking to clients.
- **Written Communication:** Being able to write clearly and professionally, whether it's emails, reports, or documentation. In technical fields, this can include explaining processes or findings.
- **Active Listening:** Listening attentively and providing thoughtful responses to ensure understanding and engagement in conversations.

2. Teamwork and Collaboration

- **Cooperating with Others:** Working effectively with colleagues or clients to achieve common goals. This includes understanding team dynamics and being able to contribute positively to group efforts.
- **Conflict Resolution:** Addressing disagreements constructively and finding mutually beneficial solutions. This skill is essential in maintaining a harmonious work environment.
- **Empathy:** Understanding and considering others' perspectives, needs, and emotions to foster positive relationships and teamwork.

3. Problem-Solving and Critical Thinking

- **Analytical Thinking:** The ability to assess complex situations, break them down into manageable components, and find logical solutions. This skill is highly valued in troubleshooting technical issues.
- **Creativity and Innovation:** Coming up with new ideas or approaches to solve challenges, especially in situations where conventional solutions may not work.
- **Adaptability:** Being able to adjust strategies and approaches when circumstances change, which is critical in fast-paced or dynamic work environments.

4. Time Management

- **Prioritization:** Identifying the most important tasks and focusing on them to meet deadlines. This is essential for managing workloads and delivering results on time.
- **Organization:** Keeping track of tasks, documents, and schedules efficiently to ensure nothing falls through the cracks.
- **Multitasking:** The ability to handle multiple tasks simultaneously while maintaining quality and efficiency.

5. Leadership

- **Delegation:** Knowing when and how to assign tasks to others while ensuring that the team works toward common goals. Even in non-leadership roles, this is a valuable skill when collaborating with others.
- **Motivation and Encouragement:** Being able to inspire and motivate others to perform at their best. This can be useful in leadership roles or even within teams to maintain morale.
- **Decision-Making:** Making informed and timely decisions, often in high-pressure situations, and taking responsibility for the outcomes.

6. Work Ethic and Professionalism

- **Punctuality and Reliability:** Showing up on time and consistently delivering quality work is fundamental to building trust with colleagues and employers.
- **Attention to Detail:** Ensuring accuracy and thoroughness in all tasks, whether in technical work or administrative tasks.
- **Accountability:** Taking ownership of one's actions and being responsible for the outcomes, whether they are positive or negative.

7. Adaptability and Flexibility

- **Openness to Change:** Being receptive to new ideas, processes, and environments, and quickly adapting when changes occur.
- **Resilience:** Remaining positive and productive despite challenges or setbacks, and bouncing back quickly from difficulties.

8. Interpersonal Skills

- **Building Relationships:** Establishing and maintaining strong professional relationships through trust, respect, and understanding.
- **Negotiation Skills:** Reaching agreements that satisfy both parties, whether in formal contracts or everyday team interactions.
- **Diplomacy and Tact:** Handling sensitive situations or difficult conversations gracefully, ensuring professionalism is maintained.

9. Emotional Intelligence (EQ)

- **Self-Awareness:** Understanding your own emotions and how they affect your work and interactions with others.
- **Self-Regulation:** Managing emotions, staying calm under pressure, and demonstrating restraint when necessary.
- **Empathy and Social Skills:** Being able to understand and relate to the emotions of others, and using this awareness to manage relationships effectively.

10. Customer Service Orientation

- **Understanding Customer Needs:** Actively listening to customer concerns and addressing them effectively. This is particularly important in technical roles that require interaction with clients or internal stakeholders.
- **Patience:** Handling challenging customer or client situations with patience and professionalism, especially when resolving issues.

Conclusion

These examples of soft skills are vital to career success, particularly in collaborative, dynamic, and client-facing roles. While technical proficiency is important, soft skills often distinguish high-performing employees from the rest, as they allow individuals to work well with others, adapt to changing situations, and lead effectively.

Appendix

	Very Important	Somewhat Important	Not Important
Whole Numbers	100%	0%	0%
Fractions	100%	0%	0%
Mixed Numbers	67%	33%	0%
Improper Fractions	67%	33%	0%
Binary Numbers	33%	17%	50%
Octal Numbers	33%	17%	50%
Hexadecimal Numbers	33%	17%	50%
Rate the importance of entry-level technicians being proficient in the following types of arithmetic operations at your facility.			
	Very Important	Somewhat Important	Not Important
Algebra Skills	0%	67%	33%
Trigonometry Skills	33%	67%	0%
Measurement and Estimation Skills	100%	0%	0%
Data Analysis Skills	33%	50%	17%
Rate the importance of the ability to troubleshoot the following systems and equipment for entry-level technicians at your facility.			
	Very Important	Somewhat Important	Not Important
Facilities power, including three-phase and single-phase supply/line side	83%	17%	0%
Single and three-phase motor starter circuits	67%	33%	0%
Variable frequency drives	50%	33%	17%
PLC circuits and field devices	33%	33%	33%
Industrial ethernet networks	17%	17%	67%
Use of a digital multimeter	100%	0%	0%
Use of an analog multimeter	33%	67%	0%
Use of a portable oscilloscope	0%	83%	17%
Temperature sensing and infrared instruments	50%	50%	0%
Vibration analysis equipment	0%	83%	17%
Basic hydraulic and electrohydraulic systems	33%	67%	0%
Basic pneumatic and electropneumatic systems	33%	67%	0%
Belt and chain drive systems	33%	67%	0%
Sensors: (Consider their wiring, adjustment, and failure diagnostics in your rating.)			
	Very Important	Somewhat Important	Not Important

Proximity Sensors	100%	0%	0%
Sonic Sensors	83%	17%	0%
Thermal Sensors	83%	17%	0%
Encoders	67%	33%	0%
Creating basic PLC ladder diagrams:			
	Very Important	Somewhat Important	Not Important
Understanding and implementing inputs and outputs	33%	50%	17%
Utilizing timers	20%	60%	20%
Utilizing counters	20%	60%	20%
Performing data manipulation	20%	60%	20%
Developing basic PLC function block diagrams:			
	Very Important	Somewhat Important	Not Important
Designing with inputs and outputs	17%	33%	50%
Integrating timers into function blocks	17%	33%	50%
Incorporating counters into function blocks	17%	33%	50%
Executing data manipulation tasks	17%	33%	50%
Additionally, please rate the importance of the following programming and mechanical skills for entry-level technicians at your facility.			
	Very Important	Somewhat Important	Not Important
Performing shaft coupling and alignment	83%	17%	0%
Rate the following:			
	Very Important	Somewhat Important	Not Important
Calculating units and solving for unknowns such as voltage, current, resistance, and power	67%	17%	17%
Grasping fundamental transformer theory	0%	83%	17%
Comprehending basic motor theory	67%	17%	17%
Understanding basic AC theory including:			
	Very Important	Somewhat Important	Not Important
Peak, average, and RMS calculations and their applications	17%	50%	33%
Wavelength concepts	17%	50%	33%
Period and frequency calculations	0%	50%	50%

Impedance and reactance calculations	0%	50%	50%
Understanding basic DC theory including:			
	Very Important	Somewhat Important	Not Important
Understanding voltage, current, resistance, and power relationships	50%	50%	0%
Working with positive and negative power supplies	50%	17%	33%
Applying concepts of forward and reverse bias/polarity	33%	33%	33%
Resistors:			
	Very Important	Somewhat Important	Not Important
Knowledge of various types	17%	67%	17%
Compositions	17%	50%	33%
Applications	17%	67%	17%
Identification methods	17%	67%	17%
Capacitors:			
	Very Important	Somewhat Important	Not Important
Understanding different types	33%	50%	17%
Compositions	17%	50%	33%
Applications	17%	67%	17%
ID codes	17%	67%	17%
Inductors:			
	Very Important	Somewhat Important	Not Important
Familiarity with range of types	17%	50%	33%
Compositions	0%	67%	33%
Applications	0%	83%	17%
ID practices	0%	67%	33%
Diodes:			
	Very Important	Somewhat Important	Not Important
Recognition of different diode types	17%	33%	50%
Composition	0%	50%	50%
Typical applications	0%	67%	33%
Identification techniques	17%	50%	33%
Transistors:			

	Very Important	Somewhat Important	Not Important
Insight into the variety of transistors	0%	33%	67%
Use of the variety of transistors	17%	17%	67%
Composition	0%	33%	67%
How to identify them	17%	17%	67%
Silicon Controlled Rectifiers (SCRs):			
	Very Important	Somewhat Important	Not Important
Understanding SCRs' types	17%	33%	50%
Applications	0%	67%	33%
Identification markers	0%	50%	50%
Diacs and Triacs:			
	Very Important	Somewhat Important	Not Important
Knowledge of their types	0%	33%	67%
Uses	0%	33%	67%
Composition	0%	33%	67%
Identification processes	0%	33%	67%
Rate the following:			
	Very Important	Somewhat Important	Not Important
Soldering components to circuit boards	33%	50%	17%
Soldering wire connectors/connections	83%	17%	0%
Wiring lighting circuits (on/off, three-way, four-way, and switch loops)	83%	17%	0%
Wiring receptacles	100%	0%	0%
Overcurrent protective devices types, sizing, and installation	83%	17%	0%
Calculating wire sizes for ampacity/allowable ampacity	83%	17%	0%
Raceway sizing, installation	83%	17%	0%
Motor-related tasks:			
	Very Important	Somewhat Important	Not Important
Installation, leveling, and alignment	100%	0%	0%
Rigging, lifting, and hoisting techniques	50%	50%	0%
Fluid system installation:			

	Very Important	Somewhat Important	Not Important
Pneumatic or hydraulic conductor setup (tubing, pipe, hose)	67%	33%	0%
Component alignment and connection:			
	Very Important	Somewhat Important	Not Important
Shaft alignment and coupling methods	67%	33%	0%
Maintenance, repair, and installation operations:			
	Very Important	Somewhat Important	Not Important
Bearings	83%	17%	0%
Gearboxes	67%	33%	0%
Belt drives	83%	17%	0%
Chain drives	67%	33%	0%
Equipment operation and handling:			
	Very Important	Somewhat Important	Not Important
Forklift operation	50%	50%	0%
Tool management and safety - Identification, maintenance, and safe use of:			
	Very Important	Somewhat Important	Not Important
Hand tools	83%	17%	0%
Portable power tools	83%	17%	0%
Stationary power tools	83%	17%	0%
Workplace Hazard Communication:			
	Very Important	Somewhat Important	Not Important
Understanding of HAZCOM and proper usage of Safety Data Sheets	100%	0%	0%
Personal Protective Equipment (PPE) Familiarity:			
	Very Important	Somewhat Important	Not Important
Hearing conservation practices	100%	0%	0%
Proper selection and use of eye protection	100%	0%	0%
Specifications for protective footwear (steel toe, safety toe, or other)	100%	0%	0%

Arc flash PPE requirements	100%	0%	0%
Laser safety precautions	67%	33%	0%
Radiation safety measures	33%	67%	0%
Safety Procedures and Awareness:			
	Very Important	Somewhat Important	Not Important
Confined space entry procedures, including permit-required spaces	83%	17%	0%
Material handling and lifting safety	100%	0%	0%
Awareness of temperature-related hazards	100%	0%	0%
Machine guarding to prevent interactions with pinch points, nip points, etc.	100%	0%	0%
Establishment and respect of exclusion zones (barricades, light curtains)	100%	0%	0%
Industrial and Material Knowledge:			
	Very Important	Somewhat Important	Not Important
Process categorization (continuous, batch, custom, etc)	17%	83%	0%
Basics of material science (polymers, metals, composites, aggregates)	33%	17%	50%
Principles of materials testing (evaluating hardness, brittleness, compressive and tensile strength)	0%	83%	17%