

The quest for an alternative paradigm of STEM education for young people

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Abstract

With the decline of competencies of science, technology, engineering and mathematics (STEM) in young people, there is a worldwide call for STEM education. While STEM education is important for young people, it is argued that it is equally important to nurture leadership attributes in young people based on an alternative version of STEM education. These STEM attributes include soft skills, trust, empathy and moral character. With the emergence of service economies, soft skills (particularly interpersonal cooperation and communication) and gaining trust from others are important attributes for adolescent development. With the decline in empathy in young people, there is a need to help young people understand the feelings and experience of other people. Finally, possessing good moral character is a core element of thriving youth development and successful leadership according to many theorists in different cultures.

Keywords: STEM education, soft skills, trust from others, empathy, moral character, leadership

Introduction

The acronym "STEM" stands for science, technology, engineering, and mathematics, which has received increasing attention on the agenda of educational reforms in the United States and many other countries in recent years. These four domains of STEM have been regarded as "cultural achievements that reflect people's humanity, power the economy, and constitute fundamental aspects of our lives as citizens, workers, consumers, and parents" (1). The term "STEM" was firstly used by the National Science Foundation in early 1990s and was subsequently used by numerous higher education institutions and academic communities.

The quest for STEM education has been propelled by two factors. First, the development of STEM

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education is largely driven by the challenge of globalization and global economic competition. As innovation-related industries have a high potential to create more value-added jobs (2), STEM education is viewed by many countries as a strategy to address the needs to improve future employment prospects for the next-generation workers, which consequently increases national competitiveness (3). The second factor leading to the STEM movement is the widespread concern about the low STEM literacy amongst high school graduates in the United States (4). For example, according to the results of the Programme for International Student Assessment (PISA), American students only ranked in the middle in both math and science literacy out of 40 participating countries (5).

With specific reference to the decline in STEM literacy in the students in the United States, new initiatives have been proposed to foster the development of STEM education. Since the new millennium, several reports advocating STEM education have been published (6). In the report entitled "Rising Above the Gathering Storm" (7), the importance of designing a strong educational program to nurture innovative scientists and engineers in the 21st century is emphasized. In the "America COMPETES Act" in 2007, it is proposed to expand the existing STEM education programs and attention to technology and engineering (4,8). The Obama administration's "Race to the Top" competitive grant program clearly put STEM priority (9). In the initiatives entitled "A framework for K-12 Science Education" (10) and "Next Generation Science Standards" (11), significant provision of the integration of the four disciplines of STEM education is included.

While STEM education is as important as the development of scientific mindset and knowledge in young people, it alone does not help to nurture holistic development in young people. There are four reasons why STEM education alone is not enough. Primarily, from the holistic development perspective, skills, and knowledge in the areas of science, technology, engineering, and mathematics are just part of the education one should receive. Besides STEM, there are other areas of study, such as language, general education, and physical education. Second, as there are research findings showing that positive development of young people, such as empathy and a

sense of social responsibility, is declining, there is a need to re-think how we can promote positive development in young people. For example, there is research showing that empathy in young people is declining throughout years while there has been an increase in egocentrism. Besides, Twenge and Donnelly (12) showed that there had been a shift in values from intrinsic motivation (e.g., learning for learning sake) to extrinsic motivation (learning for making money) from 1971 to 2014.

Third, it is obvious that the global economy is changing from an industrial mode to a post-industrial mode. In the industrial society, following orders (such as production in an assembly line) and top-down management are emphasized. On the other hand, workers are expected to be innovative and creative (i.e., not just following orders) and the supervisor-supervisee relationship is more egalitarian under the service economies (13). Against this background, one should ask what desired attributes young people should have under the service economies. For example, to have a smooth relationship between service providers and service recipients, one should have good communication skills. Besides, getting the trust from the service recipients and the co-workers is basic to transaction in service economies.

Finally, contemporary universities have been criticized as overlooking the traditional mission of universities. Twenge and Donnelly (12) explicitly remarked that colleges and universities are too market-driven. Dalton and Crosby (14) also pointed out that contemporary universities neglected the inner qualities of students, including value system, character, and social responsibility. Furthermore, employers have also criticized that contemporary university education fails to nurture graduates who can meet the demands of the real world.

In view of the above arguments, it is argued that besides STEM education in the science, technology, engineering, and mathematics fields, we should look for an alternative version of STEM education for young people (soft skills, trust, empathy, and moral character) which are important in the changing service economies. In terms of the requirements of service economies, these are essential attributes for leaders to provide quality service. From the perspective of positive youth development, these qualities are intrinsic to the optimal development of young people.

Soft skills

According to Rao (15), although the term “soft skills” was coined in the 1970s, it only gained renewed attention in the 1990s. As these skills are highly valued by employers, they are also regarded as “employability” skills. Generally speaking, while hard skills are formal, professional or technical knowledge which are commonly acquired through formal training, soft skills are informal, personal, and implicit knowledge which may be acquired through formal and informal training. According to Grugulis and Vincent (16), soft skills include “communication, problem-solving, team-working, an ability to improve personal learning and performance, motivation, judgement, leadership and initiative” (16).

Besides, soft skills have been regarded as “transferable” skills which can be applied in different contexts. After synthesizing related materials in the literature, Andrews and Higson (17) suggested that transferable soft skills and competencies leading to employability include “ability to cope with uncertainty, ability to work under pressure, ability to plan and think strategically, capability to communicate and interact with others, either in teams or through networking, good written and verbal communication skills, information and communication technology skills, creativity and self-confidence, good self-management and time-management skills, and willingness to learn and accept responsibility” (17). According to the National Soft Skills Association, there are ten top soft skills as follows (<http://www.nationalsoftskills.org/top-10-soft-skills-for-success>):

- Dependability – degree of trust by others
- Motivation – energizing oneself to complete tasks and to motivate others and the organization
- Communication – skills that facilitate human interaction including both verbal and non-verbal communication skills
- Commitment – delivering the best and sense of loyalty to the tasks and the organization
- Creativity – see things and doing things from a new angle
- Problem Solving – handling issues and difficulties

- Flexibility – open to different possibilities and easily adjusting to change
- Teamwork – ability to work together with others in a harmonious and efficient manner
- Leadership – guide oneself, others, and the organization
- Time Management – work-life balance, coping with workload, and making priorities

According to Kechagias (18), there are 13 personal attributes and eight key skills in employability. For the personal attributes, they include loyalty, commitment, honesty and integrity, enthusiasm, reliability, personal presentation, common sense, positive self-esteem, sense of humor, balanced attitude to work and home life, ability to deal with pressure, motivation, and adaptability. For the key skills, they include communication skills, team-work skills, problem-solving skills, planning and organizing skills, and self-management skills. Other conceptual models on the contents of soft skills can be seen in Table 1 and Table 2.

Soft skills are also important from the perspective of potential employers. The 2013 Global Employability Survey (19) was conducted in 20 countries involving 2,700 respondents who were experienced managers. The objective was to understand their perceptions of the “ideal university” and “employable university graduate” from a corporate perspective. Regarding the top three attributes of an ideal university, they included “practical know-how,” “integration of theories and practical knowledge,” and “provision of soft skills.” In fact, more than 90% of employers/managers maintained that an ideal university should include “soft skills” in its curriculum. Besides, personality, such as interpersonal skills and attitude, was regarded as the main success factor in a company and was more important than technical “know-how.” According to the Times Higher Education (20), in a survey conducted by the Association of American Colleges and Universities, only one quarter of the employers felt that the graduates had good preparation in soft skills, such as critical thinking, logical reasoning, problem-solving, and effective communication. Although soft skills were regarded as important attributes of university graduates, the students did not feel that the related education was adequate. The Higher Education

Academy in the United Kingdom also conducted a student engagement survey amongst roughly 24,000 undergraduates (21). While the students reported that they had much gains in “hard skills,” gains in “soft skills” (e.g., citizenship, creativity, and personal values) during their university years were little.

Trust by others (dependability)

Interpersonal trust is very important in human social relationships. Without interpersonal trust, no in-depth social relationship can be formed. According to some

theorists, interpersonal trust is a multidimensional concept. For example, Rotenberg (22) argued that trust includes reliability (i.e., the fulfillment of a promise), emotional response (i.e., reliance on others to refrain from engagement in inappropriate social behaviors), and honesty (i.e., telling the truth). Holmes and Rempel (23) maintained that trust in interpersonal relationship includes predictability (one’s behavior is consistent), dependability (one is honest or reliable), and faith (one is responsive and caring intrinsically).

Table 1. List of soft skills

1. Growth mindset	– Readiness to improve oneself
2. Self-understanding	– Strengths and weaknesses
3. Emotion regulation	– Emotional management; emotional quotient
4. Self-confidence	– Having faith in one’s ability; self-efficiency
5. Stress management	– Maintaining a balanced life during challenging situations; good emotional health
6. Resilience	– Thrive under adversity; ability to bounce back in adversity
7. Ability to forgive and forget	– Accept the mistakes of oneself and others; transcendence
8. Persistence and perseverance	– Never give in or give up
9. Patience	– Give time for things to take place
10. Perceptiveness	– Be sensitive to people, environment, life and the tasks
11. Communication skills	– Able to give and receive messages efficiently
12. Teamwork skills	– Can work efficiently with different people
13. Interpersonal relationship skills	– Social skills and interpersonal skills
14. Presentation skills	– Effective presentation skills
15. Management skills	– Effective ways to manage the organization
16. Facilitating skills	– Integrate different views to form consensus
17. Selling skills	– Facilitate buy-in
18. Management skills	– Building an effective team
19. Leadership skills	– Forming and passing on vision
20. Mentoring/coaching skills	– Guide colleagues for career development
21. Managing upwards skills	– Maintaining good relationships with one’s supervisor
22. Self-promotion skills	– Build up one’s reputation
23. Skills in dealing with difficult personalities	– Achieve outcomes although people are difficult
24. Skills in dealing with difficult/unexpected situations	– Effective in view of difficulty
25. Savvy in handling office politics	– Wisdom and skills in dealing with office dynamics
26. Influence / persuasion skills	– Able to change others’ views
27. Negotiation skills	– Ability to get a “win-win” outcome
28. Networking skills	– Ability to build up personal network

Note. 1-10 are self-management skills whereas 11-28 are people skills. Han L. Soft skills list - 28 skills to working smart. Learn Soft Skills - Work Smart and Achieve More. Available at: <https://bemycareercoach.com/soft-skills/list-soft-skills.html>.

Table 2. 87 soft skills proposed by Mar (2016)

COMMUNICATION SKILLS	INFLUENCING	CREATIVITY
1. Verbal Communication	31. Facilitation	61. Problem-solving
2. Body Language	32. Selling	62. Critical Thinking
3. Physical Communication	33. Inspiring	63. Innovation
4. Writing	34. Persuasion	64. Troubleshooting
5. Storytelling	35. Negotiation	65. Design Sense
6. Visual Communication	36. Motivating	66. Artistic Sense
7. Humor	37. Collaborating	
8. Quick-wittedness		
9. Listening	INTERPERSONAL SKILLS	PROFESSIONAL SKILLS
10. Presentation Skills	38. Networking	67. Organization
11. Public Speaking	39. Interpersonal Relationships	68. Planning
12. Interviewing	40. Dealing with Difficult People	69. Scheduling
	41. Conflict Resolution	70. Time Management
LEADERSHIP	42. Personal Branding	71. Meeting Management
13. Team Building	43. Office Politics	72. Technology Savvy
14. Strategic Planning		73. Technology Trend Awareness
15. Coaching	PERSONAL SKILLS	74. Business Trend Awareness
16. Mentoring	44. Emotional Intelligence	75. Research
17. Delegation	45. Self-awareness	76. Business Etiquette
18. Dispute Resolution	46. Emotion Management	77. Business Ethics
19. Diplomacy	47. Stress Management	78. Diversity Awareness
20. Giving Feedback	48. Tolerance of Change and Uncertainty	79. Disability Awareness
21. Managing Difficult Conversations	49. Taking Criticism	80. Intercultural Competence
22. Decision Making	50. Self-confidence	81. Training
23. Performance Management	51. Adaptability	82. Train the Trainer
24. Supervising	52. Resilience	83. Process Improvement
25. Managing	53. Assertiveness	84. Knowledge Management
26. Manager Management	54. Competitiveness	85. Writing Reports and Proposals
27. Talent Management	55. Self-leadership	86. Customer Service
28. Managing Remote Teams	56. Self-assessment	87. Entrepreneurial Thinking
29. Managing Virtual Teams	57. Work-life Balance	
30. Crisis Management	58. Friendliness	
	59. Enthusiasm	
	60. Empathy	

Mar A. 87 soft skills (The big list). Simplicable 2016. Available at: <http://training.simplicable.com/training/new/87-soft-skills>.

The quality of interpersonal relationship one encounters determines the nature of trust. For example, the experience of having a reliable caregiver affects children's expectations in social relationships and shapes children's future interactions with others (24). In adolescence, trust from other people is based on trust beliefs and trustworthy behaviors. Rotter (25) showed that individuals' trust beliefs were related to trustworthy behavior. If adolescents have low trust beliefs, they will engage in untrustworthy behaviors (e.g., not keeping promises and not respecting confidential information) which make them lose trust from others (26).

Trustworthiness is a virtue of adolescents and it is a psychosocial competence to be developed. Interpersonal trust is important for adolescent development for several reasons. First, through the development of interpersonal trust, young people would acquire an enhanced self-understanding such as their own trust beliefs and their trust behavior (e.g., keeping promises, being honest and reliable), and the process would help them develop their self-identity. Participants who had trust from peers also showed higher levels of prosocial behavior because such behavior is congruent with their attribute of trustworthiness (27).

Second, trust from others is vital to the formation and development of positive relationships with the significant-others, including parents, peers, and teachers (28). There is evidence showing that interpersonal trust promotes positive peer relationship which leads to stronger social bonding (26). Rotenberg et al. (29) indicated that children who are trustworthy had more friends, were welcomed by others and had better peer relationships. Besides, Rotenberg and Boulton (26) showed that adolescents with high trustworthiness from peers were high in both trustworthiness and trust beliefs.

Third, trust by others can promote the psychological well-being of children and adolescents. Rotenberg et al. (29) found that interpersonal trust was negatively associated with depressive symptoms and loneliness but positively associated with self-esteem. In the academic domain, when a teacher trusts the students, the students tend to have good academic performance (30). Besides, trust between teachers and students mediated the relationship between school deprivation and academic achievement (31). Besides,

lack of parental trust was associated with a higher risk of illegal and violent behavior in adolescents (32). In contrast, higher parental trust was related to lower engagement in sexual activity and lower risky sexual behavior (33).

Empathy

Empathy is an important developmental domain in human interaction. While some theorists regarded empathy as a one-dimensional construct (34), others argued that it is a multi-dimensional concept involving both emotional and cognitive components (35). Emotional empathy can be regarded as the ability to feel the emotions of others whereas cognitive empathy refers to the ability to understand others' thoughts (36). Davis (37) proposed "personal distress" as the third dimension which refers to having negative feelings when experiencing negative emotions of others.

Because of cognitive maturation in the adolescent years, young people begin to have better ability to perceive and understand others' emotions and thoughts (38), which contributes to empathy towards others. Besides, the changing social roles and escalation in social responsibilities help to promote the sensitivity of adolescents to others' thoughts and emotions (39). There are research findings showing that there was an increase in cognitive empathy amongst adolescents aged 13 to 18 years.

The development of empathy is important for several reasons. First, it helps to shape morality and social behavior among children and adolescents (40). Theoretically, researchers assume that empathy, especially affective empathy, is negatively associated with delinquent behaviors (41). Empirically, Jolliffe and Farrington (35) found that low emotional empathy was directly related to bullying amongst male adolescents (aged 13-17 years); aggressive adolescents also typically showed low levels of empathy (42). Research studies also show that high empathy inhibits aggression and anti-social behaviors in children and adolescents (43).

Second, empathy is positively associated with prosocial behaviors such as cooperation with others (44). According to Batson's empathy-altruism hypothesis (43), empathy strengthens altruism and the

motivation to help which is supported by some studies (45). Research also shows that empathy has positive impacts on the adolescents through motivating prosocial behaviors, and prosocial behaviors in turn facilitate the adolescents to have better peer relationships (46), increased general well-being (47), and better school performance (48).

Third, empathy promotes positive development in adolescents. Research showed that empathy decreases anxiety and distress (49), and contributes to reduced violent behavior (50). Empathy also promotes adolescent development in the long run. In their 23-year longitudinal study, Allemand, Steiger, and Fend (51) demonstrated that adolescent empathy at 12 to 16 years predicted social competencies at 35 years. Besides, research showed that empathy and emotional intelligence promote the emergence and effectiveness of leadership and entrepreneurship, with followers of empathic leaders experiencing less physical and psychosomatic symptoms (52).

Empathy is an important developmental ideal from the positive youth development (PYD) perspective (53). PYD is a strength-based approach that views youths as resources to be developed instead of problems to be solved. Roth and Brooks-Gunn (54) referred PYD to a “5 Cs” model which includes competence, connection, character, confidence, and caring. Among which, caring is defined as “a sense of sympathy and empathy for others” (54). Therefore, the development of empathy is indispensable for positive youth development. Hence, to nurture young people to be leaders, it is essential for them to develop their competence.

Moral character

In many cultures, children are taught to learn basic knowledge about survival. However, besides education for survival, many cultures also emphasize the importance of moral values regarding the differentiation between “good” and “bad.” Generally speaking, educators, parents and the general public expect the children to possess the ability to differentiate between “right” and “wrong.” Without such ability, the society will simply be chaotic without law and order. Hence, moral character is emphasized in many cultures.

Primarily, children and adolescents should acquire mature moral reasoning (i.e., ability to differentiate between right and wrong moral behavior). According to Kohlberg (55), there are three levels of moral development. In the pre-conventional level, moral behavior is driven primarily by physical consequences and considerations. In the first stage, human beings are driven by avoidance of punishment. For example, an adolescent does not cheat in examination because he/she does not want to be punished. In the second stage, human beings do good things because of rewards. For example, a student works hard in his/her studies because such good behavior would lead to desirable physical consequences such as scholarships. In the second level (conventional level), human moral behavior is governed by social norms and conventions. In the third stage, students perform good behavior because they will be praised by others. In other words, morality at this stage is “good boy or good girl” morality. In the fourth stage, a person does something good because of duty or obligation. For example, a student obeys the law because he/she knows that it is the duty of a citizen. According to Kohlberg, the moral development of many people stops at this stage (i.e., fulfilling the duties as a member of a community). As for the youth development, young people should be socialized to obey laws of the society and fulfill the basic duties of a citizen.

However, morality does not stop at the conventional level in Kohlberg’s model. In the post-conventional level, a person acts in a moral manner because of reasons that transcend physical and social considerations. In Stage 5, a person’s engagement in moral behavior is based on the “law behind the law” or the principle of social contract. For example, an adolescent does not spit not because of the fear of punishment or receiving bad comments from other people. Instead, he/she does not spit because he/she believes that this is not hygienic and may cause disease in the community. Hence, the law behind the law (i.e., social contract) is placed at the highest priority. In the final stage of Kohlberg’s theory, it is proposed that a person will act in a moral manner according to the universal ethical principles, such as love and justice. For example, a person does not spit because he/she believes it is not an act of love. Obviously, the post-conventional level of moral

development is developmental ideal for youth development. Young people should learn social contract as well as universal ethical moral principles.

Besides moral reasoning proposed by Lawrence Kohlberg, there are other views suggesting that young people should acquire moral competence. According to Catalano et al. (56), moral competence is a basic positive youth development construct which shapes the development of young people. It is defined as “a youth’s ability to assess and respond to the ethical, affective, or social justice dimensions of a situation” and includes “a sense of right and wrong, or a sense of moral or social justice” (56). Similarly, Park and Peterson (57) argued that “moral competence among adolescents can be approached in terms of good character” (57). They further defined good character as “a family of positive traits reflected in thoughts, feelings and behavior” (57) and character strengths as the “subset of personality traits on which we place moral values” (58). Park, Peterson, and Seligman (59) proposed that there are 24 universally-valued character strengths that can be subsumed under six dimensions. These include wisdom and knowledge (creativity, curiosity, love of learning, open mindedness, perspective), courage (authenticity, bravery, persistence, zest), humanity (kindness, love, social intelligence), justice (fairness, leadership, teamwork), temperance (forgiveness, modesty, prudence, self-regulation) and transcendence (appreciation of beauty and excellence, gratitude, hope, humor and religiousness).

Moral competence is also strongly emphasized in the leadership literature. According to Jormsri et al. (60), moral competence in nursing practice includes moral perception, moral judgment and moral behavior which has several dimensions including loving kindness, compassion, sympathetic joy, equanimity, responsibility, discipline, honesty, respect for human dignity, as well as values and rights. Similarly, Morales-Sanchez and Cabello-Medina (61) argued that there are four universal moral competencies which shape ethical decision-making. These competencies could be conceived as moral virtues which include prudence (e.g., reason, sagacity, docility, reflection, and caution), justice (e.g., performance of fair acts, doing the “just” things), temperance (e.g., self-control, moderation, chastity, honesty, humility) and fortitude (e.g., patience, perseverance, moral

courage). According to them, moral competence is character strength which is stable and can facilitate good behavior. Similarly, Gini and Green (62) argued that there are ten virtues of outstanding leaders, including deep honesty, moral courage, moral vision, compassion and care, fairness, intellectual excellence, creative thinking, aesthetic sensitivity, good timing, and deep selflessness.

Moral character is also strongly emphasized in the Chinese culture (63). In the Confucian thoughts, virtues are emphasized particularly in the development of children and adolescents. In “ba de” (eight cardinal virtues), the virtues include “zhong, xiao, ren, ai, xin, yi, he, ping” (loyalty, filial piety, benevolence, affection, trustworthiness, righteousness, harmony, peace). In “si wei” (four pillars of society), the virtues are “li, yi, lian, chi” (propriety, righteousness, integrity, shame). In “wu chang” (five constant virtues), the virtues include “ren, yi, li, zhi, xin” (benevolence, righteousness, propriety, wisdom, trustworthiness).

In particular, several virtues were emphasized in the traditional Chinese culture. First, strong emphasis is placed on the attainment of high morality. As stated in the *Great Learning*, “the way of great learning consists in manifesting one’s bright virtue, consists in loving the people, consists in stopping in perfect goodness” (*daxue zhi dao, zai ming mingde, zai qinmin, zai zhiyu zhishan*). Similar emphasis can be seen in *Di Zi Gui* (64), “neither be harsh on myself, nor give up on myself; to be a person of high ideals, moral standards and virtue is something we can all attain in time” (*wu zibao, wu ziqi, sheng yu xian, ke xunzhi*).

Second, there was a strong emphasis on self-reflection, as exemplified in the Confucian principle of “*wu ri sanxing wushen*” (I daily examine myself on three points). In *Di Zi Gui*, it is maintained that “*jian ren e, ji neixing, you ze gai, wu jiajing. Wei dexue, wei caiyi, buru ren, dang zili*” (when I see others do wrong, I must immediately reflect upon myself. If I have made the same mistake, I will correct it. If not, I will take extra care not to make the same mistake. When my morals, conduct, knowledge, and skills seem not as good as those of others, I will encourage myself to be better).

Finally, there is a strong emphasis of trustworthiness (“xin”) in the traditional Chinese

culture. Basically, trust is fundamental to human interactions and is vital to intimate human relationships. As Confucius once said, “*ren er wu xin, bu zhi qi ke*” (I do not know how a man without truthfulness is to get on). Teaching children to have trustworthiness is also very important, as exemplified in *Di Zi Gui* - “*fan chuyan, xin wei xian, zha yu wang, xi ke yan*” (When I speak, honesty is important. Deceitful words and lies must not be tolerated).

While moral character is an important developmental outcome, there are several obstacles hindering its development in young people, particularly in Hong Kong. First, with the decline of the traditional Chinese cultural influence, moral development in young people is receiving less attention. Although some traditional values, such as filial piety, are still strong in Hong Kong, other traditional values, such as emphases on reflection and humility, have weakened. Second, as Hong Kong is a pragmatic society, materialism and academic achievement are strongly emphasized. In contrast, focus on spiritual values, such as putting the interest of others above oneself, is not the main trend. Third, with the emergence of post-modern thoughts, there is a view that morality is in fact socially constructed and there is no absolute right or wrong behavior because morality is basically relative. Fourth, with the rise of marital disruption and a fewer number of children in the family, family as an important base of moral socialization has weakened. Fifth, although moral education is included in the formal curriculum, it is not strongly emphasized because going to university does not depend on the moral behavior of a student. As a result, the importance of moral development in students is more a slogan than a well-implemented educational policy.

Conclusion

STEM education is important because these four elements are vital to the technological advance and human progress. STEM education aims to promote students' interests in these areas. For some theorists, they argue that STEM alone is not enough and they add “arts and design” in the acronym to make the whole thing as “STEAM.” The basic argument is that STEM is without meaning without design concepts.

In this paper, it is proposed that an alternative form of STEM education is needed and the acronym stands for soft skills, trust, empathy and moral character. These attributes are important from two perspectives. First, from the holistic youth development perspective, the proposed elements are important for youth development. In fact, in many theories on positive youth development, the alternative STEM elements are emphasized. Second, with the changing global economy from manufacturing to service economies, the alternative STEM elements are important because of the intensive human interactions under service economies. Without soft skills (such as emotional quotient), trust, empathy and moral character, effective leadership in service economies would not be possible (13).

Ethical compliance

The authors have stated all possible conflicts of interest within this work. The authors have stated all sources of funding for this work. If this work involved human participants, informed consent was received from each individual. If this work involved human participants, it was conducted in accordance with the 1964 Declaration of Helsinki. If this work involved experiments with humans or animals, it was conducted in accordance with the related institutions' research ethics guidelines.

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