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Reviewing Problem-solving as a key employability skill for built environment graduates

John Aliu[1], Clinton Aigbavboa[2]

[1] University of Johannesburg, Johannesburg, South Africa.
[2] Sustainable Human Settlement and Construction Research Centre, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa.
[3] Springer Publishing, 69121 Heidelberg, Germany
Ajseries77@gmail.com

Abstract. The benefits of possessing problem-solving skills cannot be over-emphasised. From fresh graduates to industry employees, this skill is pivotal in achieving one's goals as well as functioning effectively in the construction industry. Several researchers have suggested that industry employers value graduates who possess practical problem-solving competencies and can deliver timely and implementable solutions to arising industry problems. Hence, this paper focuses on the benefits of possessing problem-solving abilities and possible ways to foster them in higher education. This study was conducted via a review of relevant literature from peer-reviewed journals and conference articles from databases including EBSCO Host, ProQuest, SciVal, Springer, Taylor and Francis online, Emerald, amongst others. Notable findings from this study revealed that brainstorming, Root Cause Analysis, Cause and Effect Diagram, Pareto chart, Flowcharting and decision matrix are among some of the ways by which problem-solving skills are developed in higher education institutions (HEIs). The study also found that problem-solving skills could be developed among students by moving from teacher-centred approaches to student-centred approaches. These range from case-based teaching, discovery learning, problem-based and project-based learning amongst others. It is recommended that present-day HEIs engage built-environment students even more by integrating project-based activities into their curricula, to holistically prepare the next generation of industry professionals.

Keywords: Problem-Solving Skills, Higher Education, Student-Centered Approaches, Construction Industry, Employability.

1 Introduction

The present-day construction industry remains an integral part of the global economy and shapes the built environment and quality of life for people around the world. It is a sector that has become dynamic, uncertain and continuously evolving and has increased the need for adequately skilled professionals such as architects, engineers, surveyors, town-planners amongst others to handle its activities [1]. In meeting the needs of the construction industry, graduates are required to possess several non-academic skills and competencies apart from their academic knowledge. These skills include communication skills, leadership skills, time-management skills, decision-making skills, teamwork skills, critical thinking skills, leadership skills, organisational skills, numeracy skills and problem-solving skills [2]. Hence, this study primarily focuses on problem-solving skill, which has become a critical requirement for industry employers in recent times.

The capacity to proffer solutions to arising problems has been identified as a desirable attribute of graduates across various studies. The study by [3] and [4]

describes problem-solving as the ability to be creative and practical in handling industry problems. The study by [5] also listed problem-solving as one of the critical attributes to be possessed by graduates heading into the construction industry. They describe it as the ability to strive towards achieving positive results despite a steep path in identifying and analysing problems. Problem-solving is also identified as various ways of thinking outside the box, improving one's thinking skills and providing alternative solutions to arising industry problems [6]; [7]; [8]; [9]. The benefits of possessing problem-solving skill cannot be overstated. The current and incessant demands of the industry, coupled with an increasingly complex society have increased the need for higher education to develop critical thinking and problem-solving abilities among students [10]. The uncertain and continuously changing nature of the industry has prompted graduates to become more proactive in taking initiatives, acting responsibly and thinking critically on various ways to solve problems and proffer solutions. Against this backdrop, this paper examines the importance of possessing this skill and different ways that universities can develop this competency among students before they graduate.

2 What does Problem-solving entail?

Several researchers and academia facilitators have adequately discussed what problem-solving entails. Problems are merely needs or goals that must be met [11]. In a case where the path towards achieving that goal looks uncertain, the process of moving towards that goal despite the uncertainties is a perfect picture of what problem-solving entails [12]. This explanation mirrors the definition posited by [13], [14], and [15], who describe problem-solving as an activity that enables an individual to achieve a coherent process seeking solution even when not clear on how to reach the desired state.

[16] and [17] describe problem-solving as "*the self-directed cognitive-behavioural process by which a person attempts to identify or discover effective and adaptive solutions for specific problems encountered in everyday living*." This description supports their definition of 'problem' that describes it as any "*life situation or task that demands a response for adaptive functioning, but no effective response is immediately apparent or available to person or people confronted with the situation because of the presence of one or more obstacle*." The explanation by [18] describes problem-solving as a goal-oriented systematic approach that requires a mental capture of the problem and the adoption of strategies to achieve a desired goal or outcome. Several researchers have distilled problem-solving strategies into several steps. The four steps presented by [19] includes locating and defining the problem, hinting at possible solutions, ascertaining the implications of the solution and result observations [19]. [20] problem-solving strategy also involves four steps including understanding the problem, formulating a plan, executing the plan and reflecting on the process and results. A further six problem-solving steps were presented in [21] model. They include identifying the problem, gathering and accumulating pertinent facts, defining the problem, drawing up possible and alternative solutions, identification and selection of the best solution and execution of the solution. The first three steps highlight the problem definition phase while the next three steps deal with the solution identification and implementation phase.

Problem-solving further involves several interdependent and interactive capacities and a wide range of human process and abilities as shown in Figure 1. The diagram also illustrates various interchangeable concepts of problem-solving that include

memory, intelligence, reasoning/logic, meta-cognition, motivation, learning, creativity and intuition.

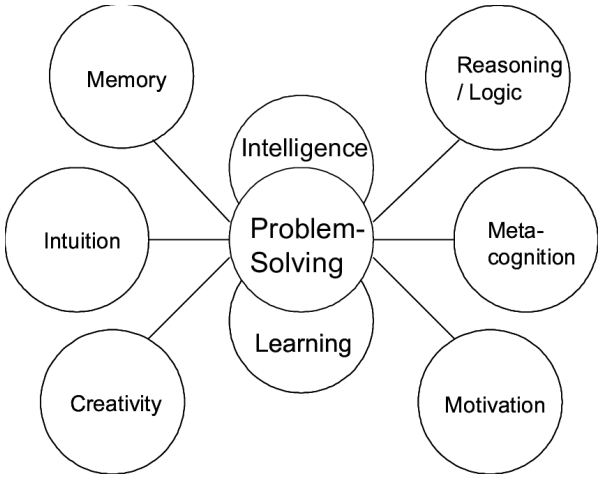

Figure 1: Capacities relating to Problem-solving (Adams *et al.*, 2008).

As seen in Figure 1, there is a strong correlation between problem-solving and several human processes and cognitive abilities. Several studies have suggested that students who possess a higher level of metacognitive competencies quickly master the art of problem-solving [22]; [23]. This is because the problem-solving process involves several operations that deals with planning, analysing, monitoring, organising and monitoring strategies in solving problems. These operations require one to employ creativity, reasoning, logic and memorising that constitute several elements of metacognition.

3 Problem-solving skill tools in higher education

Over time, numerous researchers have proposed several techniques adopted by higher education in stimulating the critical thinking and problem-solving abilities of students. [24] insists these proficiencies are critical competencies students have to develop to experience industry success after graduation.

One of the techniques used to develop these competencies is Brainstorming (BS). This technique involves the spontaneous exchange of ideas among team members to proffer solutions to practical problems, hence leading to increased productivity [25]; [26]. Also known as a technique that stimulates the ability to generate ideas and creative solutions thoughtfully, brainstorming fosters the development of problem-solving competencies among students [27] ; [28] ; [29] ; [30].

Another problem-solving technique is the deployment of the Root Cause Analysis (RCA). The objective of this method is to determine the fundamental cause of a setback, problem or incident [31]. Unlike other methods that address problematic symptoms, RCA advocates that problems can be resolved by addressing their root causes from the onset. Considered as an iterative process, RCA addresses the underlying causes of a problem to prevent the problem from reoccurring [32].

During a team-approach in problem-solving, establishing the relationships between the identified problem and its potential cause is valid through the adoption of a Cause and Effect Diagram.

Also known as a fishbone, educators visually display various potential causes for a particular problem that can stimulate innovative ideas among students. This method is suitable for group settings during brainstorming sessions in which there is limited quantitative data available for analysis. The fishbone also provides a platform for students to demystify issues thoroughly, resulting in a more robust solution [33]; [34].

Furthermore, another problem-solving tool is the Pareto chart. Named after Vilfredo Pareto, the Pareto chart consist of bars and graphs depicting the contributing factors to the more significant problem. When adopted by educators, it provides students with the various grey areas that need full focus to achieve results. Pareto charts are utilised when the need to focus on the most significant problem out of several of them is required [35].

Flowcharting is another technique by which problem-solving skill can be fostered among students. Flowcharts are easy-to-understand maps or diagrams that illustrate the various sequential steps or stages in achieving a process. They provide students with the ability to understand the various processes, hence improving their organisational competencies, an attribute of problem-solving [36] ; [37].

Finally, when students face a conundrum of multiple choices and many variables, a decision matrix can provide pivotal pointers in making a best or final option or decision. This quantitative method is designed by arranging the alternatives decisions on the left-hand rows and the selection criteria on the column sections. The rows are rated and examined against the columns to arrive at the best or final option or decision [38] ; [39].

4 Implications for higher education

From the above discussion, the process of displaying attributes and competencies in proffering solutions to arising industry problems and challenges can be regarded as a critical non-academic skill. Problem-solving skills refer to the ability of students to define the problem, think critically, display credibility and accuracy, reflect on ideas, be organised and efficient, exhibit flexibility, generate potential solutions, analyse results and apply solutions. Simply put, students with problem-solving skills tend to exhibit self-confidence and can think creatively and work independently. In developing these abilities, the traditional lecture-room approaches are just not enough. By moving from a teacher-centred approach to a student-centred approach, these set of skills could be enhanced among students. These approaches range from case-based teaching, discovery learning, problem-based and project-based learning amongst others. When deployed and adopted by higher education educators, these student-centred approaches engage students in the learning process via exposure to real-life (real-world) projects. Apart from spicing up the learning process, these student-centred approaches provide students with multi-step problems to stimulate their creativity and critical thinking abilities, hence improving their problem-solving skills.

5 Lessons learnt and conclusion

The benefit of possessing problem-solving skills is a critical requirement for graduate success in the world of work. The current and incessant demands of the industry, coupled with an increasingly complex society have increased the need for higher education to develop thinking and problem solving among students. As a collection of required skills, problem-solving is the ability to determine what problem exists and gaining critical insights to suggest possible solutions. It also deals with identifying realistic outcomes and alternative solutions in a given problematic situation. From the study, problem-solving skills involves several attributes. They include the ability to - defining the problem, think through a plethora of ideas, emphasise credibility and accuracy, reflect on the thought-process, be organised and efficient, exhibit flexibility, generate potential solutions and analyse results. From this study, Problem-solving skills are developed through various tools including brainstorming, Root Cause Analysis, Cause and Effect Diagram, Pareto chart, Flowcharting and decision matrix. Furthermore, students can be fully equipped with problem-solving skills if higher education establishes collaboration with the construction industry. The exposure to industry equipment and access to up-to-date technical information further develops this repertoire of skills among built environment students.

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