Do the Universities Have a Designed Infrastructure to Measure and Develop Student Outcomes? A Model Offer

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Abstract

The Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology revised its Criterion 3 student outcomes in fall 2017. Student outcomes represent the competencies we expect from students to have before they graduate from universities. When we talk about an "outcome" we mean an "observable behavior" which also forms a dimension of a competency. Generally, universities focus on measuring "knowledge", also a dimension of a competency which is the easiest to measure. Do the universities have a well-designed infrastructure to measure and develop student outcomes which are not related only with knowledge. The verbs used in Criterion 3 student outcomes like; apply, design, conduct, use, communicate, function are mostly action based verbs and needs to be measured by using different tools other than brain-based assignments like written/oral exam, project or term paper.

In this study, a draft model of measuring student outcomes is offered. This model mainly contains "Potential Assessment Center (PAC)" application and "Individual Development Plan (IDP)". PAC is a process where assessors work with students to collect evidence of an outcome (competence), using the tools (exercises) tailored specially for the purpose of measuring the student outcomes that comprise the Criterion 3. PAC process will be formed by different tools such as group exercise, simulations, analysis and presentation, brainstorming, role playing, etc. The PAC process should be applied by professional assessors who have background on using the measurement tools. All other supporting information including faculty members' observations in class and assignment results will be integrated into the student's final report driven from PAC applications.

Collecting results from all these channels of information about the student, we can get better conclusions on development needs of the students with higher validity. PAC applications should start at the second year of a 4-year program and students should be supported by another stage called as "Individual Development Stage" which is designed to develop the areas of development identified during the PAC process. Individual development stage should start in the second half of the 3rd year, so that students may have enough time to develop their development areas before graduation.

Relating "Student Outcomes" with the concept of "Competency"

The Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology revised its Criterion 3 student outcomes in fall 2017. The seven new student outcomes resulted, enumerated 1 – 7, replacing the previous eleven (11) student outcomes, designated a – k (Turner and others 2018). These changes to Criterion 3 will be implemented for the 2019-20 accreditation review cycle.

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1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

3) An ability to communicate effectively with a range of audiences

4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies

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Student outcomes represent the competencies that are expected from students to have before they graduate from universities. When we talk about an "outcome" we mean an "observable behavior" which also forms a dimension of a competency. Generally, universities focus on measuring "knowledge", also a dimension of a competency, which is the easiest to measure. Do the universities have a well-designed infrastructure to measure the student outcomes which are not related only with knowledge. The verbs used in Criterion 3 student outcomes like; "apply, design, conduct, use, communicate, function" are mostly action-based verbs and needs to be measured by using different tools other than brain-based assignments like written/oral exam, project or term paper.

To understand competencies, it is important to define the various components of competencies (University of Nebraska web site).

• *Knowledge* is the cognizance of facts, truths and principles gained from formal education/training and/or experience. Application and sharing of one's knowledge base are critical to individual success.

- A *skill* is a developed proficiency or dexterity in mental operations or physical processes that are often acquired through specialized training; the execution of these skills results in successful performance.
- *Ability* is the power or aptitude to perform physical or mental activities that are often affiliated with a particular profession or trade such as computer programming, plumbing, calculus, and so forth. Although organizations may be adept at measuring results, skills and knowledge regarding one's performance, they are often remiss in recognizing employees' abilities or aptitudes, especially those outside of the traditional job design.
- *Individual attributes* are properties, qualities or characteristics of individuals that reflect one's unique personal makeup. Individual attributes are viewed as genetically developed or acquired from one's accumulated life experiences. Although personal characteristics are the most subjective of the components, a growing, significant body of research links specific personality traits to successful individual and organizational performance.

Defining Potential Assessment Centers (PAC) and the use of PACs in higher education

To predict someone's performance, we should measure his/her potential. In our context, as the purpose can be defined as measuring and developing university or college students' competencies (in general their potential), it should be named as a development center. In order to distinguish the application from the business applications, the author prefers to name it as Potential Assessment Center (PAC), which is a unique concept for higher education.

When we are talking about teaching, another concept which is "learning" comes as a complemental of the process of teaching. The concept of "learning" is defined as; modification of a behavioral tendency by experience (such as exposure to conditioning) (Merriam Webster Dictionary). So, when a student learns something we should expect a behavioral change as a result of learning. Otherwise, we just impose information temporarily to their brains which is not a long-term gain. Tools generally used for assessing student's learning and performance are: Observations, performance tasks, projects/assignments, written and oral exams, tests, visual/oral communication.

Model Proposal on Applying Assessment Centers in Higher Education

Normally, administrators have 4 years of time to measure and develop students' potential (competencies) in universities. This period is half less (2 years) in colleges which creates a challenge to run the same procedure. For the initial stage, we can assume that each student is coming with a satisfactory potential which can be related to the accreditation of the selected faculty or program. Some universities apply tests such as GRE, GMAT, SAT and language efficiency tests which may be accepted as a part of knowledge and cognitive ability dimensions of a competency.

So, how will PAC work during a 4-year of university education? In Figure 1, a draft version of the PAC + IDP process is shown. As mentioned above, normally, students come with their high school diplomas with ACT Scores, in addition to their GRE, GMAT, SAT, TOEFL or IELTS scores (If

wanted). These scores may represent students' cognitive ability and knowledge level as a part of their competencies.

In their 1st year, we aim to collect all the self-assessment data of students by using proper psychometric tools. 2nd year is the year of PAC application. The students will be attending the PAC aware of their selves (at least we hope that they will). 3rd year is the year of individual development. Whatever takes place in IDP should be executed completely by the student. 4th year is the last year of the student in this process. During the last year, second PAC will be applied and the report should be shared in a 1 to 1 feedback session with the student. The report prepared for the first PAC application and the individual SWOT analysis should be compared to see if there is any change.

As can be easily understood, during this 4-year long period, it is the most important to get valid output from PAC application. To increase the validity of PAC applications we need to answer these three basic questions:

1. What to measure as competency set?
2. How to measure these competencies?
3. How to develop the students as we now know their areas of development?

- What to measure as competency set?

The answer to this question is already clear as Criterion-3 which is announced by the Accreditation Board for Engineering and Technology (ABET) involves 7 student outcomes which can be used as a competency set for students.

- How to measure these competencies?

This question is harder to answer than the first question as we need to decide which tools (it is called an exercise in literature related to assessment centers) to use in PAC. Assessment center (AC) exercises can be used to measure many different competencies, including interpersonal skills, oral and written communication, planning and evaluating, reasoning and problem-solving abilities. AC exercises vary widely in their format and the types of skills and characteristics which they are designed to assess.

- How to develop the students as we now know their areas of development?

Once a development need has been defined, the next stage is to form an action plan of how it is to be addressed. The action plan should state the learning objective, the action(s) to be taken or method by which the objective is to be met, and the means of monitoring and reviewing progress.

Discussion & Limitations

One of the gurus on the concept of competency, Richard Boyatsiz together with his colleague Saatcioglu argues that the perfect set of competencies should be formed of three dimensions which are emotional, social and cognitive intelligence (Boyatsiz & Saatcioglu, 2008). After analyzing the latest version of student outcomes from Boyatsiz's perspective, we can say that most of the outcomes match with the social and cognitive competencies, while there is no match for emotional competencies (Table-1).

Student Outcomes:	Emotional	Social	Cognitive
1) An ability to **identify**, **formulate**, and **solve** complex engineering problems by applying principles of engineering, science, and mathematics			X
2) An ability to **apply** engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors		X	X
3) An ability to **communicate** effectively with a range of audiences		X	
4) An ability to **recognize** ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.		X	X
5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, **establish** goals, plan tasks, and meet objectives		X	X
6) An ability to **develop** and **conduct** appropriate experimentation, **analyze** and **interpret** data, and **use** engineering judgment to draw conclusions			X
7) An ability to acquire and **apply** new knowledge as needed, using appropriate learning strategies			X

Table 1: Analysis of EAS Student Outcomes from the perspective of Boyatsiz's definition of competency

From this perspective, we can criticize the student outcomes declared by EAC as the new form of student outcomes don't cover all of these three dimensions of a competency set representing all of the professions.

Another discussion issue is the cost of building and applying the infrastructure of the PAC+IDP model which is not covered in this article. However, whatever it takes for the investment of

building and applying the PAC+IDP model, return of investment (ROI) should be considered in the long term.

Conclusion

Universities and colleges have the most important mission of supplying competent graduates to the workforce of a country. However, a new research, "The education and skills survey" published in The Telegraph (11th July 2017), questioned 344 companies, focusing on graduate recruitment and found out that a third of companies are unhappy with graduates' attitude to work, blaming their lack of resilience, self-management skills, cultural awareness, customer awareness. The report, published by the CBI and Pearson, also found that three-quarters of business employers were looking to increase the number of high-skilled jobs they recruit for, but that %61 feared that they wouldn't be able to fill those roles.

Lots of other most recent research findings use very similar statements as mentioned above. So, in general, we can conclude that employers do not see university graduates competent enough to be hired. And this creates a dilemma between employers' expectations and universities' mission (the reason or their existence). In order to at least offer an infrastructure to give students an opportunity to develop themselves, the PAC+IDP model may be applied by colleges and universities.

References

Boyatzis, R. E., & Saatcioglu, A. (2008). "A 20-year view of trying to develop emotional, social and cognitive intelligence competencies in graduate management education", *Journal of Management Development, 27*(1), pp. 92-108.

Turner, S., Tung K., Cooper, C. (2018), "*Transitioning to the New ABET Student Outcomes: Architecture Development for a Systems Engineering Degree Program*", Article presented at ASEE Annual Conference and Exposition.

University of Nebraska web page: "*The Definition of Competencies and Their Application at NU", Retrieved from:* https://hr.unl.edu/compensation/nuvalues/corecompetencies.shtml/