Understanding Self-Responsibility in Employability Competencies Development as the Key for Engineering Graduates to survive in the labour market

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Abstract

This study examines the perceptions of students and alumni of Australian engineering schools regarding Self-Responsibility (SR) in their employability competencies development process. It employed quantitative methods using a web-based self-report questionnaire to collect data. We found that SR consists of four underlying factors: (1) Autonomy and Self-Initiation (ASI), (2) Sense of Agency (SA), (3) Self-Awareness and Evaluation (SAE), and (4) Self-Management (SM). These factors were further analysed using Factor Analysis (FA) to determine the multidimensionality of SR. The results of this analysis showed the appropriateness of considering SR as a multidimensional concept. The findings have positive implications in helping learners to effectively manage their development process by increasing their level of awareness in four areas: namely (1) Motivation, (2) Control, (3) Human agency and (4) Perspective, with the outcome of enabling educators to assist students enhance their career and advancement prospects.

Keywords

Self-Responsibility (SR), Self-Responsibility Scale (SRS), employability, competencies development, Australian engineering students and graduates

1. Introduction

The concept of employability has been viewed as the key to increase possibilities for gaining a job, particularly related to the capability of an individual to "gain initial employment, maintain employment and obtain new employment if required" (Hillage, Pollard, & Britain, 1998, p. 1). Correspondingly, this concept strongly affected by the personal qualities possessed to meet the needs of the potential employers and contribute successfully within enterprises to a context of on-going change (Bridgstock, 2009). So, we defined employability as *the essential capability of an individual to gain and perform a given job, facilitated by the available development process*. By doing so, we highlight the efforts of an individual in developing a set of appropriate competencies needed by potential employers or the broader labour market.

Our interest in this subject arises from a number of sources including the International Labour Organization (ILO) *Annual Report (ILO, 2013)*, which showed that the number of people unemployed globally, in 2012, was 197.3 million, and 75 million of them were young people under 25 years and not in education, employment or training (NEET). In association with this unemployment issue, graduate unemployment has remained high. Graduate unemployment refers to the unemployed young people who have graduated from a university or polytechnic college, the latter being similar to Technical and Further Education [TAFE] in Australia. For example, Taiwanese unemployed graduates in 2009 were 5.86% of the total national unemployment (Wu, 2011). In 2011 in Tunisia 56% of the unemployed were holders of higher education degrees (Premand, Brodmann, Almeida, Grun, & Barouni, 2012).

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These graduate unemployment situations have drawn attention from researchers in both the employability and education fields, who have investigated the contributing factors. For example, Brown, D.K. (2001) and Brown, P. (2003) found that graduate unemployment situations are correlated with the inflation of the minimum credential qualifications required for entering the labour market and the associated devaluation of academic degrees. In engineering, this has resulted in the required credentials for engineering jobs increasing. have been upgraded but have not been followed up by an appropriate evaluation of the quality of engineering graduates. In this regard, we should question the function of our current competencies development process which has been criticised by Walther and Radcliffe (2007) as a tool for equipping graduates with a formal certificate or qualification with limited support to better develop their employability competencies with the requirements of industries.

Accordingly, we need to improve the quality of graduates by providing effective developmental approaches for helping them develop the competencies needed by employers. In line with this need, the Accreditation Board for Engineering and Technology (ABET) has mapped 11 abilities and aspects of understanding of professional aspects of engineering that generally have been incorporated into many engineering programs worldwide. In Australia, *Engineering Australia* (EA) has stipulated 10 generic attributes to be demonstrated by the graduates of accredited programs. These approaches have been aimed to improve graduate employability, although, the attributes generated have not been effective in tackling the issue of competencies mismatch. For example, Patil, Nair, and Codner (2008) elaborated the competency gap between engineering graduate attributes and employers' expectations. Similar findings also revealed in Male, Bush, and Chapman (2010) who have identified 11 areas of competency deficiency among Australian engineering graduates, namely: communication, working in teams, professionalism, self-management, ingenuity, management and leadership, engineering business, entrepreneurship, practical engineering, professional responsibilities and application of technical theory.

In this regard, Walther and Radcliffe (2007) argue that competency mismatch with workplace needs and expectations is caused by disputes between universities and industry regarding what kind of competencies need to be developed by engineering students. Indeed, if we review the competency development system in several countries, we find that the curricula have not been developed to meet the needs of the labour market. Instead of preparing learners with appropriate employability competencies, several institutions only provide a theoretical knowledge of the discipline and focus on making profit (Natarajan, 2008). Therefore, the goals of competency development practice should include a method to ensure employability development of the graduates.

The effectiveness of the competency development process, however, depends not only on the quality of the competency-enhancing activities, or the qualities of the instructor delivering the content, but is also affected by a commitment from the learner to his/her own development process. Without that commitment, the competency development process only creates low quality graduates (Callan, 2004) who are unable to reconstruct and apply the knowledge taught (Ciechanowska, 2012) and who are unable to adapt well to the variety of workplace situations and conditions (Lazarus & Ferris, 2014). The foundation of personal commitment concerns the capability of the learner, not others, to choose what competencies he/she wants to possess for enhancing his/her future. Therefore, the competency development process "requires changes to the motivations of students [where] learners need to take responsibility for their own learning" (Callan, 2004, p. 66). It is clear for Callan, learners have the sole responsibility to manage their development process. In addition, Ciechanowska (2014) argues that learners' sense of commitment should be expressed in their responsibility for their personal development along with accepting the consequences of their actions. Collectively, these arguments support the earlier work of Forrier and Sels (2003) who believe that preparation for entering the labour market is mainly determined by the student's characteristics in accepting responsibility to develop a set of competencies that could increase his/her employment opportunities. Correspondingly, this paper examines this personal responsibility, later referred to as *Self-Responsibility* (SR), for the learners' competencies development process.

2. Self-Responsibility in employability competencies development

The concept of SR is underpinned by five theories of personal development: Wedemeyer's theory of *independent study* (Wedemeyer, 1981)Moore's theory of *student autonomy* , Knowles' idea of *self-directed learning* (SDL) in an adult environment (Knowles, 1975), Bandura's perspective of *human agency* (Bandura, 1989) and Deci's *self-determined behaviours* (Deci, Vallerand, Pelletier, & Ryan, 1991). We used the theories of Wedemeyer and Moore to examine learners' *orientation* and *autonomy*. Knowles' theory of SDL in this study is an important concept for understanding the dimensions of *participation* and *reflection*. In addition, Knowles' conceptualisation of adults as learners is useful in examining learners' capability in creating alternative solutions to encounter learning barriers they might encounter in their development process (e.g. *new learning environments, time/resources limitations*). Bandura's

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and Deci' theories have been used in this paper as the foundation to explain learners' *initiative* and *characteristics*. Collecting these theories, we generated seven components, or apparent components, of SR, namely: *Awareness*, *Involvement*, *Self-reflection*, *Independency*, *Initiative and creativity*, *Characteristics role* and *Managing resources*.

(1) *Awareness*: a sense of personal awareness has a positive influence on the capability of learners (Arifin, 2016) in determining the best options for their own development process. Thus, self-awareness emerges from the situation in which an individual is able to conduct personal introspection related to his/her own potential performance (Weisskirch, 2016).

(2) *Involvement*: learners' participation in an activity is caused by their personal interest in creating the meaning of the process (Banz. Jr, 2009). Therefore, learners who actively engage in social practise activities – such as community service, part-time employment, work experience, extra-curricular and volunteering activities – have been found to gain employability competencies faster than those who do not engage (Lazarus & Ferris, 2014).

(3) *Self-reflection*: this component is helps the learner to practise their independent thinking skills for identifying their current position in the labour market. This identification allows them to address their competency weaknesses and develop their own approaches to improving in relation to these weaknesses.

(4) *Independency*: this component is determined by the active role of learners in managing their own development process with a minimum of help from others. Thus, independency is an essential capability for addressing their development limitations. A learner who practices independency tends to have greater control of their development process (Lazarus & Ferris, 2016).

(5) *Initiative and creativity*, the capability to be a self-directed learner starts when an individual is independently and proactively initiates actions for taking responsibility over his/her own development process. By taking the initiative in the process, he/she learn to develop responsibility to self-manage the process.

(6) *Characteristics role*: several characteristics – such as: autonomous motivations, self-confidence, self-esteem, self-efficacy and behaviours related to learner autonomy have been identified as important characteristics that influence the willingness of an individual to practice SR.

(7) *Managing resources*: learners could have previous development experiences of a kind such that they could positively use these experiences as resources to enrich their current process of competency development. Therefore, it is important to design development environments where learners would be able to find their own resources because this teaching strategy gives them the means to advance further based on their own initiative.

Since these seven components were deduced directly from the literature related to the factors affecting motivation and behaviour of an individual in practicing SR, Lazarus and Ferris (2016) incorporated them to examine the willingness of an individual in pursuing SR. They found that learners have different levels of interest in accepting SR. They also found that when learners accepted SR within these components, their cognitive structures have increased to a level where they could accept effectively contribute to their development process. Their findings support the protean career which was defined as a concept where "an individual manages his or her career in a proactive, self-directed way driven by personal value and evaluating career success based on subjective success criteria" (Vos & Soens, 2008, p. 449). Accordingly, this career concept focuses on the capability of an individual to self-direct their career management using their own values to guide their career related decisions (Briscoe, Hall, & DeMuth, 2006) and independently take responsibility for managing their career development (Vos & Soens, 2008). To avoid confusion about the concept of SR in the competency development process with other concepts of personal responsibility, we defined SR as *a self-determined process that a learner, at the centre of the development process, accepts personal responsibility, along with its consequences, to identify, plan and address any development limitations which he/she may have by developing a set of competencies needed to effectively manage well in his/her life or future career*. Thus, the significance of endorsing SR builds on the belief that the key for engineering graduates to be employable in the labour market is primarily related to the commitment of the learners to take responsibility to fulfil industry's demands through participating in competency-enhancing activities.

These seven components of SR (Awareness, Involvement, Self-reflection, Independency, Initiative and creativity, Characteristics role and Managing resources) were explored further used to develop the Self-Responsibility Scale or SRS (Table 1).

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Table 1 Measurement items in the SRS

	Items	Component
I18	I just follow what other people learn	Independency Initiative & creativity
I1	I always expect my lecturers to tell every student what should they do in the classroom	Awareness
I10	I will give up when I found a stressful activity	Own reflection Characteristics role
I13	I develop employability competencies only if I have spare time	Involvement Own reflection
I44	I can't find any support from the university related to my employability competencies development	Managing resources
I2	In the development process, I should decide what competencies I want to learn	Awareness Involvement
I19	For particular competencies needed to be learned, I know what to do	Own reflection Independency
I11	I always put a focus on my development goals without having anything that could become a distraction	Awareness Characteristics role
I27	No one can force me to possess appropriate competencies	Characteristics role Independency
I37	A constraining environment won't stop me from achieving my goals	Own reflection Characteristics role Managing resources
I28	I really ascertain about the impacts of my behaviours on my development progress	Independency Characteristic role
I21	I can tell whether I possess the proper competencies to gain a job	Own reflection Initiative & creativity
I14	It is important for me to find another more challenging task after accomplished a certain goal	Involvement Own reflection
I12	When I find a difficult situation, I will actively seek a solution	Awareness Own reflection Characteristics role
I7	I have no problem to stick with my development's aims and goals	Involvement
I41.	I could undertake my development better if received more support from my friends	Managing resources Initiative & creativity
I40.	I could undertake my development better if received more support from my family	Managing resources Initiative & creativity
I42.	I could undertake my development better if received more support from my lecturers	Managing resources Initiative & creativity

Note. Response Anchors: 1 = strongly disagree; 2 = somewhat disagree; 3 = neither disagree nor agree; 4 = somewhat agree and 5 = strongly agree

The measurement items in Table 1 were generated to correspond with its homogeneity, reliability and diversities. Item homogeneity refers to the degree to which items have inter-correlation; thus a data set is considered homogeneous if it consists of clusters that have similarity on a relevant variable (Ary, Jacobs, Sorensen, & Walker, 2013). The homogeneity, may increase the quality of the survey (can yield high internal consistency reliability), although, it creates a negative effect on the robustness of the composite measure. In contrast, items diversity increases the substantive robustness but has a potential to reduce the survey's quality (Wageman, Hackman, & Lehman, 2005). Thus, we also considered about the effects on the response rate and the risk of producing low quality items.

3. Methods

We used a correlational quantitative method for exploring the perceptions of Australian engineering students and alumni in relation to the importance of SR in their employability competency development practice. Their perceptions

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were measured using a specially developed scale, which we named the Self-Responsibility Scale (SRS), because the currently available measurement scales were not suitable for this study. The project, including use of the SRS, was granted ethics approval by the Human Resource Ethics Committee of the University of South Australia (HREC UniSA) on 27 January 2016, ref. number 0000035039 and the HREC of the University of Technology Sydney (UTS), ref. number ETH16-0355 on 8 June 2016.

To be time and cost-effective, we used an online survey method. We administered the Self-Responsibility Scale (SRS) to two targeted groups associated with each of seven participating Australian Engineering Schools. The inclusion criteria for the alumni group were that the subject be an alumnus from a participating Australian Engineering School and should: (a) have at least three months of working experience after graduation, (b) have a minimum age of 20 and (c) have a minimum qualification of a Bachelor degree in Engineering. The inclusion criteria for the student group required that the subject be: (a) either a full-time or part-time student, (b) who has completed a minimum of one semester of any level of study in any engineering discipline at one of the participating Australian engineering schools. We used a combination of purposive and snowball sampling to increase the responses received from the targeted population. Purposive sampling was achieved through cooperation of the participating engineering schools sending invitations to the students and alumni. Snowball sampling was achieved by inviting respondents to also invite their contacts to participate. This approach has vulnerability to the usual issues of bias in voluntary surveys: whether there a factor in common that result in willingness to participate that may bias the results, and in the case of snowballing, whether there are factors in common amongst the contact group of those who send invitations and respond additional to the common factors associated with choice to participate. A total of 1064 responses (494 alumni and 570 students) were obtained and after data screening, we found eight responses were incomplete and, thus, only 1056 responses could be used for further data analysis.

4. Findings and discussion

The obtained responses were further analysed using three methods: Principal Component Analysis (PCA), Explanatory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). The results of these analyses show that SR consists of four underlying factors: 1. Autonomy and Self-Initiation (ASI), 2. Sense of Agency (SA), 3. Self-Awareness and Evaluation (SAE) and 4. Self-Management (SM). To determine the internal consistency reliability of the SRS, we compared Cronbach's alpha (α) and Composite Reliability (CR) and found that both the global Cronbach's alpha ($\alpha = 0.852$) and the Composite Reliability (CR = 0.94), yielded the recommended values. We conclude that the SRS has a strong indication of item covariance.

To address the multi-dimensionality of SR, these four factors were further analysed using structural equational modelling (SEM) which is considered to be the most appropriate method to examine the hypothesised factors (Hinkin, 2005). Accordingly, a CFA model was developed, Figure 1. The CFA model was a first-order measurement model and can be described as the representative of the concept of SR and developed to explain how the measured/indicator variables could represent SR as a four-factors construct. Accordingly, CFA model consisted of 18 measurement items in the Self-Responsibility Scale (SRS). These 18 items were loaded on four factors: ASI, SA, SAE and SM (Figure 6.1). Because the nature of the relationship in the first-order model is correlational (indicated by the two-way curved arrows among the four factors), these four factors were considered as the exogenous constructs and were correlated with each other without any structural relationship.

The CFA Model was developed to assess the multidimensionality of SR based on the 18 items in the SRS loaded on four factors of SR: ASI, SA, SAE and SM, Figure 1. The components of CFA Model are described as follow:

(1) The four factors of SR are represented by the four ellipses, labelled the exogenous constructs.

(2) The bi-directional curved arrows represent the correlational relationship among the four factors, the exogenous constructs, which have been shown to be correlated without any a priori structural relationship.

(3) These four factors also were considered as first-order constructs loaded by 18 measured variables or indicators. These 18 indicators are represented by 18 rectangles and each indicator is loaded on only one factor.

(4) The measurement errors (e1-e18) were uncorrelated.

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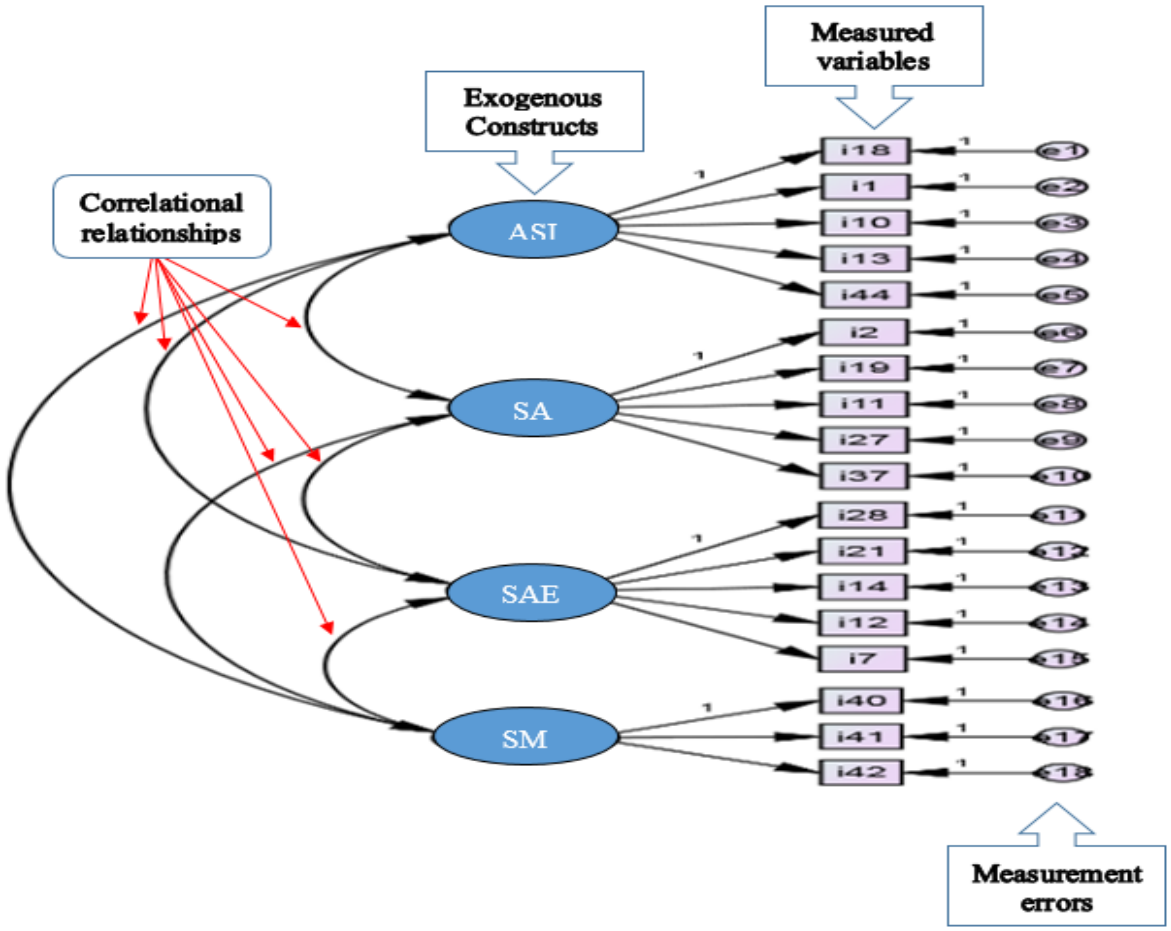

Figure 1 Path diagram of the first-order measurement model (CFA Model)

To examine the multidimensionality of SR, we assessed the validity of the CFA Model using three aspects. The first aspect examined the quality of Goodness-*of-fit* (GOF) using two assessments: Tucker-Lewis index (TLI) and adjusted goodness-of-fit index (AGFI). The second aspect was the significance of *parameter estimates* and the third aspect examined areas of poor fit through the modification indices. Correspondingly, the CFA Model was tested separately using three sources of data: 1. the combined responses from all the, student and alumni, participants, 2. the responses from the student participants and 3. the responses from the alumni participants. The results of the GOF indices are shown in Table 2.

Table 2 The GOF indices for CFA Model

Fit Indices	Data sources		
	Combined	Students	Alumni
χ^2	183.82	82.96	124.61
Df	95.00	95.00	95.00
P	0.00	0.00	0.00
CFI	0.99	0.99	0.99
RMSEA	0.03	0.01	0.04
TLI	0.99	0.99	0.97
AGFI	0.97	0.97	0.94
AIC	335.82	234.69	324.61
χ^2**/df**	1.93	0.87	1.31

The results of GOF indices for the combined data in Table 2 show that the modification process improved the model fit and the values obtained satisfied commonly recommended thresholds. For example, the value of AGFI (0.97), CFI

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(0.99) and TLI (0.99) indicated that the model adequately fitted the sample. The obtained RMSEA value of 0.03 with a confidence interval ranging from 0.023 (low) to 0.036 (high) also indicated a good fit. Therefore, it can be concluded that the hypothesised model (combined: χ^2 [1056] = 183.82, p < 0.01; RMSEA = 0.03; CFI = 0.99); (students: χ^2 [568] = 82.96, p < 0.01; RMSEA = 0.01; CFI = 0.99) and (alumni: χ^2 [488]: = 124.61, p < 0.01; RMSEA = 0.04; CFI = 0.99) appropriately represents SR as a four factorials structure.

These results were further tested by assessing internal consistency and showed that the reliability coefficients of ASI, SA, SAE and SM were 0.91, 0.83, 0.80 and 0.95, respectively. To further examine the multidimensionality of SR, we investigated convergent or discriminant validity. All values of both the student and alumni participants standardised factor loadings yielded the suggested values ranging from 0.52 to 0.99. All the CR scores were above 0.70 which indicates that the four factors of SR are reliable. In addition, all AVE values were below the values of CR. Collectively, these results are evidence to support the convergent validity of the CFA Model. To generate evidence of discriminant validity, the values of MSV and ASV should be less than the values of AVE. Therefore, we developed the correlation matrix for the CFA Model, Table 3. Table 3 CFA Correlation matrix

Factor	**1**	**2**	**3**	**4**	**MSV**	**ASV**	**AVE**	$\sqrt{AVE}$
				Combined responses				
ASI	**1**				0.43	0.15	0.67	0.82
SA	0.09	**1**			0.02	0.01	0.50	0.71
SAE	0.10	0.69	**1**		0.03	0.02	0.51	0.71
SM	0.62	0.12	0.19	**1**	0.43	0.16	0.85	0.92
				Student responses				
ASI	**1**				0.44	0.15	0.71	0.84
SA	0.07	**1**			0.01	0.01	0.54	0.73
SAE	0.06	0.69	**1**		0.01	0.01	0.51	0.71
SM	0.64	0.06	0.04	**1**	0.44	0.15	0.85	0.92
				Alumni responses				
ASI	**1**				0.410	0.138	0.53	0.73
SA	0.62	**1**			0.003	0.002	0.50	0.71
SAE	0.61	0.69	**1**		0.004	0.002	0.50	0.71
SM	0.58	0.40	0.49	**1**	0.410	0.139	0.88	0.94

Note. MSV = Maximum Shared Variance, *ASV* = Average Shared Variance

Table 3 shows the AVE values for each data source were greater than the corresponding values of MSV and ASV. In addition to these findings, all the values of square root of AVE were also above the correlation values. For example, for the combined responses data, the value of square root of AVE for ASI was 0.82 and was above the values of correlation of ASI-SA ($\phi_{ASI,SA}$ = 0.09), ASI-SAE ($\phi_{ASI,SAE}$ = 0.1) and ASI-SM ($\phi_{ASI,SM}$ = 0.62). Therefore, CFA Model demonstrated adequacy of the discriminant validity.

Further, the correlation matrix of the combined responses in Table 3 shows that the correlations of ASI-SM and SA-SAE were strong and positive ($\phi_{ASI,SM}$ = 0.62, $\phi_{SA,SAE}$ = 0.69, respectively). Similar positive correlations could be also found in the responses from the student and alumni participants. There are two implications of these correlation values. First, the internalisation of learners' extrinsic motivations into controlled actions would lead to an effective capacity to navigate their own competency development process. Consequently, they would tend to be more competent, autonomous, persistent, motivated and less dependent on friends, families or instructors. In short, any change in a learner's level of ASI will influence his/her level of SM or vice versa.

However, the second implication, is that the willingness to practice SR is not autonomous because a learner has freedom to determine the best contribution for his/her own development process. If he/she decides to practise SR, then the first step of internalisation involves his/her personal ability to recognise and identify choice-related conscious behaviours (e.g. self-organisation, self-regulation, self-control, self-reflection, self-confidence). This behaviour could

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help him/her to understand the importance of development activities for his/her future career. As the sense of agency emerged from the extrinsic motivation of bringing change to his/her life and a belief that it is possible to act in a manner that makes a material impact on one's prospects, a self-responsible learner must also have developed self-awareness of his/her condition and potential contribution. This implication is supported by a solid correlation value between SA and SAE. Here, the belief in SA is followed by the development of SAE or vice versa.

Table 3 also shows that the other correlations were also positive but the interrelationships were weak ($\phi_{ASI,SAE} = 0.1$, $\phi_{SA,SM} = 0.12$, $\phi_{SAE,SM} = 0.19$, $\phi_{ASI,SA} = 0.09$). These consistencies were also found in the student participants' responses. The presence of two constructs which show symbiotic inter-relation of distinct pairs of the four factors is interesting, suggesting that two constructs must be addressed in pursuit of the goal of enabling students to take action which leads to the development of effective SR for employability capacity. Unlike the other two findings, however, alumni responses indicate strong and positive correlations among all factors of SR. this suggests that SR is a construct which develops during the individual's period as a student with a pair of symbiotic relationships of factors which concern combinations of what must be learned or developed and what is already known. The alumni tend to have a better developed level of SR whereas the student participants may have not yet recognised or understood the importance of SR when they were developing their competencies. By implication, it is necessary for competency development activities, both at the individual unit of instruction and at the whole program level, to be constructed in a manner which will assist in transitioning learners from their development environment to the work place. This interpretation is also consistent with the proper focus of engineering education and training, which should be preparing students to enter professional practise.

This focus is much more complex than developing competencies within technical subject matter relevant to the specialisation. Too often, competencies development in professional fields tends to conceive of what kind of cognitive that needs to be attained in order for a degree qualification to be recognized as good. Thus, curricula for competencies development in particular professional areas put a heavy consideration on the cognitive domain of Bloom's taxonomy. It makes, unfortunately, competency-enhancing activities are conducted in terms of topic and level of cognitive attainment expected (Mead et al., 2010). These reference curricula contrast with Graduate Reference Curriculum for Systems Engineering (GRCSE) which remains dominated by the cognitive description of the necessary content but reflects interest in the affective and cognitive domain described by Bloom's taxonomy and also frames the results of competencies development using the 'outcomes' and 'objectives' formulation described in the Accreditation Board for Engineering and Technology (ABET) and Engineer Australia (EA) accreditation criteria (Pyster et al., 2012).

5. Implications for competency development practice

This paper has identified the multidimensionality of SR by examining the structural and construct validity of the CFA Model. The finding of the multidimensionality has been discussed in detail, identifying four areas of potential action in the SR activity: (1) Motivation, (2) Control, (3) Human agency and (4) Perspective. This finding will assist instructors in the educational activity of helping students to develop their individual SR capacity for employability skills development.

In the first area of implications, *motivation*, the competency development process should seek methods to enhance learners' motivation so they would more willingly practice SR. Initially 64% of respondents were motivated by outside forces, such as friends, families, instructors or bosses. Similarly, 63% of respondents indicated that they only develop employability competencies if they have *spare time*. Thus, simply asking a learner to engage in the competency development environment without addressing his/her motivation will result in the instructors, not the learner, accepting responsibility for managing the development process.

This paper has provided evidence to show that addressing motivation is necessary and could improve learners' perceptions about the importance of the development process for their future. The evidence may be found through the capability of the alumni participants to transform their external motivations into positive beliefs which lead to intrinsic motivation. Consequently, when confronted by perceived barriers, they become more capable of self-responsibility and showed different behaviours from the student participants. Have internalised their formerly extrinsic motivations, the alumni participants were capable of a higher level of persistence and motivation, and, therefore, they could confidently overcome perceived barriers and deliberately execute appropriate actions to achieve their goals.

This shift in motivation, however, may not occur if learners have no confidence in their own abilities. The participants highlighted their levels of confidence by effectively controlling their own development process. Thus, the second area of implications, *control*, should address an instructional approach to efficiently increase learners' autonomy in managing their own competency development process. Accordingly, instructional design for employability

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development needs to focus on activities designed to help learners gain practical experience of real-world tasks and to develop a sense of capacity to perform action that has a material effect on their prospects. Rather than have activities focusing on cognitive content to be delivered to learners by the instructor in a supervised classroom environment, learners should have the capability to make their own critical judgements to choose a range of activities within both the formal education setting and the informal societal context.

Of the participants, 88% expressed willingness to control their own development process. Accordingly, they wanted to have freedom to choose their preferred development activities. Therefore, if a learner is highly respected as an individual who takes the primary responsibility for his/her development process, then he/she should be provided opportunities to show his/her real control of that process and this control capacity is likely to be exercised to benefit in the case of many students. As a result, he/she will gain new positive perspectives that could help him/her to understand the consequences associated with holding control.

When learners can control the development process, they will develop ability to reflect on their current position in the development process in a way in which they view themselves as active agents with the power to take self-development action choices that can result in material change to their situation. Therefore, the third area of implications, *human agency*, focuses on supportive conditions that enable an individual to become an active agent. This study showed that while participants were disappointed that they did not obtain enough support from their institution or instructors, educators can engage learners in activities where the learner can become more self-responsible and willing to accept responsibility for their development process.

If learners always expect instructors to tell them what to do and only passively engage in development process, then engineering educators should frame more supportive development activities, at least at the beginning of the process, to reduce the gap between the intended participation in the learning task and the current capacity of the students. These activities need to be meaningful in enriching the learners' development experiences. Therefore, whether learners were, or were not, having difficulties in performing the development process for their future careers, the educational environment should suitably facilitate the learners' experience to positively affect his/her agency to act freely.

The fourth area of implications, *perspective or thinking*, should focus on the effort to develop a supportive environment which will assist learners to improve their perspectives on developing the necessary competencies, particularly for those who had not had positive experiences in their previous competency development processes. Learners with a well-developed SR concept appreciate that they need to be active in making development plans and managing the development process with or without guidance from others. Therefore, the SR concept development process is an active process in which learners are at the centre and take over the process of construing events and experiences so that they become learning.

6. Conclusions

This paper has analysed the multidimensionality of SR by examining the structural and construct validity of the CFA Model. The findings of the structural validity test revealed that the CFA Model appropriately represented SR as a four-factors construct comprising ASI, SA, SAE and SM. Analysis of the results showed that the alumni participants have internalised their motivation for SR more compared to the student participants. Consequently, the alumni participants report taking the initiative when confronted by perceived barriers and, therefore, they showed more persistence and motivation.

These results positively support the position that SR is key for graduates to enter the labour market. By showing the importance of SR in assisting learners to develop their own approaches to developing employability competencies, we also provide support for claiming the benefits of SR practice in helping learners to experience a greater level of freedom in managing their competency development process.

The work reported in this paper describes the development and validation of a construct of SR in relation to employability competencies in engineering students and alumni. Future work could beneficially be pursued in two directions. It would be useful to develop a greater understanding of the relationship of participant self-report measures using the SRS in relation to factors suggested by some of the categories identified. In particular, the SA factor suggests it would be interesting to investigate the relationship of social class and SA. A second topic of investigation of the correlation of measures in the four factors construct and the respondent personality profile, for example as measured through MBTI type, may inform an enriched understanding of the development of SR.

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The other type of investigation that should follow from this work is educational methods which will promote and enable the development of student SR for employability competency development. It is plausible that the appropriate educational methods may differ according to characteristics of students, whether demographic background factors or personality, or something else which could be correlated with the SRS scale measures.

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References

Arifin, M. H., Exploring Factors in Contributing Student Progress in the Open University, *International Journal of Information and Education Technology,* Vol. 6, (1), pp. 29, 2016.

Ary, D., Jacobs, L. C., Sorensen, C. K., & Walker, D. *Introduction to Research in Education* (8th ed.). Belmont: Wadsworth Cengage Learning, 2013.

Bandura, A., Human Agency in Social Cognitive Theory, *American psychologist,* Vol. 44, (9), pp. 1175-1184, 1989.

Banz. Jr, R. N. Exploring the Personal Responsibility Orientation Model: Self-Directed Learning Within Museum Education, The Pennsylvania State University, Pennsylvania, 2009.

Bridgstock, R., The Graduate Attributes We've Overlooked: Enhancing Graduate Employability Through Career Management Skills, *Higher Education Research & Development,* Vol. 28, (1), pp. 31-44, 2009.

Briscoe, J. P., Hall, D. T., & DeMuth, R. L. F., Protean and Boundaryless Careers: An Empirical Exploration, *Journal of Vocational Behavior,* Vol. 69, (1), pp. 30-47, 2006.

Brown, D. K., The Social Sources of Educational Credentialism: Status Cultures, Labor Markets, and Organizations, *Sociology of Education,* Vol. 74, pp. 19-34, 2001.

Brown, P., The Opportunity Trap: Education and Employment in A Global Economy, *European Educational Research Journal,* Vol. 2, (1), pp. 141-179, 2003.

Callan, V. J. VET Teacher and Student Attitudes About Generic Skills. In J. Gibb (Ed.), *GenericSkills in Vocational Education and Training: Research Reading*, pp. 53-68. Adelaide: National Centre for Vocational Education Research (NCVER), 2004.

Ciechanowska, D. University Teachers Readiness To Foster Students Competencies of Self-Directed Learning. In A. K. K. Denek, W. Łuszczuk, P. Oleśniewicz (Ed.), *Education of Tomorrow. From Nursery to the Professional Activity*, Sosnowiec: Ofcyna Wydawnicza "Humanitas", 2012.

Ciechanowska, D. Student Responsibility in Deep Learning. In K. Denek, A. KamiĚska, W. Kojs, & P. OleĞniewicz (Eds.), *Education of Tomorrow. Since Education in Family to System Aspect of Education*, Sosnowiec: Ofcyna Wydawnicza "Humanitas", 2014.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M., Motivation and Education: The Self-Determination Perspective, *Educational Psychologist,* Vol. 26, (3 & 4), pp. 325-346, 1991.

Forrier, A., & Sels, L., The Concept Employability: A Complex Mosaic, *International Journal of Human Resources Development and Management,* Vol. 3, (2), pp. 102-124, 2003.

Hair. Jr, J. F., Black, W. C., Babin, B. J., & Anderson, J. R. *Multivariate Data Analysis : a Global Perspective* (7th ed.). Upper Saddle River: Pearson, 2010.

Hillage, J., Pollard, E., & Britain, G. *Employability: Developing A Framework For Policy Analysis*. London: DfEE 1998.

Hinkin, T. R. Scale Development Principles and Practices. In R. A. Swanson & E. F. H. III (Eds.), *Research in organizations: Foundations and methods of inquiry*, pp. 161-179. San Francisco: Berrett-Koehler Publisher, 2005.

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ILO. *World of Work Report 2013: Repairing the economic and social fabric,* (2049-9272 / 978-92-9-251017-6), Geneva, International Labor Organization (ILO), 2013.

Knowles, M. S. *Self-directed Learning*. New York: Cambridge books, 1975.

Lazarus, D., & Ferris, T. L. J. *Assessing The Roles of Indonesian Vocational Education and Training to Increase Student's Employability*. Paper presented at the The 4th Indonesian Student International Conference (KIPI-2014), Canberra, 7-8 March 2014,2014.

Lazarus, D., & Ferris, T. L. J. *Assessing Self-Responsibility in Employability Competencies Development among Australian Engineering Students: Introductory report*. Paper presented at the 2016 International Conference on Industrial Engineering and Operations Management pp. 1729-1734, Kuala Lumpur, 2016.

Male, S., Bush, M., & Chapman, E., Perceptions of Competency Deficiencies in Engineering Graduates, *Australasian Journal of Engineering Education,* Vol. 16, (1), pp. 55-67, 2010.

Mead, N. R., Allen, J. H., Ardis, M. A., Hilburn, T. B., Kornecki, A. J., Linger, R. C., & McDonald, J. *Software Assurance Curriculum Project Volume I: Master of Software Assurance Reference Curriculum,* Software Engineering Institute, Carnegie Mellon University, 2010.

Moore, M. G. On A Theory of Independent Study. In D. Sewart, D. Keegan, & B. Holmberg (Eds.), *Distance Education International Perspective*, pp. 68-94. Canberra: Croom Helm, 1983.

Natarajan, R., An Indian Perspective on Engineering Education Reform, *Journal of Engineering Education,* Vol. 97, (4), pp. 395-396, 2008.

Patil, A., Nair, C. S., & Codner, G. *Global Accreditation For the Global Engineering Attributes: A Way Forward*. Paper presented at the 19th Annual Conference of the Australasian Association for Engineering Education, Yeppoon, 2008.

Premand, P., Brodmann, S., Almeida, R., Grun, R., & Barouni, M., Entrepreneurship Training and Self-Employment among University Graduates: Evidence from a Randomized Trial in Tunisia, 2012.

Pyster, A., Olwell, D., Ferris, T., Hutchison, N., Enck, S., Anthony, J., . . . Squires, A., Graduate Reference Curriculum for Systems Engineering (GRCSE), *Hoboken, NJ, USA: Trustees of the Stevens Institute of Technology,* 2012.

Vos, A. D., & Soens, N., Protean Attitude and Career Success: The Mediating Role of Self-management, *Journal of Vocational Behavior,* Vol. 73, pp. 449-456, 2008.

Wageman, R., Hackman, J. R., & Lehman, E., Team Diagnostic Survey: Development of An Instrument, *The Journal of Applied Behavioral Scince,* Vol. 41, (4), pp. 373-398, 2005.

Walther, J., & Radcliffe, D., The Competence Dilemma in Engineering Education: Moving Beyond Simple Graduate Attribute Mapping, *Australasian Journal of Engineering Education,* Vol. 13, (1), pp. 41-51, 2007.

Wedemeyer, C. A. *Learning at the Back Door: Reflection on Non-Traditional Learning in the Lifespan*. London: The University of Wiconsin Press, 1981.

Weisskirch, R. S., Grit, Self-Esteem, Learning Strategies and Attitudes and Estimated and Achieved Course Grades among College Students, *Current Psychology,* pp. 1-7, 2016.

Wu, C.-C., High Graduate Unemployment Rate and Taiwanese Undergraduate Education, *International Journal of Educational Development,* Vol. 31, (3), pp. 303-310, 2011.

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