# Assessing Engineering Students' Stress: Implementing the Psychometric Synonym Technique

Abdul Saman[1], Muhammad Jufri[2] and Hillman Wirawan[3]

[1]*Department of Counseling, Faculty of Education, Universitas Negeri Makassar, Jl. Tamalate, Makassar, Indonesia*
[2]*Department of Psychology Universitas Negeri Makassar, Jl. Mapala, Makassar, Indonesia*
[3]*Department of Psychology Universitas Hasanuddin, Makassar, Indonesia*

Abstract:       This study aims at investigating the engineering student's stress at a vocational-technical school and incorporating a psychometric synonym technique to screen student's careless responses. This study introduced the implementation of data screening technique to identify the students with careless or effortless responses. Participants were 31 students (74.19% male) enrolling in the first and second year at the Vocational-Technical high school. The 33-item Likert-type stress scale was administered to the participants. The scale was well-constructed, and it satisfied the validity and reliability of an acceptable measure. The results suggested that the stress level varied with a mean score of 69.13 (*SD*= 13.20). However, 15 participants showed low personal reliability index ($r \leq .22$) and some of them had personal reliability with a negative value. These findings suggested that half of the participants potentially completed the questionnaire with careless responses.

## 1 INTRODUCTION

Stress has been studied extensively by many researchers across scientific fields such as psychology, education, counselling, and management. Many of the scientists found a great effect of stress on human performance including student's academic achievement. For example, in one study, 87% of students experienced academic stress, and their stress levels were negatively correlated with their academic achievement (Liu and Lu, 2011). Meaning, the higher their stress level, the more likely the students experienced poor academic achievements.

As the parts of an educational process, learning and teaching processes trigger some degree of stress. Stress becomes one of the important variables in the area of education as it contributes significant effect on student psychological state. For instance, stress influences smoking behavior among adolescences (Unalan et al., 2008), young athlete performance (Nicholls et al., 2009), and academic achievement (Liu and Lu, 2011). Stress also influences the way students work toward their goal. However, on the other side, the student's resilience within the process also determines how they perceive stress (Gerber et al., 2013). In brief, the learning process within classroom potentially trigger students' academic stress, and this condition may contribute to other important factors in education.

Technical-vocational schools run different education system where the students are required to complete technical-based skill modules. The education curriculum is designed to foster the student's knowledge and skills. Regarding workforce, the students are expected to fulfill the needs of industries and organization. The education focuses on shaping employability skills which include personal qualifications and technical skills (Bakar and Hanafi, 2007). However, the students in the technical-vocational training and education also experience academic stress which might hinder their academic performance and lead to counterproductive behavior (Unalan et al., 2008). Stress occurs in everyday human life; it serves as motivation for growth but damage if ineffectively managed (Zitzow, 1992).

Experts, scientists, and practitioners in this regard have developed various approaches to assessing student's stress as well as designing appropriate interventions. One of the widely used interventions is mindfulness (Brown and Ryan,

543

2003) and stress management (Unalan et al., 2008). These two interventions were relevant to treat students with moderate-to-high academic stress. On the other hand, although many alternative interventions are currently offered, identifying stress level is another important task for teachers and other practitioners. They are expected to bring valid and reliable test results before the intervention.

Unfortunately, assessing the stress level requires a systematic and professional approach. Although psychometric practitioners and scale developer can provide a robust measure for stress, they still have to ensure that the participant provides only genuine responses. In this case, a student may allegedly complete the questionnaire (or survey) with insufficient efforts or provide the assessor with careless responses.

Using a self-report questionnaire in assessing student's stress provides many advantages for school counsellor if used with careful supervision (Zitzow, 1992). Unfortunately, the students may disregard the assessment or commit to careless responses. This is an issue for both individual and classical assessment. School counsellor or Psychologist could misinterpret the data and consequently deliver incorrect treatments.

To tackle this issue, therefore, many scientists propose data screening techniques to identify careless or effortless responses (Please see Curran, 2016; Desimone et al., 2015; Huang et al., 2015; Meade and Craig, 2012). Researchers will be able to detect careless responses or insufficient effort by using the data screening technique like psychometric synonym or bogus item technique (Desimone, Harms and Desimone, 2015).

The Psychometric Synonym Technique assumes that respondents do not appreciably change during the course of assessment administration (Desimone, Harms and Desimone, 2015). Thus, the respondent who shows inconsistent responses over the conceptually similar items should be treated as the unreliable respondent. Desimone and others (2015) suggested to identify the items that are conceptually and statistically similar using a correlation technique. Item pairs with correlation coefficient 0.6 or higher are defined as psychometrically synonym (Meade and Craig, 2012).

A set of the synonym item pairs is used to discriminate between effortful and effortless respondents. Each respondent is assessed to detect the correlation between the first and second set of the items. Positive and higher correlations coefficient indicate a reliable respondent. Meade and Craig (2012) suggested a correlation coefficient

higher than 0.22 as the cut-off score. The personal reliability index lower than 0.22 indicates careless responses or an unreliable respondent.

Many previous studies focused on identifying student's stress either in individual- or group-unit analysis. The self-report assessment technique was ubiquitous among researchers (Alkhateeb, 2014; Schwarz, 1999; Zitzow, 1992). The self-report stress scale potentially reduces the validity of the assessment procedure. As mentioned earlier, students might contribute insufficient efforts or respond carelessly to the items. This issue also occurs when assessing engineering student's stress. Therefore, employing robust data screening technique(s) will assist practitioners as well as scientists in implementing a better self-report assessment.

This study consists of two main parts. The first study focuses on assessing engineering student's stress in the technical-vocational school. The second study is designed to detect the participant's psychometric synonym index. In the end, this provides practical implication of the psychometric synonym technique for a self-report assessment.

## 2 METHOD

### 2.1 Participants

Participants were engineering students who enrolled in technical-vocational education and training in one of the vocational schools in Makassar, Indonesia. The participants were 31 engineering students randomly recruited from 305 students in the school. Most of the participants were male (23, 74.19%) with age ranged from 16 to 18 years old. The participants were either in electrical engineering or mechanical engineering program. Participants who were under 18 years submitted permission from their parents before participating in the study. This study complied standard ethical codes for researching participants under 18 years old. The participants had rights to choose whether to participate or stop completing the study at any time without any further questions.

### 2.2 Measure

This study employed a 33-item stress scale with Likert-type option. This scale was constructed by the authors by collecting stress-related items from various sources. The initial item pool consisted of 112 items and finally reached 48 items at the later

stage of the validation study. The scale was constructed based on the guideline for measuring non-cognitive variables (Hinkin, Tracey and Enz, 1997). The scale was constructed and administered in Bahasa Indonesia by trained school counselor. The response options ranged from 1 (strongly disagree) to 5 (strongly agree). In the first administration, the scale was a 48-item Likert type scale, but 15 items were dropped due to lower inter-item correlation ($r$< 0.30). The sample of the items are "*Saya tidak tertarik mengerjakan tugas sekolah* (I am not interested in doing school work)" and "*Saya mengkhawatirkan masa depanku* (I am worried about my future)." The initial 48-item had .88 coefficient alpha and after dropping 15 items, the alpha increased to .90. This was highly reliable stress measure for research purpose. The final 33-item scale was reliable and acceptable for research purpose.

## 2.3 Procedure

The participants ($n$= 31) were asked to complete the stress questionnaire. The scale was administered by the school counselor in classroom using a paper-and-pencil administration. The participants completed the questionnaire in less than 30 minutes with mean completion time was 20 minutes. The data were collected and analyzed using reliability test (inter-item correlation) and descriptive statistic technique. In the next part of the study, the authors conducted data screening to detect participant's insufficient efforts or careless responses. The psychometric synonym technique (Desimone et al., 2015) was implemented to the data to present a robust data screening technique. In the end, the both results (i.e., before and after the data screening) were compared.

# 3 RESULTS AND DISCUSSION

## 3.1 Results

The participants completed the stress questionnaire and the data were analyzed using descriptive statistic technique. The following table 1 described the descriptive statistics of the data.

Table 1: Descriptive statistics.

| Variable | Min | Max | M | SD |
|---|---|---|---|---|
| Academic stress | 48 | 100 | 69.13 | 13.20 |

Note: $N$= 31, $M$= mean, $SD$= Standard Deviation, $Min$= Minimum, $Max$= Maximum

The results showed that the participants had stress score ranging from 48 to 100 with mean score of 69.13 (SD= 13.20). Hypothetically, the score might range from 33 to 165. The scores showed that the participants exhibit a various degree of stress. Students in the technical-vocational school, as well as other students in regular schools, also have dynamic academic stress levels.

In the next step of the analysis, the data were screened using Psychometric Synonym technique. The authors followed the guideline on how to run Psychometric Synonym (please refer to Desimone, Harms and Desimone, 2015 for more details). This part of the analysis assisted the authors in identifying participant's insufficient effort in completing the survey.

There were three main stages in conducting this technique. First, the inter-correlations among the items were computed. This yielded correlation coefficients and the pairs of items that had $r \geq$ .60 were included in the next step. Next, the authors computed the correlation between the first set of the items (item no. 13, 16, 18, 20, 23, and 33) and the second set of the items (item no. 1, 4, 8, 9, 12, and 16). This step yielded correlation coefficients for each participant in the survey. The next step, the authors used the coefficients as the Psychometric Synonym index. Participants who had a coefficient index lower than .22 were considered as not having enough effort to complete the questionnaire (Desimone et al., 2015). The following table 2 listed the first five participants in the list with their Psychometric Synonym index:

Table 2: Psychometric synonym index

| Participants | $r$ index | Decision |
|---|---|---|
| 1 | -0.5 | Insufficient effort |
| 2 | 0.59* | Sufficient effort |
| 3 | -0.32 | Insufficient effort |
| 4 | 0.42* | Sufficient effort |
| 5 | -0.71 | Insufficient effort |

$N$= 31, *$r \geq$ .22

The results suggested that 15 participants completed the questionnaire with careless responses, while 16 participants showed enough effort. Those 15 participants showed personal reliability index lower than the acceptable cut-off score ($r \geq$ .22) and many of them had personal reliability with negative value. The findings indicate that nearly half of the participants responded to the questionnaire carelessly or they completed the questionnaire with

insufficient effort. Therefore, the conclusion of the students' stress level could be misleading due to insufficient effort in responding to each item.

## 3.2 Discussions

This study aimed at investigating the academic stress among engineering students at the Technical-Vocational School in Makassar, Indonesia. In addition to the assessment, the authors also included the implementation of Psychometric Synonym technique as one of effective data screening techniques. This study serves as an example on how to assess student's academic stress as well as identifying their effort in completing the questionnaire.

The results showed both common and surprising findings. In the first stage of the analysis, the descriptive statistic depicted normal description of student's academic stress. It is considered normal that in one school the students or a group of students have various level of academic stress. Like other studies, students in many schools also experience stress (Gerber et al., 2013; Liu and Lu, 2011; Zitzow, 1992). In the second stage, the results indicated that nearly half (15 out of 31) students possibly had insufficient or carless effort in completing the questionnaire. This technique is one among many suggested data screening technique (Desimone, Harms and Desimone, 2015; Meade and Craig, 2012). Albeit this technique serves as a robust and reliable guide for data screening, comparing two or more data screening might provide better information.

Education process – including learning and teaching process – demands hard work and it requires students to exert both their physical and psychological energy. This, then, leads to stress where the students should deal with all pressures in order to performing well in completing academic context. During this process, the students focus their attention to both academic task and their psychological constraint. Although most students can cope and manage their stress, still many of them fail in this process. This creates tremendous effect to the academic performance and leads to poor academic performance.

As mentioned earlier, a number of interventions have been developed by experts. They intended to assist students in dealing with their life stress as well as academic stress. However, the major shortcoming in implementing the interventions is assessing the stress per se. The students may not realize the importance of filling a stress questionnaire. As the result, many of the students only submit careless responses. In many cases, this will lead to poor assessment results and potentially influence validity and reliability of the measurement.

In this study, the engineering students were highly influenced by their thoughts towards the stress assessment. The results of this study suggested that nearly half (15 out of 31) engineering students failed at providing sufficient effort. Hypothetically, their low psychometric synonym index ($r < .22$) indicated that they might respond carelessly to each item. This was in-line with many previous studies where the measurement must be accompanied by data screening technique (Desimone, Harms and Desimone, 2015; Huang et al., 2012; Meade and Craig, 2012). During the assessment process, the students may not realize that the assessment was the main information to initiate intervention for each student. Failing in providing valid and reliable measure leads to irrelevant interventions for students.

This study brought a new concern on assessing student's stress, especially for classical administration. Researchers and practitioners should realize student's insufficient effort to each item. Using data screening technique provides extra evidence for the assessment validity which later can be used for interpreting the results. However, the psychometric synonym technique is not the only data screening technique. The data screening techniques vary from the simplest one (e.g., including bogus item) to the more advanced technique (e.g., personal reliability technique). In addition, this study was also intended to show teachers and practitioners the importance of valid and reliable responses.

This study was able to implement the psychometric synonym technique. Nevertheless, there were some limitations related to the sample size and the stress scale. First, the sample size was considered small and may not represent the whole population. The authors invited all students in the school to participate. Unfortunately, only 31 participants who returned the questionnaire with complete response. Although nearly half participants were found to be careless, this does not conclude that half of the student population at the school were also careless.

Second, this study only employed one measure (i.e., stress scale) to assess the student's stress and to detect any careless responses. This study does not claim that the unreliable respondents will consistently show careless or insufficient effort

across different measures. It requires different measure or assessment to reach such conclusion.

Third, the stress scale used in this study still needs further improvement. The authors had computed validity and reliability test for the scale. However, small sample size hindered the authors from showing more evidence regarding validity. To illustrate, it needs around 200 participants to perform Confirmatory Factor Analysis (Myers, Ahn and Jin, 2011).

# 4 CONCLUSIONS

This study was designed to assess the engineering students' stress at a vocational-technical school. In addition, the data screening technique was also included in identifying their true responses. The results suggested that the students' stress level was normally distributed and it depicted that students may have different level of stress across their academic lives. Nevertheless, using the Psychometric Synonym technique, this study also found that students potentially responded to the items carelessly or responded with insufficient effort.

# ACKNOWLEDGMENTS

# REFERENCES

Alkhateeb, H., 2014. Reading anxiety, classroom anxiety, language motivation, reader self-perception, and arabic achievement of arab-american students learning arabic as a second language 1. *Psychological Reports: Sociocultural Issues in Psychology*, 115(3), pp.918–931.

Bakar, A.R. and Hanafi, I., 2007. Assessing Employability Skills of Technical-Vocational Students in Malaysia. *Journal of Social Sciences*, 3(4), pp.202–207.

Brown, K.W. and Ryan, R.M., 2003. The benefits of being present: mindfulness and its role in psychological well-being. *Journal of personality and social psychology*, 84(4), pp.822–848.

Curran, P.G., 2016. Methods for the detection of carelessly invalid responses in survey data. *Journal of Experimental Social Psychology*, [online] 66, pp.4–19.

Desimone, J.A., Harms, P.D. and Desimone, A.J., 2015. Best practice recommendation for data screening.

*Journal of Organizational Behavior*, 36(1), pp.171–181.

Gerber, M., Brand, S., Feldmeth, A.K., Lang, C., Elliot, C., Holsboer-Trachsler, E. and Pühse, U., 2013. Adolescents with high mental toughness adapt better to perceived stress: A longitudinal study with Swiss vocational students. *Personality and Individual Differences*, [online] 54(7), pp.808–814.

Hinkin, T.. R., Tracey, J.. B. and Enz, C.A., 1997. Scale construction: Developing reliable and valid measurement instruments. *Journal of Hospitality and Tourism Research*, 21(1), pp.100–120.

Huang, J.L., Bowling, N.A., Liu, M. and Li, Y., 2015. Detecting Insufficient Effort Responding with an Infrequency Scale: Evaluating Validity and Participant Reactions. *Journal of Business and Psychology*, 30(2), pp.299–311.

Huang, J.L., Curran, P.G., Keeney, J., Poposki, E.M. and DeShon, R.P., 2012. Detecting and Deterring Insufficient Effort Responding to Surveys. *Journal of Business and Psychology*, 27(1), pp.99–114.

Liu, Y. and Lu, Z., 2011. Longitudinal analysis of Chinese high school student's stress in school and academic achievement. *Educational Psychology*, 31(1), pp.723–729.

Meade, A.W. and Craig, S.B., 2012. Identifying careless responses in survey data. *Psychological Methods*, 17(3), pp.437–455.

Myers, N.D., Ahn, S. and Jin, Y., 2011. Sample size and power estimates for a confirmatory factor analytic model in exercise and sport: A Monte Carlo approach. *Research quarterly for exercise and sport*, [online] 82(3), pp.412–423.

Nicholls, A.R., Backhouse, S.H., Polman, R.C.J. and McKenna, J., 2009. Stressors and affective states among professional rugby union players. *Scandinavian Journal of Medicine and Science in Sports*, 19(1), pp.121–128.

Schwarz, N., 1999. Self-reports: How the questions shape the answers. *American Psychologist*, 54(2), pp.93–105.

Unalan, D., Celikten, M., Ozturk, A., Senol, V., Health, H.B. and Mazicioglu, M., 2008. the Relationship Between Vocational College Students ' Smoking Behavior and Self- Actualization , Interpersonal Support and Stress Management. *Social Behavior and Personality*, 36(6), pp.721–726.

Zitzow, D., 1992. Assessing student stress: School adjustment rating by self-report. *School Counselor*, 40(1), pp.20–23.