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Grit Predicts Academic Achievement among Undergraduate Science Teachers at a University of Science and Technology

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Abstract

Background: Research shows that grit is one of the non-cognitive factors that affect academic achievement among college students. As a result, grit has of late attracted attention among academic circles.

Methods: We used a correlational research design and a quantitative technique to establish the association between grit and academic achievement among pre-service science teachers. The sample was taken using a census and comprised 381 participants. The study site was a university of science and technology in Mbarara city, Uganda. A self-administered questionnaire was used for data collection. The analytical strategy was linear regression models, at a significance of $p \leq .05$.

Results: In the findings, 22.69 (SD = 1.43) was the mean age of the study participants. The majority of the students were male (80.3%) and government-sponsored (53.3%). There was a significant and positive association between grit and the academic achievement of the students (B =.231, $p < .001$). Overall, 5.1% of students' academic achievement was explained by grit.

Conclusion: Grit is a relatively important non-academic element that predicts academic achievement among pre-

service teachers of science. Focused intervention is necessary for improving undergraduate students' grit and enhancing their achievement in their Science with Education program.

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Background

Academic achievement has been emphasized as key to educational success, and how "gritty" a student is defines much of their achievement. Consequently, poor academic achievement becomes a serious concern among institutions of higher learning (Ngina et al., 2018). Academic achievement refers to the outcome of education—the extent to which a student, teacher, or institution has achieved their educational goals (Lone, 2016). In the context of this paper, academic achievement is regarded as students' general intellectual achievement and comparative standing relative to other students in their year (De Castella & Byrne, 2015). While intellectual ability is one of the most widely considered attributes in predicting academic achievement (Froedge, 2017; Fraser & Killen, 2003; Poropat, 2009), it is not the only guarantor of success in completing university programmes (Duckworth et al., 2007). Students' academic achievement in institutions of higher learning is as well influenced by various non-cognitive factors (Hijazi & Naqvi, 2006; Dixon et al., 2016). Non-cognitive factors are those concerned with motivation, attitude, and temperament (Jaclyn et al., 2018). Dweck and Sorich (1999) propose that many bright students show striking underachievement, and many who may have seemed less brilliant end up achieving a great deal more than predicted. These achievement differences could be explained by personality variables such as mindset. Indeed, students' achievement needs more than just content knowledge and academic skills (Mokhithi et al., 2020). Moreover, students who love challenges, who are willing to take risks, and who thrive when they hit obstacles are the ones who achieve up to or beyond their apparent potential. Those students who are afraid of challenges, avoid risks, and quit in the face of failure are likely to lose ground over time. The growing inadequacy of intellectual ability to predict all facets of academic achievement has prompted researchers to incorporate other motivational variables in order to explain academic achievement differences (Bazelais et al., 2016). These achievement differences could be explained by personality variables such as grit. Evidently, students' achievement needs more than just content knowledge and academic skills (Mokhithi et al., 2020).

Duckworth et al. (2007) define grit as perseverance and passion for long-term goals. They believe that grit entails working

strenuously towards challenges, maintaining effort and interest over the years despite failure, adversity, and plateaus in progress. Grit may be an important factor in explaining achievement and persistence (Bowman et al., 2015; Strayhorn, 2013). Thus, students who work hard but also love what they do are more likely to overcome barriers and achieve better (Dweck et al., 2014). It is noteworthy that academic learning is an incremental process that requires perseverance of effort, particularly in the face of challenges (Binning et al., 2018). According to the goal-setting theory (Locke & Latham, 2000), having a goal leads to the direction of attention and energizing of one's effort, resulting in a positive influence on academic achievement. A wealth of empirical studies has yielded evidence of a positive link between grit and academic achievement in college-age samples (Tang et al., 2019; Duckworth et al., 2007; Strayhorn, 2014; Wolters & Hussain, 2015; Eskreis-Winkler et al., 2014; Clark & Malecki, 2019; Pate et al., 2017).

In Ugandan universities, studies show that students are registering poor grades. For instance, Kyoshaba (2009) found that while some students performed well, others performed poorly. Akatuhurira (2019) further supported these findings. At Mbarara University of Science and Technology (MUST), the higher failure rates were evidenced by the many retake examinations conducted over the years per semester (Atibuni, 2012, 2017; Nakalema, 2013). For instance, it was found that over 100 retake examinations had been registered per semester for a period of 5 years (Atibuni, 2012), and 91 retakes were done out of 98 first-year undergraduates of the Faculty of Science during the academic year 2007/2008 (Nakalema, 2013). Such low grades are likely to have serious negative consequences on the learning of sciences in schools since the teachers that underachieve from the programme eventually join teaching. The study findings could inform interventions in the low rates of academic achievements among the students.

Methodology

The present study adopted a quantitative technique, based on variables measured with numbers and analysed using statistical procedures. The study employed a correlational design in measuring the direction and magnitude of an existing relationship between variables (Pierce, 2009). Undergraduates from the Bachelor of Science with Education constituted the study population and sample. The participants included 131 students from the first year, 119 from the second year, and 141 from the third year, making a total of 391 students. Of these students, 316 were male and 75 were female. The census method was used where all student teachers in years one, two, and three were enrolled in the study, as the population was small. In addition, censuses are large and complete, thus precise and detailed (Leslie, 1979). Only 381 returned complete questionnaires with no missing values; 10 questionnaires were incomplete and hence were discarded, giving a response rate of 97.4%.

A self-administered questionnaire was used for data collection. The questionnaire consisted of sections on demographics, grit, and an academic achievement scale. The 8-item Short Grit Scale (Grit-S) was used to measure the academic grit of undergraduates. Grit-S was scored on a 5-point Likert scale, that is, 1=not at all like me to 5= very much like me. A mean score for the items was obtained by adding up the scores and dividing by 8. The range of scores for grit is 1 to 5, corresponding to the Likert scale. The scale comprised two 4-item subscales that measure Perseverance of Effort (PE) (for example, "setbacks don't discourage me") and Consistency of Interest (CI) respectively, with an average Cronbach's

alpha coefficient of.71 for the PE subscale and.74 for the CI subscale (Duckworth & Quinn, 2009). However, the combined Cronbach's alpha for both subscales was.70. Whereas for this study, the Cronbach's alpha for Consistency of Interest and Perseverance of Effort was.60 and.68 respectively, and the combined one was.71, which shows that the tool used had acceptable internal consistency for the present study.

Academic achievement was measured by a self-reported academic achievement scale (De Castella & Byrne, 2015) using 4 items asking students to describe their general academic achievement and their comparative standing relative to other students in their year. An example of an item on the scale was: "In the past semester exam, the grades mostly received were as follows" and "I would describe myself typically as an A-average student". A mean score ranging from 1 to 5 was used to determine self-reported academic achievement, with high scores denoting higher achievement. The self-reported achievement items have an internal consistency (Cronbach's alpha =.90). However, in this study, the internal consistency was (Cronbach's alpha =.83), which shows that the tool used was still reliable in the present study settings.

In data management, data editing was done to remove impurities. Data were categorized by assigning codes to each item, as guided by the authors of the respective scales. Coded copies of the questionnaire were entered into the Statistical Package for the Social Scientists (SPSS) version 25 for analysis. Prior to analysis, all variables were examined through SPSS for missing values and distributional assumptions of regression analysis. Of the total 391 respondents, 10 questionnaires were incomplete (missing data > 25 percent) and were deleted, reducing the total sample to 381. For the remaining cases, missing data was extremely rare (<.01 percent), and where present, it was replaced with the mean for that variable (Tabachnik & Fidell, 2007).

Results

The present study was designed to find out the association between grit and academic achievement among undergraduate teachers of science. The sample characteristics are presented, and the main results follow.

Socio-demographic Characteristics of Undergraduate Teachers of Science

Table 1 below shows that of the 381 students enrolled, the majority were males, 80.3% (n=306), aged <25 years, 91.3% (n=348), on government sponsorship, 53.3% (n=203), in year 3 of study, 39.4% (n=150), of the physics and maths combination of study, 40.2% (n=153), with a second upper class of degree, 44.6% (n=120), and few had retakes, 18.4% (n=70).

Table 1. Socio-demographic characteristics of undergraduate teachers of science at MUST (N=381)

Socio-demographic Characteristics		Frequency	Percent
Gender	Male	306	80.3
	Female	75	19.7
Age (years) (Mean = 22.69, SD = 1.43)	<25 years	348	91.3
	25 years and above	33	8.7
Sponsorship	Private	178	46.7
	Government	203	53.3
Choice for BSc course	1st	104	27.3
	2nd	69	18.1
	3rd	71	18.6
	4th	46	12.1
	5th	24	6.3
	6th	67	17.6
Year of study	One	112	29.4
	Two	119	31.2
	Three	150	39.4
Subject combination	Phy/Math	153	40.2
	Bio/Chem	132	34.6
	Chem/Math	96	25.2
*Retake (N = 269)	No	202	75.1
	Yes	70	18.4
	Fail	2	0.7
	Pass	18	6.7
*GPA (N = 269)	Second lower	112	41.6
	Second upper	120	44.6
	First class	17	6.3

First-year students (n=112) were excluded from retakes and GPA since their results hadn't been released.

Descriptive Statistics of the Key Study Variables

Table 2. Descriptive statistics of academic achievement and grit of undergraduate teachers of science at MUST (N = 381)

Variables	Min	Max	Mean±SD	Median (IQR)	Skewness	Kurtosis	Distribution
Academic achievement	7	20	14.45±2.50	14 (12-16)	-0.1	-0.2	Normal
Grit	12	40	27.70±6.00	28 (24-32)	-0.3	-0.4	Normal
Perseverance	4	20	14.95±3.52	16 (13-18)	-0.7	0.2	Normal
Consistency	4	20	12.75±3.76	13 (10-15)	-0.1	-0.6	Normal

Min = Minimum, Max = Maximum.

Table 2 shows that both skewness and kurtosis are either > -1 or < 1. This means that all the study variables, including academic achievement and grit of undergraduate teachers of science at MUST, were normally distributed. This was based on the general rule of thumb for skewness > -1 or < 1 (George & Mallery, 2010). Thus, parametric analyses were used to analyze the study objectives. In addition, parametric analyses can identify small differences and are used with a large sample size.

Correlation between Grit and Academic Achievement among Undergraduate Teachers

The researcher established if there was a relationship between grit and academic achievement by conducting Pearson correlations. The results were presented in the table below.

Table 3. Pearson Correlation Matrix for the association between grit and Academic Achievement (N = 381)

	1.	2.	3.	4.	5.	6.	7.
1. Achievement	1						
2. Grit	.238**	.260**	.226**	.212**	1		
3. Perseverance	.218**	.177**	.143**	.157**	.811**	1	
4. Consistency	.176**	.249**	.227**	.192**	.836**	.357**	1

**p <.05. **p < 0.01.*

Findings in Table 3 show that there was a weak but significant positive correlation between grit and academic achievement (r =.238, p <.01). Moreover, the highest correlation was between the perseverance of effort subscale and academic achievement (r =.218, p <.01). This is in line with Cohen (1988). However, since correlation coefficients do not imply a causal-effect relationship, linear regression was conducted between mindset, its constructs, and academic achievement. Coefficients (β), p-values, and adjusted R^2 were presented and used to confirm the hypotheses.

Association between Grit and Academic Achievement among Undergraduate Teachers of Science

The objective, which was intended to find out the association between grit and academic achievement of undergraduate teachers of science at MUST, was tested through a null hypothesis that stated: There will be no statistically significant association between grit and academic achievement among undergraduate teachers of science. To reject or accept the hypotheses, the critical significance level at.05 was used to ascertain whether to accept or reject the hypotheses. Table 4 presents the test results.

Table 4. Regression results of the association between grit and Academic Achievement (N = 381)

Variable	B	*B*	R^2	Adj R^2	*P*
Overall grit	.235	.231	.053	.051	.000***
Perseverance	.215	.208	.043	.041	.000***
Consistency	.176	.175	.031	.028	.001**

**p <.05. **p < 0.01. ***p < 0.001*

Table 4 shows that grit explains 5.1% of the variability in the academic achievement among undergraduate teachers of science at MUST (Adjusted R^2 =.051). Results demonstrate a standardized beta of.231, indicating that a one-unit increase in overall grit would result in a.231-unit increase in academic achievement. However, perseverance of effort alone explains 4.1% of the variability in academic achievement (Adjusted R^2 =.041). A standardized beta of.208 indicates that a one-unit increase in overall mindset would result in a.208-unit increase in academic achievement. Consistency of interest alone explains 2.8% of the variability in academic achievement (Adjusted R^2 =.028).

Discussion

In this correlational study among undergraduate science teachers at MUST, in which the association between grit and academic achievement was investigated, findings indicated that grit was positively associated with academic achievement in that high grit led to high academic achievement (see Table 4). The study findings are consistent with those of Alhadabi and Karpinski (2019), and Mason (2018).

Alhadabi & Karpinski (2019), in a cross-sectional study, aimed at investigating the relationship between grit and academic achievement among university students of Public Midwestern University in the U.S. (n=258). The results revealed that grit was positively associated with academic achievement. In another cross-sectional study, Mason (2019) examined grit and academic achievement among a sample of South African university students (n=121). The results demonstrated that students who scored highly on the Grit Scale also obtained high academic achievement. These findings affirm that grit is an important predictor of academic achievement.

According to Christopoulou et al. (2018), grit entails working persistently and vigorously towards a challenging goal, sustaining effort and keeping unabated interest over a long period of time despite failure, setbacks, obstacles, and phases of instability in the course of progress. Gritty individuals employ stamina to stay on track and attain their goals, contrary to individuals low in grit who get easily bored or disappointed and give up effort or choose an alternative action.

On the contrary, several studies found no relationship between grit and academic achievement (Chang, 2014 & Bazelais, 2018). Chang (2014) studied the effect of grit on incoming freshmen at a competitive four-year institution. A hierarchical multiple regression analysis found that overall, the grit score was not a significant predictor of first-year academic achievement. In the same study, the two facets of grit were examined separately; it was found that the consistency of interest subscale score predicted negatively first-year academic achievement, while the perseverance of effort subscale led to an increase in first-year achievement.

Palisoc et al. (2017) examined if grit was correlated with academic achievement in a pharmacy program at Touro University California (n=98). The results revealed that there was no significant correlation between grit scores and academic achievement.

The pursuit of academic learning is a long-term goal full of difficulties that require students to regulate themselves to conquer challenges. Grit triggers one to overcome difficult tasks, leading to great academic achievement (Jiang et al., 2019; Romer et al., 2010). That is, students who work hard and also love what they do are likely to overcome setbacks and challenges such as financial problems, examination pressure, coursework load, among others, during their academic journey and achieve greatly in their academics. Thus, less gritty individuals are easily distracted by such challenges and quickly lose track of their goals. Moreover, they are easily distracted by new ideas in projects since they are not as persistent as gritty individuals. All this can result in low academic achievement. On the other hand, Hogan and Wong (2013) consider that grittier students tend to work harder and longer and are more inclined to engage in deliberate practice to enhance performance and success. In addition, gritty people are less inclined to be discouraged by failures and are self-motivated in the absence of external rewards (Duckworth et al., 2007; 2011).

Conclusions

This quantitative study was an investigation of the association between grit and academic achievement of science undergraduate teachers at MUST. The study findings implied that although cognitive measures are often considered when making university academic decisions, certain non-cognitive variables have proven to be successful in identifying and supporting individuals most likely to achieve a long-term goal, such as academic achievement, degree completion, among others. Generally, there was a significant relationship between grit and academic achievement among undergraduates.

Recommendations

The findings provided a positive statistically significant relationship between grit and academic achievement of science undergraduate teachers at MUST. Some previous studies have also confirmed these relationships. Therefore,

Undergraduate teachers should avail themselves of opportunities to increase their grit. For instance, workshops, seminars, and peer counselling sessions should be organised to enhance students' grit. Such learning opportunities should offer them knowledge and skills pertaining to perseverance and building stamina through struggles and failures.

Lecturers should consider imparting non-cognitive skills, particularly those that promote grit, to students. Including these skills in the curricula could be effective in enhancing academic success. For instance, learners should be availed with the nature of curricula that offer real-world learning, exposing learners to real-world problems, allowing them to investigate and create their own learning and make use of their mistakes to perfect their learning. This will enable them not to fear making mistakes and view challenges as an opportunity to gain more knowledge.

Additionally, professional development through staff workshops is needed for educators to offer proper feedback that promotes grit.

Implications for further research

A longitudinal study on the relationship between grit and academic achievement of students during their transition to the university is recommended. This will be more predictive as the levels of grit will be measured over time. This could allow the researcher to examine such questions as how grit and mindset may grow throughout students' undergraduate years.

This study was limited to science undergraduate teachers of MUST, Faculty of Science. Therefore, the results may not be generalised to other faculties at MUST and other universities. The study should be replicated considering a cross-section of samples from other faculties at MUST and other universities to enhance the generalisability. Furthermore, research on grit and academic achievement should include diploma and postgraduate students who are equally affected by study variables.

Findings from mixed research methods may provide elaborate information on these study findings. Thus, further research should employ mixed methods to incorporate non-quantifiable variables into the data analysis, thereby providing a platform for gaining a fuller understanding of the participants' perspectives on the intricacies of the study.

Where possible, further research on grit should seek to incorporate data derived from additional sources such as ratings from parents, teachers, and academic records, which were unavailable in this study. This would give a wide range of information about students' grit.

Other non-cognitive factors can be studied in addition to grit to establish their influence on academic achievement since the findings show that grit has little influence on academic achievement.

Statements and Declarations

Data Availability

The data associated with this article will be deposited in a suitable repository for open accessibility and upon reasonable request.

Informed Consent

The study participants provided written informed consent, using the IREC consent form, protocol number MUST-2021-175.

Author Contributions

Both authors conceived the study concept. IT developed the concept and secured ethical approval under the guidance of AR. IT collected the study data under the supervision of AR. Both authors participated in data analysis and the writing of the manuscript.

Competing Interests

The authors declare no conflict of interest.

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References

- Akatuhurira, S. (2019). Factors that affect the academic performance in Makerere University. [Unpublished master's dissertation], Makerere University.
- Alhadabi, A., & Karpinski, A. C. (2019). Grit, self-efficacy, achievement orientation goals, and academic performance in university students. *International Journal of Adolescence and Youth, 25*(1), 519-535. https://doi.org/10.1080/02673843.2019.1679202
- Atibuni, D. Z. (2012). Academic attitudes, religiosity, locus of control, and work readiness among university students.

[Unpublished master's dissertation], Mbarara University of Science and Technology.

- Barrington, M. M. (2017). Assessing the link between grit and academic achievement in reading, mathematics, and writing among 4th graders: An explanatory sequential mixed-method inquiry. [Unpublished doctoral dissertation], Texas A&M University.
- Bazelais, P., Lemay, D. J., & Doleck, T. (2016). How does grit impact college students' academic achievement in science? *European Journal of Science and Mathematics Education, 4*(1), 33-43.
- Binning, K. R., Wang, M. T., & Amemiya, J. (2018). Persistence mindset among adolescents: Who benefits from the message that academic struggles are normal and temporary? *Journal of Youth and Adolescence, 48*(2), 286-296. https://doi.org/10.1007/s10964-018-0933-3
- Bowman, N. A., Hill, P. L., Denson, N., & Bronkema, R. (2015). Keep on trucking or stay the course? Exploring grit dimensions as differential predictors of academic achievement, satisfaction, and intentions. *Social Psychological and Personality Science, 6*(6), 639-645. https://doi.org/10.1177/1948550615574300
- Chang, W. (2014). Grit and academic performance: Is being grittier better? [Doctoral dissertation], University of Miami. https://scholarly.repository.miami.edu/oa-dissertations
- Clark, K. N., & Malecki, C. K. (2019). Academic Grit Scale: Psychometric properties and associations with achievement and life satisfaction. *Journal of School Psychology, 72*, 49-66. https://doi.org/10.1016/j.jsp.2018.12.004
- Christopoulou, M., Lakioti, A., Pezirkianidis, C., Karakasidou, E., & Stalikas, A. (2018). The role of grit in education: A systematic review. *Psychology, 9*(15), 2951-2971. https://doi.org/10.4236/psych.2018.915171
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Lawrence Erlbaum Associates.
- De Castella, K., & Byrne, D. (2015). My intelligence may be more malleable than yours: The revised implicit theories of intelligence (self-theory) scale is a better predictor of achievement, motivation, and student disengagement. *European Journal of Psychology of Education, 30*, 245-267. https://doi.org/10.007/s0212-015-0244-y
- Dixon, D. D., Worrell, F. C., Olszewski-Kubilius, P., & Subotnik, R. F. (2016). Beyond perceived ability: The contribution of psychosocial factors to academic performance. *Annals of the New York Academy of Sciences, 1377*(1), 67-77. https://doi.org/10.1111/nyas.13210
- Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the short grit scale (Grit-S).*Journal of Personality Assessment, 91*(2), 166-174. https://doi.org/10.1080/00223890802634290
- Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087-1101. https://doi.org/10.1037/0022-3514.92.6.1081
- Dweck, C. S., Walton, G. M., & Cohen, G. L. (2014).*Academic tenacity: Mindsets and skills that promote long-term learning.* Bill & Melinda Gates Foundation.
- Dweck, C. S., & Sorich, L. A. (1999). Mastery-oriented thinking. In C. R. Snyder (Ed.),*Coping: The psychology of what works*. Oxford University Press.
- Eskreis-Winkler, L., Duckworth, A. L., Shulman, E. P., & Beal, S. A. (2014). The grit effect: Predicting retention in the military, workplace, school, and marriage. *Frontiers in Psychology, 5*, Article 36. https://doi.org/10.3389/fpsyg.2014.00036
- Fraser, J. W., & Killen, R. (2003). Factors influencing academic success or failure of first-year and senior university

students: Do education students and lecturers perceive things differently? *South African Journal of Education, 23*(4), 254-260.

- Froedge, L. K. (2017). The effect of growth mindset on student achievement among students with disabilities [Doctoral dissertation, Western Kentucky University]. http://digitalcommons.wku.edu/diss
- Hijazi, S. T., & Naqvi, S. M. M. R. (2006). Factors affecting students' performance.*Bangladesh e-Journal of Sociology, 3*(1).
- Hogan, M., & Wong, K. (2013). Grit and mindset: Do you have the grit to go the distance?*Women Lawyers Journal, 98*(3).
- Jaclyn, M. S., & Cain, J. (2018). Review of grit and resilience literature within health professions education.*American Journal of Pharmaceutical Education, 82*(2).
- Jiang, W., Xiao, Liu, Y., Guo, K., Jiang, J., & Du, X. (2019). Reciprocal relations between grit and academic achievement: Longitudinal study. *Learning and Individual Differences, 71*, 1-9. https://doi.org/10.1016/j.lindif.2019.02.004
- Kyoshaba, M. (2009). Factors affecting academic performance of undergraduate students at Uganda Christian University. [Unpublished master's dissertation]. Uganda Christian University.
- Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist, 57*(9), 705-717. https://doi.org/10.1037/0003-066x.57.9.705
- Lone, P. A. (2016). A study of the relationship between self-concept and academic achievement among secondary school students of Jammu district. *Journal of Education and Practice, 7*(31), 19-23.
- Mason, H. (2018). Grit and academic performance among first-year university students: A brief report.*Journal of Psychology in Africa, 28*(1), 66-68. https://doi.org/10.1080/14330237.2017.1409478
- Mokhithi, M., Campbell, A., & Shock, J. (2018, November 16-19). The relationship between mindset and academic achievement at university: A quantitative study of South African students [Virtual conference session]. World Engineering Education Forum, South Africa.
- Nakalema, G. (2013). Academic stress, study habits, and academic performance of university students. [Unpublished master's dissertation]. Mbarara University of Science and Technology.
- Ngina, M. J., Kinai, T., & Ndambuki, F. (2018). Academic mindset as predictors of achievement among public secondary school students in Nairobi County, Kenya. *International Journal of Psychology and Research, 6*(2). http://www.ijern.com/
- Palisoc, A. J., Matsumoto, R. R., Ho, J., Perry, P. J., Tang, T. T., & Ip, E. J. (2017). Relationship between grit with academic performance and attainment of postgraduate training in pharmacy students. *American Journal of Pharmaceutical Education, 81*(4). https://doi.org/10.5688/ajpe81467
- Pate, A. N., Payakachat, N., Harrell, T. K., Pate, K. A., Caldwell, D. J., & Franks, A. M. (2007). Measurement of grit and correlation to student pharmacist academic performance. *American Journal of Pharmaceutical Education, 81*(6). https://doi.org/10.5688/ajpe816105
- Poropat, A. E. (2009). A meta-analysis of the five-factor model of personality and academic performance. *Psychological Bulletin, 135*(2), 322-338. https://doi.org/10.1037/a0014996

- Romer, D., Duckworth, A. L., Sznitman, S., & Park, S. (2010). Can adolescents learn self-control? Delay of gratification in the development of control over risk taking. *Prevention Science, 11*(3), 319-330. https://doi.org/10.1007/s11121-010-0171-8
- Strayhorn, T. L. (2013). What role does grit play in the academic success of black male collegians at predominantly white institutions? *Journal of African American Studies, 18*(1), 1-10. https://doi.org/10.1007/s12111-012-9243-0
- Tang, X., Wang, M. T., Guo, J., & Salmela-Aro, K. (2019). Building grit: The longitudinal pathways between mindset, commitment, grit, and academic outcomes. *Journal of Youth and Adolescence, 48*, 850-863. https://doi.org/10.1007/s10964-019-00998-0
- Wolters, C. A., & Hussain, M. (2015). Investigating grit and its relations with college students' self-regulated learning and academic achievement. *Metacognition and Learning, 10*(3), 293-311. https://doi.org/10.1007/s11409-014-9128-9