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Achievement Profiles in Math, Science, and English: Exploring Contextualized Sex Differences

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Abstract: Achievement Profiles in Math, Science, and English: Exploring Contextualized Sex Differences. Objectives: The study used a person-oriented approach to explore sex differences at the level of achievement profiles and describe such differences in the context of urban/rural schools. **Methods:** The achievement test scores in math, science and English of 2,408 tenth graders sampled from the database of the Center for Educational Measurement (CEM) in the Philippines were used to derive achievement profiles through cluster analysis. **Findings:** Four profiles were derived: Low Achievers, True Average Achievers, High Achievers with weak math and science skills, and High Achievers with strong math and science skills. Significant sex and urban/rural school differences among the profiles were found. The “female advantage” was more evident among Low Achievers, but not among High Achievers. Finally, High Achievers with weak math and science skills were mostly females in urban schools. **Conclusion:** The findings suggest that it was important to situate sex differences in context in order to understand achievement in key courses, such as STEM, of young children.

Keywords: achievement profiles, urban and rural schools, sex differences, cluster analysis.

Abstrak: Profil Capaian Belajar Matematika, Sains, dan Bahasa Inggris: Eksplorasi Perbedaan Jenis Kelamin yang Dikontekstualisasikan. Tujuan: *Studi ini menggunakan pendekatan person-oriented approach untuk mengeksplorasi perbedaan jenis kelamin pada tingkat capaian belajar dan mendeskripsikan perbedaan tersebut dalam konteks sekolah perkotaan/pedesaan.* ***Metode:*** *Nilai uji capaian pembelajaran matematika, sains, dan bahasa Inggris dari 2.408 siswa kelas sepuluh yang diambil sampelnya dari database Pusat Pengukuran Pendidikan (CEM) di Filipina digunakan untuk memperoleh profil capaian belajar melalui analisis kluster.* ***Temuan:*** *Empat profil diperoleh yaitu siswa dengan capaian rendah, capaian rata-rata, capaian tinggi dengan keterampilan matematika dan sains yang lemah, serta capaian tinggi dengan keterampilan matematika dan sains yang kuat. Ditemukan perbedaan profil yang signifikan untuk jenis kelamin dan sekolah perkotaan/pedesaan yang berbeda. “Keunggulan wanita” lebih terlihat di antara kelompok capaian rendah, tetapi tidak untuk kelompok capaian tinggi. Akhirnya, kelompok capaian tinggi dengan keterampilan matematika dan sains yang lemah sebagian besar adalah perempuan di sekolah perkotaan.* ***Kesimpulan:*** *Temuan menunjukkan bahwa penting untuk menempatkan perbedaan jenis kelamin dalam konteks untuk memahami pencapaian dalam pelajaran-pelajaran inti, seperti STEM, bagi anak-anak.*

Kata kunci: *profil prestasi siswa, sekolah perkotaan dan pedesaan, perbedaan jenis kelamin, analisis kluster.*

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INTRODUCTION

Many educational institutions all over the world are seeing a reversal of sex-based disparity in educational attainment. Girls and women are being documented as having higher general achievement than boys and men (Bacharach et al., 2003; Clark et al., 2008; Demie, 2001; Hubbard, 2005l Yunus et al., 2021), and are over-represented in academic completion and success (Becker, 2014; Cohn et al., 2004; Quenzel & Hurrelmann, 2013; Saunders et al., 2004; see reviews, Buchmann et al., 2008; Hadjar et al., 2014). In Stoet and Geary's (2015) work, they analyzed academic achievement data from four PISA assessments, representing 1.5 million learners, and found that girls outperformed boys in math, reading, and science. Most scholars (e.g., Adamuti-Trache et al., 2013; Etim et al., 2016; Legewie & DiPrete, 2012; Lörz et al., 2011) consider this as a significant change from the past that saw the prominence of the male advantage and, at the same time, a different version of disparity in the access to education. Such is still a problem that invites further research, since this gap will eventually have large-scale impact in various social, political, and economic structures (Berggren, 2011; Klasen & Lamanna, 2009; Seguino, 2000).

Understanding sex-based disparity in educational attainment and success is typically done by looking into performance differentials of students in achievement tests. Reviewing this research area, however, depicts a somewhat messy picture. First, studies that focused on domain-specific achievements (e.g., specific math achievement, specific reading achievement) largely point that achievement differences between females and males are only minimal and negligible (Dimitrov, 1999; Reardon et al., 2019; Rosén, 1995; Stumpf, 1995; see review, Hyde et al., 1990) while others see a glaring female superiority (Stoet & Geary, 2015). Second, investigations using a nested-factor model of achievement, which specifically examined achievement in one subject area while controlling for the influence of general academic achievement (the *g* in education), provides evidence for large differences favoring males in terms of math and favoring females in terms of reading (Brunner, 2008; Brunner et al., 2008, 2013). Lastly, research works that focused on achievement differences by sex categories alone were strongly criticized as being context-free. For example, Wai and colleagues (2010) believed that sociocultural factors have a potential role on the changes in achievement patterns of females and males. Consideration of these factors, which include SES and culture, along with sex, has always been advocated to provide a better picture of sex-based achievement disparity (Brunner et al., 2013; Chapin, 2006; Dimitrov, 1999; McDaniel et al., 2011; Scott, 1987; see reviews, Buchmann et al., 2008; Legewie & DiPrete, 2012).

Taken together, much of what we understand is that sex-based achievement disparity may create different scenarios depending on how academic achievement and attainment is framed conceptually and psychometrically. In addition, sex-based achievement difference research may potentially reveal new and important insights when contextual influences are considered, which comes from an understanding that sex and achievement are not free from sociocultural influences. This present study aimed to contribute in this line of research by considering academic achievement as person-oriented. This conceptualization is unique as it captures students' academic achievement as a configuration or profile of achievements in different subject areas. Moreover, a commonly neglected school contextual variable, the school location (urban/rural schools), was considered in this study to situate and describe the nuances of achievement differences between females and males.

The Importance of Achievement Profiles

The person-oriented approach (Bergman & Wångby, 2014) provides for a theoretical basis for the determination of students' academic achievement profiles. The basic proposition of this theory is that an individual is an organized whole with elements operating to achieve a unified functioning system (Bergman & Wångby, 2014; Sterba & Bauer, 2010). This means that there is structure and coherence in the way individuals function. In terms of academic achievement, this means that patterns of achievement in different subject areas can be discerned, thus the term *achievement profile*.

Surprisingly, extant literature has little to say about achievement profiles; the literature is dominated by examination of achievement in a subject area-oriented manner (e.g., math-focused analysis in Stoet & Geary, 2015). There were works that examined students' achievement profiles but they separately examined achievements in different subject areas. That is, they did not document academic achievement holistically from a person-focused perspective (e.g., Dimitrov, 1999). There were works also that may be described as close to a person-oriented conceptualization, such as the study on math-science expertise of mathematically precocious youth (Lubinski & Benbow, 2006), and the work on secondary school students' achievement profile shapes (Brunner et al., 2013). The latter was particularly interesting as it gave some evidence for the idea that students may have a profile of strong in reading but weak in math, and others a profile of strong in math but weak in reading. However, such work was predominantly subject area-centered as disparity between females and males was examined only at the level of specific achievement and not at the profile level.

Several scholars argue that the use of the person-oriented approach allows researchers to make inferences about specific individuals, and not about the variables under study (e.g., Konold & Pianta, 2005; Yukselturk & Top, 2013). As non-overlapping, homogenous groups could be created in doing a person-centered study, interventions and other practical considerations can be addressed directly to specific groups of individuals. This is difficult to achieve in variable-centered studies, where inferences are made on single, or a set of, variables (e.g., math achievement scores alone or science achievement scores alone). The value of determining person profiles from variables have been demonstrated in various research (e.g., Bavolar & Bacikova Sleskova, 2020; García Mendoza et al., 2019; Heikkilä et al., 2011; Lyndon et al., 2017; Vettori et al., 2022).

In this present study, achievement profiles were derived using tenth-grade students' achievement scores in three subject areas: science, math, and English. It is important to note that, with the person-oriented conceptualization of achievement, the generation of profiles would be driven by data. No specific hypothesis, or premeditated number of achievement profiles, guided the analysis. However, it was reasonable to expect that the achievement patterns that have been explored in the literature would be replicated: the math-science expertise and or the high-in-reading-and-low-in-math pattern.

Sex Differences in Achievement and the Urban/Rural Schools

Ceci and colleagues (2009) proposed a general causal model why there are sex differences in cognitive performance and educational success. Its main proposition is that the interplay of individual and sociocultural factors affects individuals' cognitive performance and success. This perspective complements the person-oriented approach by forwarding a proposition that there might be urban/rural school differences, aside from sex differences, in achievement profiles.

Accordingly, there are broad contextual influences (e.g., cultural beliefs, school location) that shape individual characteristics (motivations, beliefs, and activities, including biological make-up), which in turn influence brain development and consequent abilities. These abilities are then manifested in assessed performances, such as achievement test scores. Generally, support to Ceci and colleagues' (2009) causal model has been generally positive (Ackerman et al., 2013; Brunner, 2008; Brunner et al., 2008, 2013; Entwisle et al., 1994; Francis, 2000; Grabner et al., 2003; Johnson et al., 2009; Lubinski & Benbow, 2006).

In addition, for Ceci and colleagues (2009), biological sex can introduce differences in assessed academic performances as it directly affects brain development through hormones. It also shapes broad cultural and societal expectations, and indirectly influences brain development and related abilities. In a study, Johnson and colleagues (2009) found that sex differences may be attributed to the presence of certain genes in the *X* chromosome, and such genes have been known to have involvement in mental retardation. Similarly, Grabner and colleagues (2003) found that males and females differ in performance, achievement, and development of expertise because of differences in brain activation, particularly in cortical activity when solving intelligence-related tasks. Together, these studies indicate that achievement trajectories may be different for females and males, but they also suggest that schools have to continually create environments that can equalize access to resources, opportunities for growth, and support for the optimal development of both sexes.

Aside from the biological influences, Ceci and colleagues (2009) also gave emphasis on psychological influences, which include motivation and personality. This idea has been demonstrated in Ackerman and colleagues (2013), where they identified aptitude complexes or trait constructs not related to cognitive ability as factors that can determine performance differentials between females and males. Particularly, they identified four aspects of trait construct: intelligence-as-process, personality, interests, and intelligence-as-knowledge, representing them with measures of math/ science self-concept, mastery/organization, openness/verbal self-concept, anxiety in achievement contexts, and extroversion. Their findings revealed significant sex differences in all of these dimensions, except for openness/ verbal self-concept, and the interaction between sex and trait complex was significant in the regression of STEM persistence. In a different paper, a similar position was forwarded in Sakellariou (2020), where non-cognitive factors were also found to affect sex disparity in achievement in math, which include self-efficacy beliefs, self-concept, and math anxiety.

In a similar vein, Francis (2000), through a qualitative inquiry, found that in the context of favorite or preferred subjects, students felt that there were no sex differences in their abilities. Meaning, females and males may be better at different things, but both girls and boys had similar preferred subjects. Sex-based disparity was only found in least preferred subjects. On the other hand, Lubinski and Benbow (2006) used the theory of work adjustment in explaining sex differentials in personal and professional development. The theory states that certain individual's abilities and preferences interact with ability requirements of various aspects of environments, thus individual differences in psychological attributes are important considerations when understanding trajectories of males and females in academic achievement.

On the sociological side of the model, Entwisle and colleagues (1994) provided some support for it. In their study, they found that differentials in boys' and girls' math performance can be linked to differences in access to neighborhood resources. In particular, they explained that boys outperformed girls in math by because the former had more involvement in cultural and recreational activities outside their homes compared to the latter. Such neighborhood involvement was critical to the development of reasoning skills, a critical component of success in math. On the other hand, Xu and Li (2018) also contributed to this line of research on the social context influence by examining student-teacher gender match. Specifically, they found that teacher's sex can affect students' academic performance, where female teachers enhanced the performance of girls, but not boys'.

Further, in explicating the role of social context, Brunner and his colleagues (2013) argued that the role of environment, including cultural differences in how education is valued and cross-national differences in educational systems, contributes to sex disparity in achievement. Buchmann and his colleagues (2008) also noted that patterns of sex-based inequalities in education are, in fact, different for developing and highly industrialized societies.

In this study, the concept of urban/rural school was used as a social-contextual factor of achievement disparity between females and males. In a review article, Bæck (2016) argues that students in rural and urban schools vary in terms of the compositional and contextual effects of their communities. Specifically, for rural school students, compositional effects (e.g., ethnicity, SES and educational background of people in the locality) interact with contextual effects (e.g., local or regional labor markets, rural school management) of their community that impact their psychological attributes related to schooling, such as motivation, choices, preferences, and interests. More specifically, for boys and girls in rural schools, the patriarchal and masculine cultural features of rural societies, including gendered work and social patterns, contribute to sex differences in academic achievement.

This Study

Sex disparity in academic achievement remains to be an issue. Though recent literature is seeing a reversal of sex disparity from male to female superiority, such is still a problem. To bring more light into this matter and contribute in the ongoing discourse, it is argued that analyzing academic achievement from a person-focused analysis and situating it in the context of school location (i.e., urbanity or rurality of schools) could bring in more insights. This is in line with the proposition forwarded by Ceci and colleagues (2009) and others (e.g., Lubinski & Benbow, 2006) that individual characteristics, including sex, interact with sociocultural and environmental factors in the development of academic abilities and skills, achievement patterns. Specifically, this study aimed to contribute in the literature on sex differences in academic achievement by (a) using a person-oriented approach and (b) considering the context of rural and urban schools. More specifically, two specific research questions guided this study:

1. What achievement profiles could be derived from the achievement test scores in science, English, and math of tenth graders?
2. Are there significant differences in empirically-derived achievement profiles when compared according to a) males and females, b) rural and urban schools, and c) males and females in rural and urban schools?

■ METHODS

Participants

A total of 2,408 tenth-grade students was randomly selected from the database of the Center for Educational Measurement (CEM), an institution that provides testing services for public and private schools all over the Philippines. These students were from the three major regions of the country: Luzon (23% urban; 20% rural), Visayas (10% urban; 26% rural), and Mindanao (17% urban; 4% rural).

Research Design and Procedures

The design of the current study was descriptive, cross-sectional, non-experimental quantitative research (Johnson, 2001). Descriptive because this study aimed to describe achievement profiles of tenth-grade students; cross-sectional because comparisons were made between girls and boys in rural and urban schools; and non-experimental because no variables were manipulated nor controlled.

The researcher initially conceptualized this study based on the kinds of data that CEM was willing to make available from their database. After the research proposal was approved, CEM consented the author to make use of all data that he needed to complete this study. That is, the CEM provided the researcher with all the information about the 2,408 students. Upon completion, this research was presented for a conference organized by CEM itself.

Instrument

Since this study only used existing scores from the CEM database, no research instruments were used. The CEM provided the researcher with the following data: 1) sex, 2) type of school of learners, whether it was in a rural or urban location, and 3) raw scores in achievement tests in English, math, and science. The achievement tests were K-12 curriculum-based tests assessing knowledge and skills for Grade 10 and were administered in the last quarter of school year 2016-2017.

Data Analysis

Preliminary data analysis was done to perform data screening and cleaning. This mainly involved identification of multivariate outliers using Mahalanobis distance and examination of descriptive statistics for normality.

Cluster analysis was used an exploratory classification technique to answer the first research question. It was performed in two phases: the first was to determine the acceptable range of cluster solutions using agglomerative-hierarchical clustering and the second was to identify the best cluster solution within the identified range using k-means clustering. This technique was used in similar studies (e.g., Collie et al., 2017; Yukselturk & Top, 2013).

For ease of interpretation, the *z*-scores (mean = 0; standard deviation = 1) of the total raw scores for English, math, and science were used for the analysis. The agglomerative-hierarchical clustering used the Ward's method as the clustering algorithm and the squared Euclidean distance as the proximity measure to extract non-overlapping and homogeneous clusters. Benchmarking on the work of Collie and others (2017), the determination of the acceptable range of cluster solutions was based on the percentage change in agglomeration coefficients of cluster groupings, which should not be lower than 10%. In k-means clustering, the judgment of the best cluster solution was made on the bases of plausibility and relatively-balanced cluster sizes.

The best cluster solution was considered as the set of achievement profiles. Then, cross-tabulations with chi-square testing were done to answer the second research question. Specifically, one-way cross-tabulations were done to examine differences between (1) males and females and (2) urban and rural schools. Two-way cross-tabulation was also done to examine differences among males and females in urban and rural schools. All analyses were performed using the IBM SPSS Statistics version 23.

RESULTS AND DISCUSSION

The final dataset that was analyzed had 2,398 cases after ten outliers were deleted. There was approximately equal representation of rural females (25.10%), rural males (24.85%), urban females (25.06%), and urban males (24.98%). Table 1 displays the descriptive statistics, which generally indicate normality.

Table 1. Descriptive statistics

	M	SD	Skewness		Kurtosis	
			Statistic	Std. Error	Statistic	Std. Error
English	28.633	9.6006	.017	.050	-.956	.100
Math	21.826	8.5343	.672	.050	-.081	.100
Science	22.663	7.8977	.275	.050	-.641	.100

Note: Descriptive statistics were calculated on unstandardized variables.

Phase 1: Agglomerative Hierarchical Clustering

The identification of achievement profiles using scores in English, math, and science began with performing agglomerative hierarchical clustering with the data. The percent changes in agglomeration coefficients for two to ten clusters were computed, and it was revealed that moving from one to two clusters explained 44.74% variance in cluster groupings. Moreover, moving from two to five clusters explained 39.95%, 17.66%, and 10.72% additional variances, respectively. After this, moving from five to ten clusters explained less than 10% additional variances in cluster groupings. Hence, based on this information, the range of cluster solutions that should be explored further was two to five.

Phase 2: *k*-means Clustering

The *k*-means clustering was performed to manually generate and evaluate the two-, three-, four-, and five-cluster solutions; the two- and thee-cluster solutions were first examined. In terms of the sizes of clusters in both solutions, a relatively proportionate representation of the sample was evident. However, in terms of the level of detail, the two-cluster solution revealed a high-in-all cluster and a low-in-all cluster as potential achievement profiles, while the three-cluster solution had a middle ground. Hence, the three-cluster solution was considered more desirable than the two-cluster solution.

Next, the three- and the four-cluster solutions were compared. It was revealed that the low-in-all cluster and the middle-ground cluster in the three-cluster solution were retained in the four-cluster solution. The high-in-all cluster, however, was noticed as being split into two clusters with marked differences in math and science scores. This pattern echoed the previous works of Lubinski and colleagues (2006) on high-achieving students' math-science expertise. That is, one cluster could be the high-achieving math-science expert profile and the other could be the high-achieving math-science inexpert profile. Examining the cluster sizes of the four-cluster solution revealed relatively balanced sample representation. Thus, the four-cluster solution was considered more plausible and informative than the three-cluster solution.

Finally, the four- and five-cluster solutions were compared. In the five-cluster solution, one cluster was clearly the same as the low-in-all cluster seen in previous solutions. However, two clusters were somewhat duplicates of the other two, hence difficult to interpret. In terms of cluster sizes, there was somewhat imbalanced sample representation (e.g., one cluster has 14% and another 29%). The final, deemed most plausible, cluster solution was the four-cluster solution.

In Figure 1, the empirically-derived achievement profiles are shown based on the four-cluster solution. The profiles are labeled Low Achievers, True Average Achievers, High Achievers with Weak Math-Science Skills, and High Achievers with Strong Math-Science Skills, with sample representation of 31%, 30%, 21% and 18% respectively.

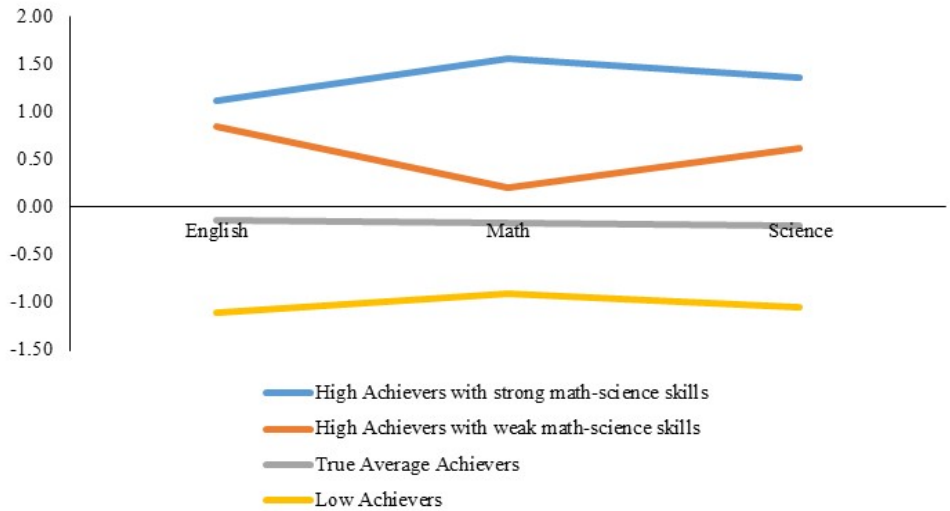

Figure 1. The empirically-derived achievement profiles

Cross-tabulations and Chi-square Analyses

Figure 2 displays the bar charts of one-way cross-tabulation of sexes and achievement profiles. Chi-square test revealed there were significant differences in achievement profiles when compared according to sex (Pearson's X^2 (3, 2398) = 43.84, p > .001, Cramer's V = .135). The sex differences in achievement profiles suggest that the female advantage was strong among Low Achievers, but not among High Achievers with strong math and science skills. This means that among high achievers, there was not much disparity between females and males, but this also suggests that among low achievers, there were pronounced sex differences in test scores in three subjects. This finding connects to the work of Stoet and Geary (2013) on their analyses of math and reading scores from ten years' worth of PISA data where they found that, among low performing students, there was large sex differences in reading. However, in the same study, they found no sex differences in math

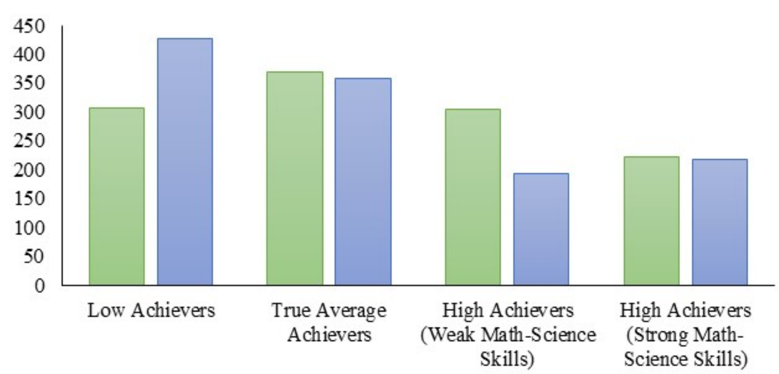

Figure 2. Sex differences in achievement profiles. Female and male are represented in green and blue color, respectively.

among low performing students. Further research needs to done to verify this observed result. In addition, it is interesting to point that most High Achievers with weak math and science skills were mostly females. This finding could explain why, in senior high school and higher education levels, there is underrepresentation of females in STEM courses (Ceci et al., 2009).

Figure 3 presents the one-way cross-tabulation of urban-rural schools and achievement profiles. Chi-square test revealed there were significant differences in achievement profiles when compared according to urban-rural schools (Pearson's X^2 (3, 2398) = 437.79, p > .001, Cramer's V = .427). These findings suggest that the urban school advantage was outstanding and strong. Among Low Achievers, most were from rural sc

(2019) and Sanfo and Ogawa's (2021) works that there were learning challenges in rural school settings. Among the High Achievers with strong and weak math and science skills, most were from urban schools. This finding supports the literature that certain compositional effects (e.g., low SES, ethnic minority background, low parental educational background) and contextual effects (e.g., rural school management) of rural schools are detrimental to students' academic achievement (Bæck, 2016; Lin et al., 2014; Lounkaew, 2013; Miller & Votruba-Drzal, 2013; Wang et al., 2018). Generally, this finding invites more research to pin down the specific aspects of rural schools that do not facilitate high academic achievement among students. Similarly, more research also needs to be done to identify the specific positive effects of urban schools on

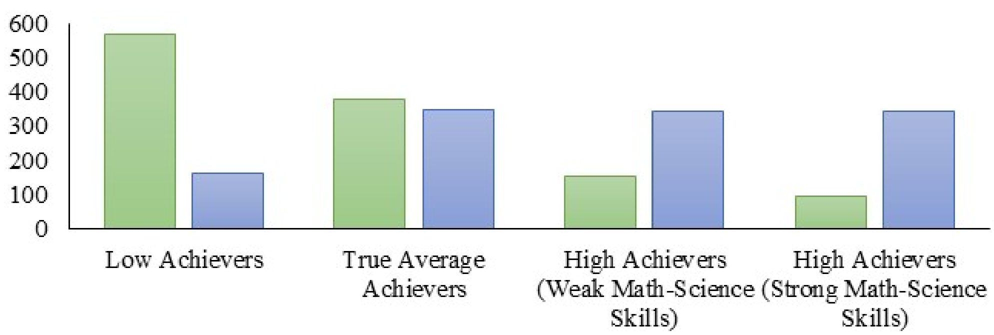

Figure 3. Urban-rural school differences in achievement profiles. Rural and urban schools are represented in green and blue color, respectively.

Figure 4 presents the two-way cross-tabulation of sex, urban-rural schools, and achievement profiles. Chi-square test revealed that there were differences in achievement profiles when females and males in urban and rural schools are compared (Pearson's X^2 (3, 2398) = 467.60, p > .001, Cramer's V = .263).

The differences among females and males in rural and urban schools point to at least two discussion points. First, when school location was considered, the female advantage was less apparent; instead, the urban school advantage became more prominent. As it can be seen in Figure 4, there were more urban males in each High Achievers profile than there were urban males in Low Achievers profile; there were also more urban females in each High Achievers profiles than there were urban females in Low Achievers profile. Similarly, there were more rural females in Low Achievers profile than there were rural females in each High Achievers profiles and there were more rural males in Low Achievers

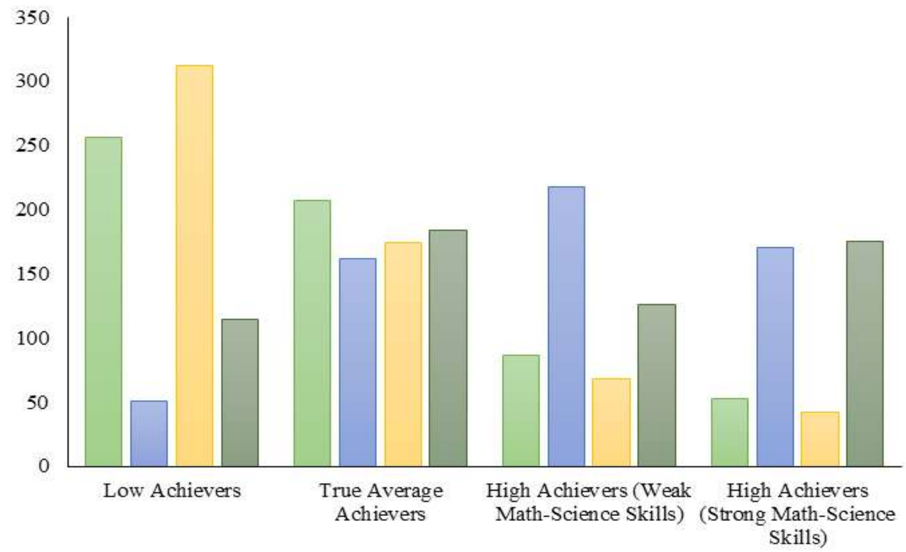

Figure 4. Sex and urban-rural school differences in achievement profiles. Females and males in rural schools are represented in light green and yellow, while females and males in urban schools are represented in blue and dark green.

profile than there were rural males in each High Achievers profiles. These observations suggest that the story may not really be about sex disparity at all, but about disparity between urban and rural schools. The salience of school location, specifically its rurality or urbanity, may exert potent influences in shaping student achievement. For example, in Miller and Votruba-Drzal (2013), they found that rural areas may see poor achievement of learners because the households in such areas are less advantageous, parents are more likely to use home-based pre-schooling instead of center-based preschool training, and parents in rural areas are less knowledgeable in child development compared to parents in urban areas. This is similar to several other studies where rurality of schools is held responsible for poor academic achievement of learners regardless of sex, and school rurality is described in terms of few educational resources for learners (Lounkaew, 2013; Wang et al., 2018), difficult school accessibility (Lin et al., 2014), infrastructure issues and poverty (Khudadad & Mickelson, 2021; Lindsjö, 2018), lower levels of education of parents in rural areas (Cheng et al., 2019; Wang et al., 2018; Zhao, 2022), and some other social and economic features of a locality (Shafiq, 2013).

Second, there were many urban females in both High Achievers clusters and very minimal in the Low Achievers cluster, suggesting that school urbanity may have unique affordances for girls that could not be found in rural schools. This unique observation indicates that, compared to boys, girls may be taking more advantages from urbanity of a school. Though research along this line is limited, some have noted that girls and boys may differ in responding to certain social affordances. For example, in the work of Liu and colleagues (2020), they found that urban girls in China were more likely to be advantageous compared to urban boys in terms of parental expectations, which in turn contributed to better academic performance. In other words, girls were found to be more likely motivated than boys to do good in school because of expectations set by parents.

CONCLUSIONS

The present study aimed to explore sex and urban/rural school differences at the level of achievement profiles empirically derived from three sets of scores: math, science, and English. Using cluster analytic techniques, four achievement profiles were derived from the data: Low Achievers, True Average Achievers, High Achievers with weak math and science skills and High Achievers with strong math and science skills. These profiles were non-overlapping; it could be said that a tenth-grader assumed an achievement profile that was one of the four profiles. While the two profiles were straightforward (the Low Achievers and the True Average Achievers), the other two (the High Achievers who were different in terms of math and science skills) were noteworthy. The studies of Lubinski and colleagues (2008) on the math-science expertise among gifted students were replicated with such finding. Specifically, it could be said that the high-achieving students may differ in terms of whether they were weak or strong in math and science subjects, and this difference could not be observed among low-achieving and average-achieving students. In addition, it had been fruitful examining sex and urban/rural school differences in achievement profiles. A message was made clear that achievement differentials could be more about the urban/rural school disparity instead of gender disparity.

The findings of the present study have at least three implications for practice. First, there is a need to focus on low performers in both rural and urban schools. School administrators and heads may consider looking into their difficulties and formulate appropriate bridging programs to help them cope up with their high-achieving peers. Based on the findings, the focus on the low achievers is as important as remedying sex-based achievement disparity, since male and female high achievers (with strong math and science) tend to not differ with each other. Second, there is a need to eliminate the urban/rural school differences as it is the factor that strongly creates achievement disparity among students. The male/female dichotomy may still be ignored, but not the urban/rural school dichotomy. Interventions may be planned to counter the effects of "rurality" of schools. To do this, more researches certainly need to be done, including dissemination of this information to policy makers who decide on resource allocation for urban and rural schools. Finally, school administrators and teachers may need to identify who among the female high achievers in urban and rural schools are weak in math and science. They need to gather them as they are probably the cause whey there is currently underrepresentation of women in STEM courses. Intervention programs may be designed to remediate their weakness.

This study is not without limitations. First, the sample cannot be readily considered as nationally representative of Filipino students. It may be noted that the data were from students of client-schools of the Center of Educational Measurement (CEM), and most of these schools were, in fact, private institutions. Future researchers who might want to replicate the present findings may consider a nationally representative sample, a sample of students from a post-secondary school level, and/or a sample of students from different countries. Second, the clusters derived empirically need to be validated using an external variable (Pastor & Erbacher, 2019). In the case of the present study, no validation was done. Future researchers who might consider replicating the achievement profiles may do a validation by performing further statistical tests wherein the achievement profiles are the independent variable and theoretically-relevant constructs, such as college admission test performance and career interests, are the dependent variables.

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