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Individual Educational Achievement of Children Under Five Years Old as a Predictor of School Readiness

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ABSTRACT

The current paper aims to review the body of literature on the topic of academic achievement prediction to establish if it is possible to predict the academic achievement of children before the end of their fifth year. A narrative synthesis performed on the body of the research obtained from Google Scholar, the 'Jstor' digital library and the university library, suggests that predictions can indeed be made regarding the academic achievement of this age group. The literature seems to suggest that both academic factors, such as Cumulative average, and non-academic factors, such as socioeconomic status, pre-school development and parental capital, can serve as moderately reliable predictors of academic performance from as early as 22 months. However, the evidence must be considered with caution as the definition and operationalisation of academic achievement varied across the research. In addition, factors such as motivation and self-efficacy were rarely taken into account. Still, the prediction of academic achievement in young children is possible. It can be improved with time as research continues to flourish in this area, and the issues regarding definition and measurement are recognised in the academic community

الملخص

هدفت هذه الورقة العلمية إلى استعراض الأدب والدراسات حول موضوع التنبؤ بالتحصيل الأكاديمي للأطفال دون عمر الخامسة، وذلك لمعرفة ما إذا كان من الممكن التنبؤ بالتحصيل الأكاديمي للأطفال دون الخامسة من العمر. طريقة السرد الذي يتم إجراؤه على مجموعة الأبحاث التي تم الحصول عليها من الباحث العلمي ومكتبة "Jstor" والمكتبة الجامعية، يسمح لها باقتراح إمكانية عمل تنبؤات بالفعل بشأن التحصيل الأكاديمي للفئة العمرية المذكورة من الأطفال. وبمراجعة العديد من الدراسات التي أجريت بهذا الغرض، والتي تؤكد جميعها على أن كل من: العوامل الأكاديمية (كالتحصيل الدراسي)، والعوامل غير الأكاديمية (كالوضع الاجتماعي والاقتصادي)، وتنمية ما قبل المدرسة ودخل الوالدين أيضا يمكن أن تعطى لنا صورة واضحة عن مدى تأهب الأطفال دون الخامسة للالتحاق بالمدرسة، وعن طريقها يمكن التنبؤ في وقت مبكر يصل إلى 22 شهرا، بشأن التحصيل الأكاديمي المستقبلي لهذه الفئة العمرية. ومع ذلك، يجب النظر إلى الأدلة بحذر حيث أن تعريف الإنجاز الأكاديمي وتفعيله يختلفان عبر البحث. وبالإضافة إلى ذلك، نادرا ما تؤخذ في الاعتبار عوامل مثل التحفيز والفعالية الذاتية. ومع ذلك، فإن إمكانية التنبؤ بالتحصيل الأكاديمي لدى الأطفال الصغار ممكنة ويمكن أن تتحسن مع مرور الوقت وباستمرار البحوث في هذا المجال، كما أن مشاكل التعريف والقياس المذكورة معروفة في المجتمع الأكاديمي.

1. Introduction

1.1. Importance of Predicting Academic Achievement:

The importance of being able to predict students' performance is irrefutable because it can be useful for both students and teachers and, implicitly, for the school as an institution (Shetty et al., 2019). Students who are struggling or find themselves on the verge of failing can benefit from special assistance, and the teacher can use such information to predict the percentage range for future exams (Shetty et al., 2019). Furthermore, the ability to predict educational performance has also been used to help students choose a suitable university major, to discriminate among participants in the university application process, to identify potentially productive individuals or just improve classes (Hellas et al., 2018). A specific use of predictors of achievement is represented by the school readiness screenings, which are meant as instruments to measure pre-school children's readiness to start school in order to improve current guidelines and policies regarding the adequate age for children to attend school (La Paro & Pianta, 2000).

1.2. Previous Reviews on Predicting Achievement:

The literature on this subject before the year 2000 mainly focused on the predictive potential of the school readiness screenings due to an increased interest in providing quality education to pre-school children (Boyer, 1992). According to a meta-analysis by La Paro and Pianta (2000), individual differences in students' academic/cognitive and social/behavioural development are small to moderately correlated to academic outcomes measured in the early school years. Despite the large number of studies included in the meta-analysis and the variety of methods used, the predictions in the academic domain were moderate while the ones for the social domain were low. These results suggest that there is a moderate level of stability of children's performance throughout their pre-school and school years. However, they also highlight that there is substantial variability within children's school performance, which is unaccounted for by the current assessment tools for school readiness (La Paro & Pianta, 2000).

In the last 20 years, the focus has changed from early assessment to identifying the factors that have accounted for the biggest proportion of variance in achievement. In line with previous work, studies that have investigated individual intrinsic characteristics, such as aptitude, motivation and self-regulation, have yielded inconclusive results with low to moderate effect sizes (Ray et al., 2003; Fong et al., 2017), and a growing number of studies have therefore been published investigating non-cognitive factors, such as socioeconomic background (Sirin, 2005), parental involvement (Fan & Chen, 2001) or parental level of education (Pishghadam et al., 2011). The results of such studies revealed medium to moderate correlations between socioeconomic level and achievement (Sirin, 2005) and between parental involvement and achievement (Fan & Chen, 2001). Although these results are not sufficiently powerful to suggest that non-cognitive factors could, on their own, predict academic achievement, they are a good indicator of how early educational performance might be predicted because they do not entail any assessment of the individual.

2. Methodological Issues

One of the main issues in studying predictors of academic

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achievement is the broad definition of the term, which makes the process of quantifying the concept slightly difficult and allows for differences from study to study. In the previous literature, it has been referred to in terms of GPA, exam results, overall or single subject achievement, acquisition of knowledge or even school retention (York et al., 2015). Therefore, comprehensive studies that try to gather evidence from multiple sources are faced with the issue of different measurements for achievement, which eventually leads to weaker or unreliable results. For example, in studying the relationship between SES and academic achievement in a meta-analytic review, Sirin (2005) notes that the correlations between single subject achievement measures (mathematics achievement, reading achievement, etc.) were stronger compared to general achievement measures (e.g. GPA). The lack of consistency in the methodology from one study to the next might also impact the validity and reliability of the research because the results cannot be replicated (Sirin, 2005). Similarly, the results of previous literature reviews on the subject could be impacted by publication bias, which is the tendency of a journal to publish studies that have yielded positive or statistical results. For the future of predicting academic achievement, this means that the evidence gathered is based only on studies that have found statistical correlations between achievement and different factors without accounting for how many studies have failed to find significant associations (La Paro & Pianta, 2000).

3. Goal

In light of the ideas mentioned above, the present paper seeks to review the current trends in predicting academic achievement and make predictions based on the available literature with regard to whether it would be possible, within the next 50 years, for individual educational performance to be predicted before a child completes its fifth year. The more recent literature will be used to gather evidence for the claim and to offer an overall picture of the current knowledge on the subject, which will form the basis for the predictions.

4. Research Question and Method

Based on current literature, the research question (RQ) is whether it will be possible in 50 years' time to predict individual academic achievement before a child completes its fifth year. In order to answer this RQ, the current paper will draw on existing literature on the subject to gather evidence that could support or reject the claims behind the RQ. The narrative synthesis method will be used to present the results and findings of the studies selected for the analysis. Narrative synthesis was preferred to other methods, such as meta-analysis, due to the predictive and estimative implications of the research subject. Furthermore, meta-analysis as a research method involves a rather complex process, and it is more time and effort consuming, which makes it inappropriate for the current paper (Mikolajewicz & Komarova, 2019). The current synthesis seeks to gather evidence from previous studies performed on academic achievement that could indicate the possibility of the early prediction of children's performance in the near future. Due to the novelty of the subject, narrative synthesis was more appropriate as it allows a broader range of studies to be included in the analysis (e.g. different study designs) compared to a meta-analysis, which uses a statistical approach to combine the results from similar studies to increase the strength of the results (Ryan, 2013). A common criticism of this approach, however, is the lack of transparency in interpreting the results and the development of the conclusion, as the subjectivity of the author is hard to control for (Ryan, 2013). This can lead to a decrease in the validity of the synthesis and, ultimately, to the extent to which the conclusion can be relied upon.

For the current synthesis, the included studies were selected from articles published in peer-reviewed journals, and the databases used were Google Scholar, 'Jstor' and the university library. Among the keywords used to look for the relevant articles were academic achievement, predicting factors, educational performance, GPA, SES and early assessment. To help increase the relevance of the articles, Boolean operations (OR; AND) were used together with the advanced search functions available on the chosen databases, which allowed for better filtering of the articles (Cronin et al., 2008). In addition, the truncation of words by replacing the ending of a term with a symbol was used to allow for a more comprehensive search that included variant spellings of the given term (Cronin et al., 2008).

The articles included in the analysis were published in the English language and were filtered according to date in an attempt to use only the most recently published papers. Because the aim of the paper was to gather evidence to support or reject the RQ, the papers included in the analysis had to either bring something new or challenge previous dominant ideas. Thus, multiple articles were found with similar research subjects (e.g. demographic factors as predictors of academic achievement). They were clustered together to form the next chapter and their results were used to provide a single data set. Finally, the studies were assessed for methodological quality, and the limitations were presented in the results section to allow for a critical evaluation of the current evidence on the subject of study (Ryan, 2013).

5. Results of the Review

5.1. Current Trends in Predicting Achievement:

According to a recent meta-analysis by Hellas et al. (2018), over the last decade there has been an increase in the number of research papers published on this topic, especially focused on predicting academic achievement in the form of course grades, exam grades or dropout rates. The factors named by Hellas et al. (2018) as being predominantly used to forecast achievement are split into five categories: demographic (e.g. age, gender), personality (e.g. self-efficacy, self-regulation), academic (e.g. high-school performance, course performance), behavioural (e.g. log data) and institutional (e.g. high-school quality, teaching approach). However, the research is dominated by the use of academic data, such as performance in previous years, and cumulative performance metrics, such as GPA or exam results (Hellas et al., 2018). The relationship between the predictive factors and performance is commonly assessed through linear regression and ANOVAs or decision trees. The meta-analysis also noted some possible methodological limitations caused by validity issues, such as the possibility of not including sufficient or appropriate articles, and whether the review criteria was applied consistently by all the reviewers. Some of the features used to predict achievement, such as 'motivation' or 'interest', were not described in sufficient detail, with some articles not even mentioning the instruments used to measure these features. Furthermore, the strongest effect sizes were reported when measuring achievement in terms of course grades, exam grades or GPA. The tendency to measure academic achievement in terms of course grades, GPA or exam results has been noticed in many recent studies (Klapp & Cliffordson, 2009; Olani, 2009; Rabiner et al., 2016; Bergold & Steinmayr, 2018). This is not entirely surprising as grades and GPA measures are the most readily accessible measurements provided by institutions (York et al., 2015). Although the approach of reducing the concept of academic achievement to just grades or exam results is highly debated by people arguing that they are not entirely representative of students' academic progress (Allen, 2005) and can be situation and institution specific (Vulperhost et al., 2017), students' grades offer a valid starting point in measuring academic

achievement because there is considerable overlap between completing learning objectives and the acquisition of knowledge and skills (York et al., 2015). In regard to the present RQ, an increase in the number of studies operationalising the concept of academic achievement in terms of grades or GPA could indicate that either such measures are becoming increasingly more reliable or that the concept has been narrowed down to reflect just one portion of students' performance (York et al., 2015). Either way, for the future of research on predicting students' educational performance, this could mean that predicting an individual's academic achievement from an early age is possible.

Another claim that individual educational performance could be predicted by a child's fifth year is reflected by the achievement gap between students of lower socioeconomic backgrounds and higher socioeconomic backgrounds, which has remained mostly unchanged for the past 50 years. According to the literature on the subject, students' SES remains one of the main predictors of academic achievement despite some structural changes at the societal level (Hanushek et al., 2009). In a comprehensive meta-analysis, Sirin (2005) investigated the relationship between parental socioeconomic status and students' academic achievement. The paper included an extensive number of studies that reported effect sizes varying from .005 to .77 in an attempt to control for publication bias and found an overall medium level of association between the two variables at student level and a larger one at school level (Sirin, 2005). However, it is worth mentioning that a big limitation in studying SES is the way the concept is quantified and measured. SES is usually described as both the economic and social worth of an individual or a family in terms of work experience, relations with others, household income, education, etc. (Hanushek et al., 2009). Thus, the complexity of the concept makes it hard to measure and leaves room for different approaches from study to study. For example, in the above-mentioned meta-analysis, the way SES was measured influenced the relationship with academic achievement (Sirin, 2005). The effect size was smaller when SES was operationalised using the neighbourhood characteristic and, conversely, larger when it was measured using home resources as an indicator.

This evidence suggests that although socioeconomic level is a strong predictor of academic achievement, research is currently lacking a comprehensive measuring scale for its multi-dimensional nature (Sirin, 2005). However, the relationship between SES and students' achievement can be explained by the fact that parents' background influences students' performance directly by providing the necessary resources and indirectly by determining the kind of school and classroom environment that they will attend (Sirin, 2005). Furthermore, differences in SES in childhood have a lasting effect (Caro et al., 2009). Students from the lower socioeconomic levels are more likely to leave school early (Alexander et al., 2001; Rumberger, 2004) and have less chances of being allocated to the college preparatory track compared to students from higher socioeconomic levels (Condron, 2007; Davies & Guppy, 2006). Although the gap emerges early in life (Hertzman & Weins, 1996), most research indicates that the gap only widens at the age of nine (Caro et al., 2009). The phenomenon explaining the widening gap is usually referred to as the cumulative advantage process (Caro et al., 2009). In the school setting, learning develops in hierarchical ways with more complex forms of learning building on simpler ones and, thus, inequalities at any developmental stage will have future consequences. Furthermore, students of lower socioeconomic backgrounds tend to be treated differently by teachers and are more likely to have lower academic aspirations due to financial barriers, such as high college tuition fees (Goldthorpe, 1996). Therefore, based on the current research on SES as a predictor of academic achievement, unless new policies are implemented to help students with lower SES, it is very likely that in the next 50 years SES will be a reliable predictor of achievement, especially if the research methodology improves.

5.2. How Early Can Achievement Be Predicted?

The above paragraphs provide evidence based on the current body of literature on predictors of achievement that forecasting an individual's educational performance from an early age should be possible within the next 50 years. Further on, the paper will try to assess just how early achievement can be predicted. Research on pre-school children provides evidence for the possibility of predicting achievement from a very young age (Feinstein, 2003). Using the information from a comprehensive dataset from 1970, Feinstein (2003) investigated if pre-school development was a significant indicator of later performance and whether the stratification observed originally remained consistent over the years or changed significantly. During the study, the participants were assessed four times, at 22 months old, at 42 months old, at five years old and at 10 years old. Finally, the results were compared with the actual qualification level of the participant at the age of 26.

The results showed that the assessment at the age of 42 months was predictive of achievement at age 10 and even of qualifications at the age of 26. However, some children who were categorised as being in the bottom quartile at pre-school age caught up or even overtook their peers, which emphasises the need to interpret such results as indicators of development rather than a strong classifying mechanism (Feinstein, 2003). Even though the results were less reliable when measured at 22 months, the author observed that children in the bottom quartile were still significantly less likely to obtain any qualifications compared to their peers from the top quartile. Due to the very young age of the participants, the author noted that such results represented strong findings and highlighted that even before children start school there are substantial signals that can be picked up by standard tests of child development that can predict their further educational performance (Feinstein, 2003). However, there are a few limitations to this study, the main one being that the dataset used is rather dated and new research is needed to confirm the results. It is also worth mentioning that even though the assessment of participants at different points in their lives was quite extensive, intrinsic factors, such as motivation, learning strategies or intelligence, were not accounted for. Evidence from a recent study on students' academic motivation shows that it can be predictive of academic achievement (Amrai et al., 2011), and it could account for the changes observed in the data (e.g. 15% of the participants from the bottom quartile had moved to the top by the age of 10).

Evidence for early predictors of achievement also come from a similar test performed in the U.S. that tested children and their parents at the end of kindergarten and then later on in the third grade (Schlee, 2009). The paper found that parental influence over their children's academic success was very strong, especially in the form of social capital. First, children coming from single-parent families performed significantly worse on achievement tests in comparison to children coming from traditional families. This finding was in line with previous literature that tried to explain the result by justifying that parents from single-parent families have less available time to develop stable relationships with their children (Leonard, 2005). Second, parents were found to influence their children's academic achievement through the provision of resources, both financial (e.g. having a computer in the home) and psychological (e.g. a mother's level of education was predictive of her child's achievement) (Schlee, 2009).

This finding was also consistent with the previous literature that emphasised the influence of socioeconomic levels on academic achievement (Haveman & Wolfe, 1995; Sirin, 2005). However, the study only measured children's reading and mathematical skills and did not account for any individual differences that might have affected the results, such as self-efficacy and academic motivation, which have been linked to achievement and school retention (Robbins, 2004). Based on the available literature, it can be estimated that prediction of academic achievement at a young age might be possible based on both student pre-school development and parental capital. However, it might not be a reliable tool unless it accounts for more personal factors that could influence a child's potential.

One issue seems to be recurring in the present review of the existing literature that makes predicting an individual's educational performance from an early age currently problematic. There seem to be variations in regard to measuring scales for both academic achievement and predictors of achievement (Kim & Suen, 2003). Across different types of test administration, the effect size for predictability varied. For example, readiness tests measuring children's academic skills were strongest when correlated with later academic achievement measured as a course grade or exam results (Kim & Suen, 2003). Kim and Suen (2003) analysed 44 studies that investigated the relationship between early predictors and academic achievement to show to what degree these relationships were generalisable. Based on the results, the authors concluded that the predictive power of early assessment is situation specific and discussed a number of conditions affecting the generalisability of early assessment predictions. These included the idea that different types of test administration created differences in the effect size for predictability, and the tests that were scored through ratings were the most efficient. This is to be expected if academic achievement is measured based on grades or exam results, which points to the idea that rather than assessing the predictive validity between test and criterion measure, further research needs to understand early procedures as a whole system and how academic achievement is currently assessed (Kim & Suen, 2003). In that regard, York et al. (2015) argue that academic achievement is only a portion of academic success, which is a more complex concept on which research should be focused. Unlike achievement, academic success also includes students' satisfaction, acquisition of skills and competences, persistence, attainment of learning outcomes and career success (York et al., 2015). By using a more comprehensive concept, research on predicting students' performance could be more reliable because it would account for psychosocial factors as well (York et al. 2015). Furthermore, Chiekem (2015) reported that current grading practices are not a valid measure of achievement because they are not solely based on academic performance but can be influenced by students' behaviour, attendance, homework completion or the teacher's expectations of specific students.

One revolutionary piece of technology that could improve research on predictive academic achievement is the method of educational data mining (EDM). EDM 'is an emerging discipline, concerned with developing methods for exploring the unique and increasingly large-scale data obtained from educational settings, and uses those methods to better understand students and the settings in which they learn' (Vizvizi et al., 2018). With the more frequent use of online educational platforms, more and more data is being collected on each student and can be used in research as a more comprehensive tool to assess an individual's educational performance (Silva et al., 2017). By having access to more information, researchers can assess more variables, such as the students' performance compared to the difficulty of the module, their performance before and after completing a certain course, patterns of behaviour, learning strategies, etc. (Silva et al., 2017). Although EDM has only been used in a few studies so far (see Silva et al., 2017, for a review) it can hold the key to more comprehensive research that could eventually build a more reliable model of predicting achievement.

6. Conclusion

The present paper has sought to draw on the existing literature on predictors of academic achievement to try to answer whether it will be possible in 50 years' time to predict individual academic achievement before a child completes its fifth year. The results of the present review were mainly supportive of the RQ; however, some limitations were found. First, the increase in the amount of published research measuring academic achievement in terms of course grades or GPA might suggest an improvement in the reliability of the measuring tools or that the term has been narrowed down to reflect a more specific concept. For predicting students' performance, improvements in the way research is conducted could mean that earlier and more reliable predictions are more likely to occur in the near future. Second, due to the predictive capabilities of non-academic factors, such as socioeconomic background and social inequalities, on students' academic achievement, in the absence of policy changes it is very likely that in the next 50 years the same factors will still represent reliable predictors. The literature suggests that the gap between students of lower and higher socioeconomic levels has remain unchanged for the past 50 years and the student differences appear early and have long-lasting consequences. Furthermore, the prediction of academic achievement at an early age might be possible based on both student pre-school development and parental capital. Pre-school development was found to be predictive of achievement from as early as 22 months old and parental capital, as measured at the end of kindergarten, was predictive of later school performance. However, in the absence of accounting for individual factors, such as motivation or self-efficacy, the results were not very reliable. Among some of the limitations identified in regard to early predictions of achievement, variations in the way achievement was defined and operationalised was found to be the most problematic for current research. Finally, the implications of the new EDM method have been discussed with regard to the future of predicting academic achievement from an early age.

Bios

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