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Exploring the ResearchGate score as an academic metric: Reflections and implications for practice

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ABSTRACT

This paper presents a response to the paper 'A critical look at the ResearchGate score as a measure of scientific reputation' [1]. Following up on arguments presented by the authors, which argue that the ResearchGate score is irreproducible and dependent upon Journal Impact Factors, a small-scale exploratory analysis of ResearchGate scores was undertaken to examine correlations between ResearchGate score and profile metrics. The importance of the Journal Impact Factor in determining ResearchGate score is confirmed, and insights gained into the relationship. A model which significantly predicts ResearchGate score is described. The findings are discussed in terms of the three arguments outlined in the original paper, and in relation to academic practice.

Categories and Subject Descriptors

D.2.8 [**Software engineering**]: Metrics; H.2.8 [**Database Applications**]: Scientific databases

General Terms

Measurement

Keywords

Bibliometrics, ResearchGate, composite indicators, Journal Impact Factor, reproducibility, digital scholarship.

1. INTRODUCTION – A CLOSER LOOK AT RESEARCHGATE SCORES

This paper presents a response to the paper 'A critical look at the ResearchGate score as a measure of scientific impact' [1]. Academic social networking sites such as ResearchGate are the focus of my current research. Working from a technology-enhanced learning background, I am examining the network structures facilitated by such sites and whether trends exist according to discipline or seniority [2,3]. My perspective centres upon the role that such sites plays in terms of developing an online identity as an academic, and their role in academic practice.

The authors present three key arguments, based on guidelines for research metrics, which restrict the suitability of the ResearchGate (RG) score as a measure of scientific reputation at present [1]. The arguments are as follows: first, the score is intransparent and irreproducible; second, the score incorporates the JIF to evaluate individual researchers; and third, changes in the RG score cannot be reconstructed [1]. The arguments presented resonate with my own perspective; openness and transparency are key tenets of good digital scholarly practices [4]. However, the assumptions behind the arguments do raise a question of whether attempts have

been made to reproduce the score, or quantify the contribution of different factors such as the JIF. To this end, a small-scale exploratory analysis of RG scores was undertaken.

According to the ResearchGate website, the RG score is "a metric that measures scientific reputation based on how all of your research is received by your peers" and incorporates three factors: contributions, interactions and reputation. No detail is provided as to how the factors are measured; however, clicking on an academics' RG score from their profile provides a pie chart of the extent to which four metrics present on profile pages contribute to their score. These include publications, questions, answers, and followers.

1.1 RG scores for single-paper academics

As a starting point, a small sample of academics (30) was constructed (during June 2015). The sampling strategy was non-random and purposive [5]; academics were included on the criteria of having a single paper, having been assigned a RG score, and not posted any questions or answers. This approach was used in initially order to eliminate the effects of multiple papers, or the contribution of questions and answers. Note that many single-paper authors have not been assigned a RG score, and any with over 1000 profile views were not included as above this threshold ResearchGate rounds the data. RG score, impact points, views, citations, downloads, followers and following data were collected from profiles. The ResearchGate 'impact points' metric is the sum of impact factors of journals the author has published in [6]. A correlation between impact points and RG score was apparent; plotting the data suggests that the natural log of impact points underpins the relationship (Figure 1).
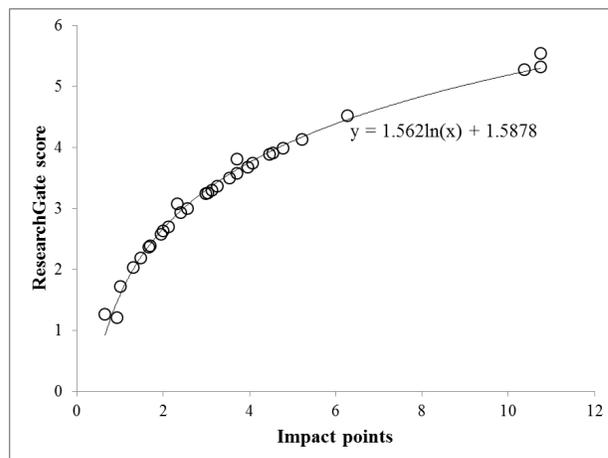

Figure 1: ResearchGate score plotted against impact points for single-paper academics (n=30).

1.2 RG scores for multi-paper and Q&A active academics

To explore the effects of multiple publications and question and answer activities, two further sub-samples of academics were added, again via purposive and non-random sampling. Thirty academics were included on the basis of having a RG score and multiple publications; a further thirty were added who have a RG score, multiple publications, and have posted at least one question and answer. Combined with the initial sample, this created a total sample of ninety academics. Again, academics with over 1000 views were excluded. In addition to the data collected in the first phase, number of publications, questions and answers were collected.

A multiple regression analysis [7] was carried out, using Minitab. An initial model was fitted using all available factors (including 2nd order factors, the natural log of factors, and two way interactions). Subsequently, non-significant factors were eliminated until the model contained only significant terms and the R^2 adjusted was maximised. In this case non-hierarchical models were allowed. Residuals plots and the R^2 predicted were examined to ensure the data did not violate any critical assumptions and that the model was not over-fitted.

It was found that the number of views ('views' term in the model), natural logs of impact points ('lnIF'), answers ('lnanswers'), and number of publications ('lnpublications') explain a significant amount of the variance in RG score ($F(6, 83)$ = 287.10, $p<.05$, R^2 = .954, $R^2_{Adjusted}$ = .951). The relationship between predicted values based on the model and actual RG scores is shown in Figure 2. Adjusted sum of squares values for significant factors are shown in Table 1. The regression equation of the model is as follows:

```
score = 1.223 + 0.629 lnIF
+ 1.2555 lnanswers + 0.6231 lnIF*lnIF
+ 0.003346 views + 0.018 lnpublications
+ 0.4227 lnIF*lnpublications
```
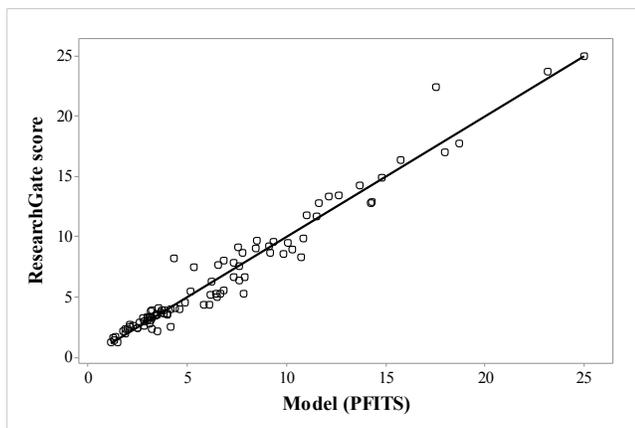

Figure 2: Correlation between predicted scores and actual ResearchGate scores (n = 90).

Table 1: Adjusted sum of squares for significant factors.

Source	ln IF	ln answers	ln IF^2	views	publications	lnIF*ln publications
Adj SS	655.5	260.70	129.3	36.70	13.9	33.9

2. DISCUSSION

Implications of the analysis, and other empirical studies which have focused upon the ResearchGate platform, are outlined here in relation to the three arguments made by Kraker and Lex [1].

2.1 The score is intransparent and irreproducible

The RG score is certainly intransparent; this would only be addressed if ResearchGate chose to publish the algorithm. Why the platform does not do so is not clear; it may be speculated that if the algorithm was public, academics may seek to actively distort the highest-impact contributing factors in order to 'game' the system and inflate scores. ResearchGate is a for-profit organization so perhaps the algorithm is considered a commodity – however, this would only be 'valuable' if the wider academic community chose to adopt the RG score (see concluding remarks).

It is possible to reproduce the RG score, to an extent. While the model here significantly predicts RG score, a small proportion of the variation within the data remains unexplained (4.9%) so it cannot be said with certainty that it replicates the RG score algorithm. The model does not include the term 'followers', although this can occasionally be seen in the pie chart score breakdowns on profile pages. It is therefore unknown whether the model holds for more popular profiles, and rounded data prevents accurate testing. Nonetheless, the model does provide some insight into the relative importance of factors likely to be contributing to the RG score (Table 1).

2.2 The score incorporates the JIF to evaluate individual researchers

Following the second argument [1], the analysis here confirms that impact points (a metric used by ResearchGate which appears to be the sum of academics' papers impact factors) make a substantial contribution to RG scores (68%). The data indicates that it is not a linear relationship, but relies upon the natural log of impact points scores. An implication of this is that academics with high impact points scores will experience diminishing returns by adding further papers in terms of their RG score. A possible explanation for the use of the natural log in this case may be an attempt to counter-act the skewed distribution of journal impact factors. However, this transformation does not offer much beyond simply comparing JIFs, nor does it ameliorate any of the issues related to the use of the JIF [1]. The number of citations an individual paper receives does not feature in the model. The analysis therefore underlines the inappropriateness of use of the JIF as a measure of an individual academic [1].

2.3 Changes in the RG score cannot be reconstructed

The sample here was not conducted over a period of time so does not offer any further insight into this argument. A temporal limitation was encountered in terms of the RG score is updated weekly, whereas many of the metrics displayed on profile pages (e.g. followers, views, answers) are updated in real time, which may account for a proportion of the unexplained variation in the model. While the way that the RG score is calculated is changing and developing in non-transparent ways over time, the interface of the site is also subject to continual redesign which may affect the way that academics interact with each other [8]. This would not affect the proportion of the score accounted for by the JIF, but

may influence the social factors such as questions, answers, followers, following and number of views.

2.4 Concluding remarks

This small-scale, exploratory analysis of RG scores extends the discussion and underlines the arguments presented by [1]. However, there remains a question of the extent to which the RG score is being used by academia as a metric in practice. This is related to questions of uptake of the site and its use in academic practice more generally.

A composite metric – of which the RG score is an example – offers advantages over the JIF and citation counts, as it has the potential to account for alternative ways of measuring activity and impact, which the RG score claims to intend to do via academics' social interactions on the site. However, there is a mismatch between the goal of the RG score and use of the site in practice, which may amplify the influence of the JIF upon RG score. Most academics who use ResearchGate view it as an online business card or curriculum vitae [9], rather than a site for active interaction with others [9,10,11]. In contrast, Twitter is more frequently the site for active discussions or commenting on research [10,11]. However, Stewart reports that metrics are a poor indicator of perceived academic influence on Twitter [12]; rather, less tangible factors such as recognisability and commonality play an important role.

The model suggests quantity of answers correlates with the RG score. Number of questions and answers are shown on ResearchGate profiles, but with no indication of their level of quality. Li et al. [13] examined perceived quality of answers provided to questions on ResearchGate; RG score was found to predict quality, however, so there may be a circular argument if a measure of quality was accounted for in calculating the score. When constructing the sample, it was observed that relatively few academics appear to post questions and answers, reflecting the perceived role of profiles as an online CV [9].

Kraker and Lex [1] conclude that network structure could be used as an alternative measure of reputation. Hoffmann, Lutz and Meckel [14] examine a range of network centrality metrics for a sample of academics via ResearchGate and discuss their potential as altmetrics. However, surveys have suggested that there is a disciplinary divide between ResearchGate (favoured by Natural and Formal Scientists) and its principal rival academic social networking site, Academia.edu (more popular with Humanities scholars) [11]. This may skew network structure [2] and be another reason against using a community metric based on one site alone.

To conclude, the aim of the RG score as a composite metric taking into account social interactions and reputation alongside traditional publication-based metrics is a desirable one, but there are limitations to the extent that this can be realised in practice. First, the factors that contribute to RG score are somewhat intransparent and can be changed without notice or explanation. Second, the RG score depends mainly on JIFs with little influence of social interactions. This may be by design of the algorithm or because most users view ResearchGate as an online CV, rather than using it as a site for social interactions. Third, the RG score only accounts for interactions on that particular site whereas activities may be distributed across different social media platforms. Finally, there is not consensus at present on the most appropriate way to conceptualise and measure academic influence via social media.

3. ACKNOWLEDGMENTS

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