A Note on Cost-Benefit Analysis

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Following the framework presented by Leech and Onwuegbuzie (2004), results from an heuristic example added to the very limited scholarly literature in the area of cost-benefit analysis, and also served as a potential template related to the relative ease of implementation of some of cost-benefits' components that have shown initial properties of augmenting results affiliated with correlational designs and/or program evaluation.

In the research literaure for the social sciences, the idea of understanding and/or reviewing the cost effectiveness and also the benefit(s) derived from an intervention or program activity is an emergent concept with limited scholarship devoted to it. Of the research in this domain, programmatic overall cost analysis has been presented in the literature via estimated measures (King, 1994; Odden, 2000). Program cost effectiveness measured through meta-analysis has been proffered by Borman, Hewes, Overman, and Brown (2003) and Yeh (2008). A correlational study combining both cost (i.e., program) and benefit (i.e., increased student test scores) was conducted by Quinn, Van Mondfrans, and Worthen (1984). Barnett (1985) offered a cost (i.e., program) and benfit (i.e., social investment of a program) analysis of a preschool program.

Finding literature and guidelines that amalgamate both known, direct costs of a program and said program's tangible benefit(s), coupled with other measures such as effect sizes and practical effects of an intervention and/or program activity, is arduous. Two seminal sources in the literature that looked at both cost and benefit in terms of the effectiveness of intervention results were offered by Levin (1983) and Levin and McEwan (2001). These authors develed into this area by providing guidance related to how reviewing costs of an intervention given the outcome(s) derived may provide new and/or additional information pertaining to an intervention's effect. Related to the Levin and Levin and McEwan works, Leech and Onwuegbuzie (2004) coined the term 'economic significance' as the "economic value of the effect of an intervention" (p. 185). Their work yielded a typology of five economic-related indices used to measure cost in its various forms: effectiveness, benefit, utility, feasibility, and sensitivity. A major component of their indices was to incorporate the cost, either direct or estimated, along with the effect, typically measured as either *post-hoc* raw differences or standardized differences (i.e., effect sizes). Finally, along this same line of thought in the field of psychology, Wittmann (2004; 2007) proposed the use of *a priori* break-even effect sizes (i.e., standardized differences) to compare with known effects from the literature resultant from meta-analysis to assist in estimating a return on investment of an intervention. Wittman's work was an extension of earlier social science cost-benefit research completed on economic impact from workforce productivity studies (Schmidt, Hunter, & Pearlman, 1982).

Context

A school-university partnership between Northern Illinois University and Rockford, Illinois Public School District 205 has been in existence for the past decade. The focal point of this comprehensive partnership is to enhance student learning. As part of a partnership evaluation, a correctional design was employed to measure the relationships and effect sizes obtained from programming initiatives concerning student learning in the content areas of mathematics and reading at two school sites: a P-5 elementary school and a 6-8 middle school (MS). The concept of "student learning" for schools in the partnership was measured via data attained from their performance in mathematics and reading on the Illinois Standards Achievement Test (ISAT).

Cost-Benefit Design

Following the framework of a cost-benefit analysis presented by Leech and Onwuegbuzie (2004), two indices were implemented. The first index related to the cost per level of effectiveness (CE), where C was the direct cost of the program and E was the practical effect measured in terms of the raw difference in testing points (i.e., ISAT mathematics and reading). Note: the practical effect of the effect size measure in terms of testing points gained was based on average standard deviations from sample data trends found for ISAT mathematics elementary = 28.04, mathematics MS = 27.83, reading elementary = 27.51, and reading MS = 24.27 (Consortium on Chicago School Research, 2007).

$$CE = C / E \quad (1)$$

A second index measured the maximum effectiveness of a program per level cost (MCE), where cost (C) and effect (E) were continued in their use, but the idea of desired expernditure (D) was added; theoretically by the district as a form of sustainability after the initial program:

$$MCE = (E / C) \times D \quad (2)$$

Heuristic Example

An activity of the partnership to enhance student learning, National Board for Professional Teaching Standards (NBPTS) certification, lent itself to a cost-benefit analysis due to the ability to tally direct costs and relational effects for this endeavor. A NBPTS certification program was initiated at the P-5 and the middle school as a sustained mentoring and professional development plan focused on teacher instructional and curricular development, specifically in the subject areas of mathematics and reading, as well as a focus on the association between the practices of teaching and learning.

Effect Sizes

Figure 1 shows the average effect size in reading and mathematics for the P-5 and the middle school. The effect size used in this study was Cohen's d and employed benchmarks set at .20, .50, and .80 that represented small, medium, and large effects, respectively (Cohen, 1988). Results from research conducted by Lipsey and Wilson (1993) corroborated Cohen's .50 cut-point for a medium effect by finding, via meta-analysis, that the mean and median effects from over 300 studies were established at .50 and .47, correspondingly. Recently, Sawilowsky (2009) found in a review of the literature that the aforementioned effect size cut-points of .20, .50, and .80 could be conceptualized also as small, medium, and large; though as inclusive members of a more expanded d-based benchmark scheme. Throughout the duration of measuring the relational effects of the NBPTS initiative, certainly other factors in addition to it accounted for a percentage of the effect size results depicted in Figure 1. By comparative measures with the Cohen benchmarks and/or the Lipsey and Wilson and Sawilowsky values, both of the schools showed medium to large effect sizes in reading and mathematics scores, where the relational effect in mathematics, for instance at the MS, approximated a large effect contrasted against known criteria from the literature.

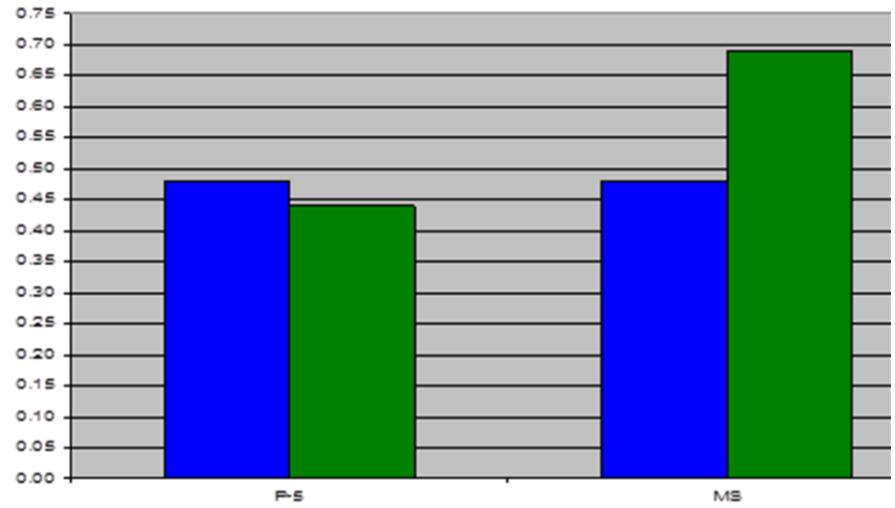

Figure 1. Average effect size. (Reading Scores in Blue; Mathematics Scores in Green)

Practical Effects

In conjunction with the effect size results, Figure 2 shows that in a practical sense for the amount of testing points gained, there was an increase at both schools. In fact, there was quite a substantial increase given that the ISAT test varies from a minimum of 120 to a maximum ranging from 340 to 411 based on grade level (Consortium on Chicago School Research, 2007).

Cost per Level of Effectiveness

The total direct cost for each of the 14 NBPTS certified teachers at the two schools was $12,571.43 with 7 teachers serving in both the P-5 and the MS. Figure 3 displays the cost per level of effectiveness. As examples, in the P-5 school, the relational effect in reading from the presence of 7 NBPTS certified teachers was an average gain of 13.20 ISAT points or a cost of $952.38 per each one point mean difference in reading scores (i.e., $12,571.43 / 13.20). For the NBPTS MS mathematics, the cost was $651.37 per each one point mean difference in math scores (i.e., $12,571.43 / 19.30).

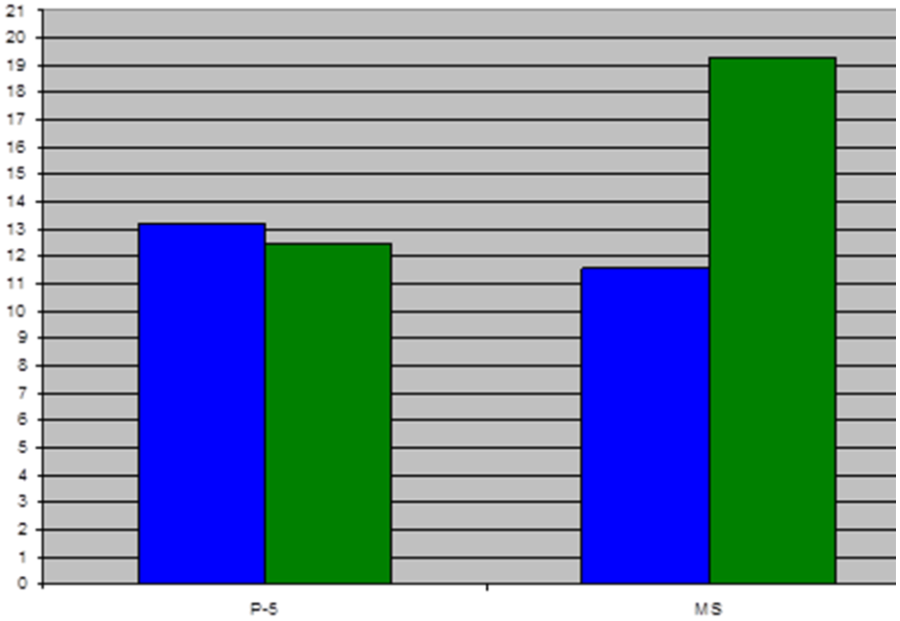

Figure 2. Average practical effect in testing points.
(Reading Scores in Blue; Mathematics Scores in Green)

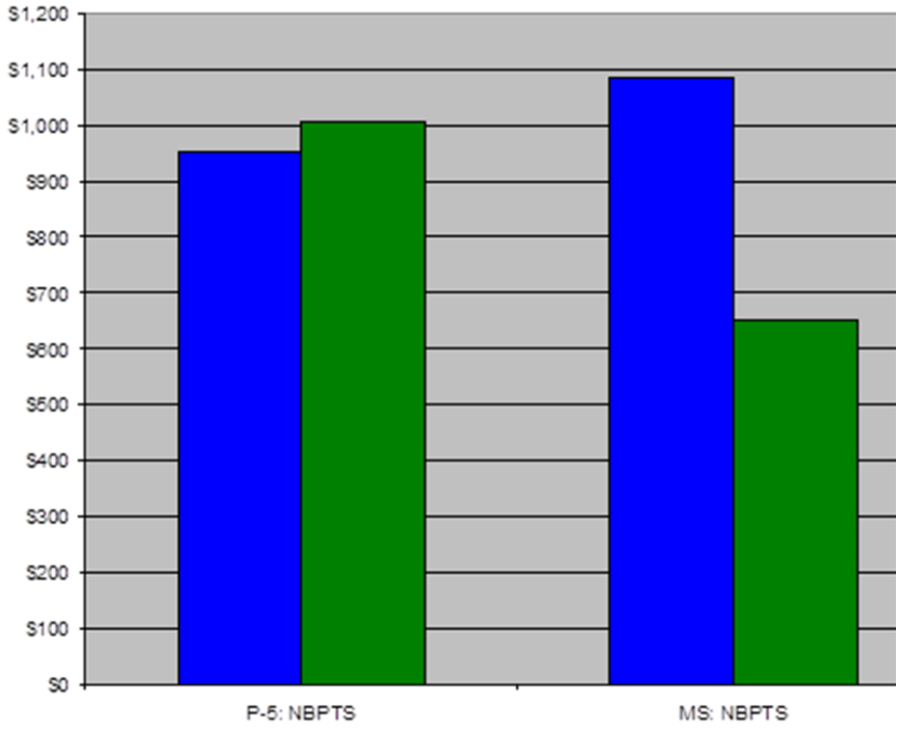

Figure 3. Cost per one point mean difference in test scores..
(Reading Scores in Blue; Mathematics Scores in Green)

Maximum Effectiveness of an Intervention per Level Cost

As a means to look at the potential sustainability of the NBPTS programs within the district, a maximum effectiveness of an intervention per level cost analysis was conducted to correspond with the previous findings. Given the medium to large effect sizes and the relatively low costs per one point mean difference in reading and mathematics scores for both school settings and each program, the question of effectiveness sustainability emerges. Thus, if after reviewing the positive, previously-mention results, the district were to allocate $50,000 a year for the continuation of the NBPTS programs (i.e., apportioning $25,000 to NBPTS x 2 schools).

Figure 4 indicates that they could predict quite large maximum mean test score increases. For instance at the MS NBPTS, increases of approximately 23 (i.e., (11.57 / $12,571.43) x $25,000) and 38 testing points for reading and mathematics, respectively may be predicted in the near future by continuing with the program of National Board certification of additional teachers within the school, however; with the caveat of having a reasonably similar student body and teacher ability as was accompanied with past results.

Conclusion

An importance of this research note is that it adds to the very limited scholarly literature in the area of cost-benefit analysis for the social sciences and serves as a potential template related to the relative ease of implementation of some of cost-benefits' components that have shown initial properties of augmenting results affiliated with, for example, correlational designs or program evaluation.

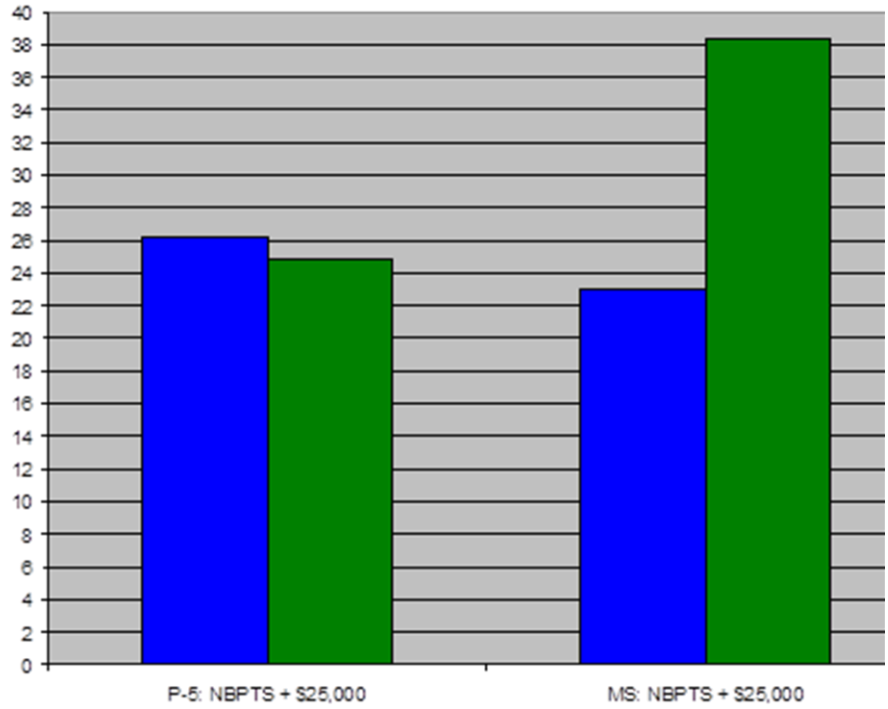

Figure 4. Maximum in mean test score gain.
(Reading Scores in Blue; Mathematics Scores in Green)

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