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Assessing the impacts of traditional school year calendar start dates

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ABSTRACT

The importance of education is undeniable. With considerable investment by the public in education, effectiveness and mechanisms for delivery must continually be monitored and evaluated. Proposals to alter the school calendar year therefore merit serious consideration if this translates to better management of scarce resources. Among those facets of school level costs that offer an opportunity for significant savings are plant operations. Any savings that enable resources to be focused more centrally on delivery and support of the educational mission are clearly worthy of exploration. At issue is the variability of school beginning and ending dates across the United States. It is hypothesized that strategic planning of break periods can lead to decreases in energy costs, and usage. For example, in the southwest United States, hot summer conditions can lead to significant spikes in energy consumption at times of the year when energy prices are at their highest. An approach for evaluating energy usage patterns relative to school calendars is developed, where usage and climate conditions are sought to be better understood. An optimization model is structured, formulated and applied capable of identifying ideal school start/end dates with plant operation costs in mind. Application results for a school are presented, with findings discussed within the context of proposed state-level public policy.

1. Introduction

Education is an important yet costly component of public and private expenditures across the United States and abroad. Few would question the need for and benefits of continued investment in public education. Most certainly education represents a cornerstone of a functioning and healthy society, capable of self-governance, rational thought and innovation. As with all other publicly supported goods and services, however, critical re-evaluation is always good, particularly if service delivery and outcomes can be improved in some way.

In the United States, annual federal, state and local spending on pre-kindergarten through 12 grade (denoted K-12 for simplicity) public education is roughly $600 billion. At the state level, Arizona offers an interesting and fairly representative example of expenditure, but also of reflection. It is not unlike other states and/or municipalities, investing billions of dollars annually in education. For FY 2016, as an example, nearly 43% of the $9.1 billion total budget is allocated to public K-12 education. Further, it is suggested that combined with federal, capital and local funds the actual expenditure exceeds $10 billion in Arizona just for elementary and secondary public education [18]. If private schools are considered, the annual level of funding is obviously even greater.

This level of annual recurring expenditure most certainly motivates interest in where these monies go, associated costs and potential to improve operations, all within the context of providing a learning environment where students can succeed. In this spirit, there continue to be proposals for examining, altering and changing various aspects of K-12 education. This has ranged from looking at the impacts of summer break knowledge loss [11] to the effectiveness of charter schools [7]. Some have argued that schooling should be privatized, as have other public services, suggesting that greater efficiencies and better outcomes can be achieved. Less extreme are movements to a 4-day school week, where closing a school for one day per week offers potential savings in transportation, energy consumption, etc. Other examples include improving the construction of schools through the addition of new buildings or renovating existing infrastructure to promote greater energy efficiency. Options along these lines promote the use of (better) insulation, upgraded windows and doors, new cooling/heating systems, automation of lighting and activity sensor-based controls, among others, and are embodied in programs like that of the US Environmental Protection Agency [23] promoting energy efficiency in K-12 schools.

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The fiduciary responsibility of managing limited public funds is important. Those involved, including elected officials, administrators, boards, staff, teachers and students, owe it to the public to ensure that taxpayer dollars are used in the best ways possible. As suggested above, Arizona has engaged in reflection of sorts. Recent proposed state legislation has sought to mandate when the traditional school year should begin, recognizing in part the potential for reducing energy consumption. As the single largest expense outside of human resources, there would appear to be real opportunities for savings. Plant operations in Arizona represent 12.2% of school district spending [3]. The United States average is 9.5%. Any improvements in efficiency could result in saving millions of dollars across the state. In order to realize any decreases in plant operations, greater efficiency along many avenues would no doubt be needed. With this in mind, Arizona House Bill 2303 introduced earlier this year by State Representative E. Farnsworth proposed a change to the traditional school calendar year for Arizona public schools. Currently, the first day of the new school year is generally early to mid-August. The bill seeks to move the start to the beginning of September. The proposed legislation reads as follows [4]:

> "… the first day of instruction for each school year shall begin not earlier than the first Monday of September and the last day of instruction shall be not later than June 30."

An interesting policy question is whether such a change is worthwhile. The legislation is defended on the basis of placing Arizona schools on an academic calendar that is more typical across the United States and offers potential for operational cost savings in building cooling [9]. The broader question, however, is whether there are significant opportunities for individual schools or school districts across regions or states to achieve greater operational efficiencies simply through better strategic scheduling of the traditional school year calendar. This question no doubt resonates beyond a particular state.

This paper sets out to examine this issue, based on supporting empirical information, assessing the relative merits of a change in the traditional school year calendar. The next section reviews background and associated literature. This is followed by regional context details for empirical investigation, where Phoenix, Arizona will serve as a representative case study. Observed energy consumption over one year is examined. An analytical approach is then proposed for determining the best traditional school year start date with respect to summer plant operations. Findings are then presented. The paper ends with discussion and concluding comments.

2. Background

Education is an important public service. As noted above, it remains a significant component of state and local government budgets, often exceeding 40% of total expenditures. Not only is the level of investment substantial, but there are also many unique considerations that must be taken into account. Educational planning is a complex and often publicly contentious endeavor. Administrators and policy makers must think about strategic plans as well as daily details. Among the more prominent concerns are student performance, staffing, equity issues, programs and offerings, special needs, nutrition, etc. Given these complexities, there has been much interest is supporting the examination of school system operations through the use of mathematical models that account for strategic and operational considerations.

Refs. [5,6,8,12,17,20] are examples of research efforts that have sought to aid decision making processes associated with the opening and closing of schools, forming of districts, allocating students to individual schools, balancing utilization and composition, etc. The reason is that all of these issues have operational cost implications, necessitating the examination of the financial efficiency of a school system. Thus, detailed analysis supported by comprehensive and thorough planning is paramount.

The single largest expenditure in education is human capital, including instruction, staff and administration. Strategic planning across a school district has been supported by modeling approaches that consider opening new schools, closing under-utilized or costly schools, determination of the appropriate number of classes by grade, etc. [8,12], factors directly affecting human capital needs. After human capital the next largest expense in public education involves plant operations and transportation [1]. Note that more than one-fifth of all end-use energy is devoted to space-conditioning (cooling and heating). To this end, it is not surprising that plant operations are one of the larger expenses for a school district. To address this, considerable research has been devoted to energy conservation efforts in schools. Refs. [15,16,21,24] review goals and efforts to reduce carbon dioxide emissions, improve building construction and renovate facilities. On the transportation side of things, efforts to design more efficient boundaries and districts enhance access [6] and offer much potential for reducing associated transportation costs [13].

Another avenue pursued to address costs has been to alter the school year, most prominent being efforts to move to a 4-day week. A general discussion can be found in Ref. [2]; but most appealing to advocates is the potential to decrease transportation and utility costs, among others. Actual realized savings have been mixed [2,19]. Most certainly, however, there is a reluctance by many to accept change that deviates from past practices – tradition.

The traditional school calendar in the United States is considered to be that beginning in early September and ending in June, consisting of some 180 teaching days. There is debate as to the origins of this "traditional" calendar for schooling [10], but what is clear is that coordination among schools (and community colleges and universities) has no doubt been important as is the block of "summer vacation" time widely coveted by families and teachers.

Unexplored in a formal manner are the implications of when schools should begin and end within the context of a traditional school year. There is much variation in the start of school across the United States. Consider for example some of the larger school districts. For the 2015–16 year, schools that begin around September 8, 2015 include New York City Department of Education (over 1 million students), Chicago Public Schools (nearly 400,000 students), School District of Philadelphia (approximately 142,000 students) and San Diego Unified School District (over 132,000 students), with an ending date around June 21, 2016. There are also many schools that begin in late August, including Hillsborough County Public Schools in Tampa, Florida (over 200,000 students) and Columbus City Schools in Ohio (approximately 51,000 students) and Santa Barbara Unified School District in California (over 15,000 students), and end in the beginning of June 2016. Earlier even still, the Los Angeles Unified School District (approximately 643,000 students) begins in mid-August 2015, ending on June 10, 2016. Finally, the largest school district in Arizona is Mesa Public Schools (over 67,000 students) and has a beginning date of August 12, 2015 running through May 26, 2016. Of course, there is much significance to the start/end of a school year, with clear implications for plant operations, and cooling in particular for schools in the southwest United States.

3. Study area

The context considered in this paper concerns traditional school year calendar planning. Arizona was selected as a case study because of recent proposed legislative efforts. There are over 6.7